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BOOK OF ABSTRACT

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Energy Transition & Decarbonisation; Sustainable Energy Generation & Environment; Hydrogen Energy and Fuel Cells (Solid oxidized fuel cells); Solar Photovoltaic Cell and Solar Thermal Energy; Biomass Energy, Innovations in Energy-Measurement; Policy Analysis & Interventions; Technological Advancements & Alternatives Energy; Waste to energy; CO2 reduction & sequestration; Electrochemical reduction of CO_2.

Abstract ID: EE-OP1

Sustainable sequestration of carbon dioxide – A review

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Abstract
Carbon dioxide, a byproduct of fossil fuel combustion is the principal greenhouse gas contributing to global warming. Among the three main routes of carbon capture namely pre-combustion, post combustion and oxy-fuel combustion, post combustion capture is the most viable option for existing coal-fired power plants. Post combustion carbon capture technology includes chemical absorption, adsorption, membrane separation, cryogenic separation etc. however these methods have some or other disadvantages. Ocean injection of CO_2 results in lowering of the pH of sea water thus affecting the species like zooplankton, bacteria and benthos. Moreover, the sequestered CO_2 can leak after a long period of time. Recently optimum injection of CO_2 in ready-mix concrete has been practiced by industrial users as it improves the compressive strength due to in-situ formation of mineralized $CaCO_3$, without sacrificing performance or durability. Bio-fixation of CO_2 waste by microalgae (about 1.83 Kg CO_2/ Kg of dry algal biomass by some species) using photosynthesis is a very sustainable sequestration method. Rapid growth potential and high oil content (20-50% dry weight of biomass) of microalgae make this cultivation a commercially interesting and promising technology not only to mitigate global warming problem but to generate of bio-fuel along with other benefits namely production of nutrient dense foods, chemicals and fertilizer.

Keywords: Greenhouse gases; Sustainable; Microalgae; Biomass

Abstract ID: EE-OP2

Rice-bran-Soyabean oil blended biodiesel production and utilization for four-Stroke Single Cylinder IC Engine

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Abstract
This paper reports the production of biodiesel from blended oil containing 80% of rice bran oil and 20% soyabean oil. Further the biodiesel is tested upon the 4-stroke single cylinder IC engine in which different parameters is measured which include the engine efficiency, break thermal efficiency, break specific fuel consumption and the efficiency of the biodiesel. Biodiesel produced from blended oil is further compared by the biodiesel produced by pure soyabean oil. The production involves transesterification process by methanol and NaOH which is discussed further in the paper. The production of the biodiesel and its testing was performed in CRED Lab IIT BHU and the result that was obtained was that, the biodiesel from blended oil was more efficient that the biodiesel from pure soyabean. Break thermal efficiency (%) of the blended biodiesel was 7.4%, 14.3%, 21.9%, 23.6% on 1kg, 2kg, 3kg, 4kg loads. The break specific fuel consumption (kg/Kw-hr) of blended biodiesel was as followed 2.425, 1.536, 1.168 and 0.989. The time taken to consume 5ml of blended biodiesel at 1500RPM are as followed (in seconds)38.50, 35.72, 28.19, 24.72, 21.88 at loads

1kg, 2kg, 3kg ,4kg. It is concluded by the investigation made that the blended biodiesel is more efficient than the pure soyabean oil biodiesel.

Keywords: Diesel engine; Rice-bran oil; Biodiesel; Transesterification process; Performance

Abstract ID: EE-OP3

Effect of amine groups on Zeolite-Y for carbon dioxide adsorption

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Abstract
A growing concern regarding global warming and greenhouse effects has increased demands on energy efficiency and carbon dioxide emissions, making the energy-intensive process of carbon dioxide separation imperative. Hence, energy-efficient, economically viable carbon dioxide separation technologies are needed for industrial processing and future carbon dioxide capture options. The purpose of this research is to develop amine-loaded Zeolite-Y adsorbents to improve carbon dioxide adsorption capacity. This paper presents an overview of the current technology for separating carbon dioxide, namely adsorption. It also discusses emerging technologies for separating carbon dioxide, and recommendations for future research on adsorption, as part of this research. The paper aims to synthesize, characterize, and adsorb carbon dioxide to provide an overview of current separation technology. This study aims to study the ability of amine-loaded Zeolite-Y to adsorb-desorb carbon dioxide through three different loadings of ethanolamine, diethanolamine, and triethanolamine. Zeolite-Y and amine-loaded materials are investigated through X-ray diffraction patterns (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric analysis (TGA), Brunauer–Emmett–Teller (BET), Field Emission Scanning Electron Microscope (FESEM), and Energy-dispersive X-ray Spectroscopy (EDX). It is promising and cost-effective to use adsorbents loaded with monoethanolamine as carbon dioxide adsorbents. The adsorbent is able to adsorb 4.98 mmol CO_2/g at 30°C and 10 bar when loaded with 1 wt% amine. This will be used for carbon dioxide separation from flue gases.

Keywords: Zeolite-Y; Adsorption; Global warming; Greenhouse effect; Amine groups

Abstract ID: EE-OP4

Entropy creation, waste work and thermodynamicefficiency of galvanic cells: effects of dischargecurrent and environment temperature

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Abstract
In this work, knowledge of efficiency from the perspective of second law for chemical processes (Guha S. *Environmental Progress and Sustainable Energy*, 39(2), 2020; GuhaS., *International Journal of Industrial Chemistry*, 11(2), 2020,) has been applied to find outhow environment conditions and discharge current affect critical performance parameters such as *Waste Work*, *Thermodynamic Efficiency* and irreversible *Entropy Creation* of any Galvanic Cell. Calculations are carried out for Galvanic Cell discharge operation to evaluate magnitude of irreversible *Entropy Creation*, *Waste Work* and *Thermodynamic Efficiency* using second law efficiency as a basis rather than mere energy balance concept.

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It is found that irreversible *Entropy Creation*, *Waste Work* and *Thermodynamic Efficiency* are strongly dependant on environment temperature and discharge current.
Finally, for maximizing electrical energy output, a Galvanic Cell with exothermic dischargereaction should be operated at lower discharge current and at a cell operating temperature which is close to the environment temperature ensuring minimum difference between these two temperature values.
Similarly, a Galvanic Cell with endothermic discharge reaction should also be operated at lower operating current and at cell operating temperature which is close to the environment temperature maintaining minimum difference between these two temperatures formaximizing electrical energy output.
Lower cell discharge current and minimum difference between the cell and environment temperatures will ensure higher "availability" which in turn will lead higher *ThermodynamicEfficiency*. As an example, Table-1 is presented to establish the facts stated.

Table-1

Cell	Voltage (V)	Cell Temp (K) Environment Temp (K)	Discharge Current (mA)	Entropy Creation (Cal/K)/Waste Work(Cal)	Thermodynamic Efficiency (%)
Al/Al^{3+}, $SO4^{2-}$ // Cu^{2+}, $SO4^{2-}$ /Cu * (Exothermic)	0.6	298 / 293	4.0	12.64/3703.5	95.7
Al/Al^{3+}, $SO4^{2-}$// Cu^{2+}, $SO4^{2-}$ /Cu * (Exothermic)	0.6	298 / 293	5940	17.38/5092.3	2.3
Al/Al^{3+}, $SO4^{2-}$ // Cu^{2+}, $SO4^{2-}$ /Cu * (Exothermic)	0.6	298/260	4.0	108.27/28150.2	74.6
Ag/Ag^{+1}, Cl^- // Hg^{+1},Cl^- /Hg (Endothermic)	0.04550	298/303	0.32	0.13/39.39	96.4
Ag/Ag^{+1}, Cl^- // Hg^{+1}, Cl^-/Hg (Endothermic)	0.04550	298/303	178	0.072/21.81	51.4
Ag/Ag^{+1}, Cl^- // Hg^{+1},Cl^- /Hg (Endothermic)	0.04550	298 / 320	0.32	0.54/172.8	85.9

* Sirshendu Guha, Indian Patent Application No.202231063340 A, (2022)

Keywords: Galvanic cells; Entropy creation; Waste work; Thermodynamic efficiency

Abstract ID: EE-OP5

Effects of using Granite Dust and Palm Flower Carbon as Partial Cement Replacer in Pervious Concrete

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Abstract
Pervious Concrete pavements are used in various places to ensure sustainable construction as these pavements tend to reduce risk of flash flooding and enhances storm water management. However, lower load bearing capacity of pervious pavements has curtailed the widespread usage of these pavements. In order to enhance pervious concrete performance usage of partial cement replacers is encouraged. Current study focuses on using Granite Dust and Palm Flower Carbon in the ratio of 1:1 as partial cement replacer in pervious concrete. Usage of these materials not only enhances the performance of the mix but also tends to reduce environmental pollution caused by cement, granite dust and palm flower wastes. Four different replacement percentages are considered. Effects of replacements in various fresh cement, fresh concrete and hardened concrete properties are analysed. Results show that though the replacements do not show efficient mechanical performance, they tend to enhance the performance of pervious concrete with respect to water absorption. Thus, material with this replacement can be used to successfully curtail urban heat island effect.

Keywords: Granite dust; Palm flower carbon; Pervious concrete

Abstract ID: EE-OP9

Production of biodiesel from *Euglena Sanguinea* using heterogeneous catalyst

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Abstract
Immense focus has shifted to producing biofuels from renewable sources. This article focuses on production of bio diesel from Euglena Sanguinea algae. Euglena Sanguinea constitutes highest lipid content in marine algae. Degumming and Esterification reaction was done at optimized reaction conditions to reduce the phospholipids and free fatty acid content present in feed algal oil. Transesterification reaction was mainly used to convert the algal oil to biodiesel. The catalyst used for the reaction is MgO-SiO_2 in which silica is extracted from steel slag effluent. The slag is characterized by XRF, TGA, BET, PSA, FTIR and SEM. The extracted silica is used as support catalyst on which MgO is impregnated by wet impregnation method. The catalyst synthesised is characterized by SEM, XRD, TGA and BET. The biodiesel produced is characterized by GC-MS and FTIR. The parameters such as methanol to oil ratio, catalyst weight % and reaction time was optimized to produce the maximum yield of biodiesel.

Keywords: Algal oil; Heterogeneous catalyst; Waste slag; Biodiesel

Abstract ID: EE-OP10

A Comprehensive Review on Homogeneous Charge Compression Ignition Engine

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Abstract
Research on engines using different combustion principles has been spurred up by widespread worries about dangerous pollutants, stringent emission restrictions, and global warming. Low Temperature Combustion (LTC) is a cutting-edge idea for internal combustion engines that will be able to replace the standard modes of combustion and have the benefit of using both conventional and renewable fuels. In this sense, LTC has garnered interest on a worldwide scale recently, particularly the Homogeneous Charge Compression Ignition (HCCI) mode. The absence of flame propagation or diffusive flame distinguishes this combustion mechanism from spark ignition and compression ignition. On the contrary, chemical kinetics controls HCCI combustion. When the mixture approaches chemical activation in HCCI engines, which employ much diluted homogenous charge, auto ignition occurs simultaneously in several locations. In comparison to diesel engines, HCCI technology enables high efficiency operating with little nitrogen oxide, soot, and particulate matter emissions. The primary obstacles to be addressed are, however, the regulation of ignition timing, the impossibility of the high load operation, as well as increasing emissions of carbon monoxide and unburned hydrocarbons. The past and current work across the globe have revealed that engine working on HCCI module can be fuelled with different fuels with little emissions and high efficiencies. All the past work has been mentioned and explained in this current work.

Keywords: LTC; HCCI; SI engine; CI engine; EGR; ATAC

Abstract ID: EE-OP11

Electrocatalytic conversion of CO_2 to CO using Copper based catalystunder low overpotential range

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Abstract
Electrocatalytic conversion of CO_2 to CO is investigated using copper based catalyst. Copperbased material was selected as electrocatalyst for the experiment after performing cyclic voltammetry (CV), linear sweep voltammetry (LSV), EIS techniques in CO_2 saturated 0.5 (M) KHCO3 solution. The catalyst loaded working electrode was used for the different electrochemical techniques in KHCO3 solution. CV was performed under potential range of +0.3 to -1.5 V vs Ag/AgCl reference electrode in KHCO3 solution and a current density above50 mA/cm² was obtained from the reduction of CO_2.Chronoamperometry technique was performed for 1 hr. in H cell reactor for the reduction of CO_2 and the gaseous product was collected after 1 hr. of operation. The gaseous product was analyzed in Gas Chromatographyand CO gas was detected as main product. The amount of formation of CO was 13.21 μmolwith Faradaic efficiency of 27 %.

Keywords: Electrocatalysis; H cell reactor; CO_2 reduction.

Abstract ID: EE-OP12

Air Pollution and Climate Change

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Abstract
Less air pollution is the answer to a healthy life solution this sentence should be a motive of each and every person if you study deeply in air pollution then you realize what is air pollution meteorology. This review describes as human beings, we have the opportunities before us to make a change like micro, meso and macro. Indoor air pollution results from products used in construction materials, inadequacy of general ventilation.
Greenhouse gases such as carbon dioxide are part of air pollution. By retaining heat from the Sun in the Earth's atmosphere, greenhouse gases warm the temperature. Although greenhouse gases are a naturally occurring component of the Earth's atmosphere, since the beginning of the 20th century, they have become more common, warming the planet's climate.
Aerosols are little particles that are released into the atmosphere when fossil fuels are burned. Some of these particles enter the atmosphere as air pollution from automobiles, trucks, and industrial emissions, but they most naturally enter through volcanoes, dust, or marine pollution. Climate is impacted by aerosols. Although not all aerosols have the same effects on the atmosphere, they all serve to cool it.
Climate change is causing air quality to change, while air pollution is driving climate change. Increased heat waves and droughts brought on by global warming can have a negative impact on the purity of the air we breathe. Since the chemical processes that produce ozone in the atmosphere take place more often at hot temperatures, heat waves increase the amount of ground-level ozone pollution.

Keywords: Air pollution; Aerosols; Emissions; Meteorology; Human beings; Micro; Macro; Inadequacy; Automobiles; Purity

Abstract ID: EE-OP13

Production of Biodiesel and Bioethanol from Food Wastes

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Abstract
An incredible amount of waste is generated every day which gets dumped into landfills or oceans or gets incinerated which degrades the existing ecosystem. It has been observed that one of the major components of this waste generated is food waste which can be recycled more effectively to more sustainable sources of energy because of its biodegradable properties. The food waste generated from kitchens, canteens, and bakeries was obtained and then segregated into two categories. The first category comprised of food waste rich in triglycerides and fatty acids like animal and fish waste and waste cooking oil. These food wastes were converted to biodiesel through transesterification, which lowers the viscosity of the fuel obtained, making it more effective in replacing diesel in vehicles. In this process, the food wastes were treated with Sodium Hydroxide and Methanol in a 1:6 ratio to produce biodiesel and soap as a byproduct. The second category comprised of food waste rich in sugar and starch like vegetable and fruit peelings. These food wastes were converted to Bioethanol by fermentation with *Saccharomyces cerevisiae*, a commonly available yeast strain. These fuels generated were then evaluated for their octane number and ignition point. The Biodiesel and

Bioethanol generated can be used as an alternative to fuels like diesel and petrol. These fuels can be used to power motor vehicles and be a more renewable energy source for the future.

Keywords: Biodiesel; Bioethanol; Transesterification; Fermentation

Abstract ID: EE-OP14

SMART WAY TO DISPOSE HOUSEHOLD WASTE THROUGH INTELLIGENT DUSTBIN (In-Bin)

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Abstract

Solid waste is the unwanted or useless solid materials generated from human activities in residential, industrial or commercial areas. According to Central Pollution Control Board (2017) India generates about 0.213kg (in rural areas) - 0.8kg (in urban areas) of MSW (Municipal Solid Waste) per capita. The average collection efficiency is about 22% to 60%. The total MSW generated in urban India has been estimated at 68.8 million TPY (tons per year in the year 2008). Average moisture content of MSW in India is 17-25%.

The household waste can be divided into two parts; biodegradable and non biodegradables. Proposed Intelligent dustbin has two compartments: one for biodegradables and other is for non-biodegradables/combustibles. The biodegradables part converts the waste into compost and also takes less time for composting than the conventional composting method. The non-biodegradable / combustibles waste will be shredded into smaller pieces and compacted with suitable device to convert them into pellet.

The *In*-Bin is automated to handle the solid(House hold) waste by initiating size reduction of waste material, dispensing required quantity of compost maker/coco peat followed by thorough mixing. The progress of composting is monitoring critical parameters such as temperature and humidity .For designing the In-bin, the dimensions of the In-bin are noted. The suitable fabricating material is selected for the fabrication.

Keywords: Efficiency; Biodegradable; Non Biodegradables; Combustible

Abstract ID: EE-OP15

Design Simulation Study of Novel ORC System with a Heat Source of Rice Husk, and Solar Energy

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Abstract

The organic Rankine cycle based on waste heat, waste biomass and solar energy have an advantage over conventional power cycle which adhere to net zero emission and control to environmental impact. This study essentially consists of converting heat into useful work by using heat from solar and rice husk in the Organic Rankine cycle (ORC) based system. The ORC system performance has been simulated on Aspen plus using R245fa refrigerant with two and three heat exchangers namely evaporator, condenser and additional heat exchanger. It is inferred from the simulation that net power output from the system is 10.59 kW at flow rate of refrigerant 2.4 kg/s with heat input of 516.88 kW when evaporator and condenser are

used in the cycle. With an additional heat exchanger, the heat input is reduced with the sum of 56.56 kW at same output condition thereby increase in efficiency by 15%.

Keywords: Organic Rankine Cycle; Heat exchanger; Aspen plus; Rice husk; R245fa

Abstract ID: EE-OP16

Recovery of Valuable Components from Spent Li Ion Batteries via Phase Composition Analysis and its Impact

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Abstract
Lithium-ion batteries (LIBs) are widely used in portable electronic devices, different energy storage systems, electric vehicles etc. owing to their high energy density, low self- discharge rate and light weight. But these world-wide demand for LIBs will cause a large quantity of chemical wastage after their life span. Increasing digitization and rapid expansion of electric vehicles will skyrocket this issue manifolds in near future. Spent LIBs contain heavy metals, flammable electrolyte, organic chemicals, plastics etc. which can pose a serious environmental risk if not disposed properly. On the other hand, these LIB wastes can be valuable secondary resources of graphitic carbon as well as some significant metals like Li, Co, Cu etc. if their composition can be properly analyzed prior to recycling process. Current work focused on the thermogravimetric pattern, phase study and composition analysis of the different spent commercial lithium-ion batteries prior to recovery that could directly mitigate the environmental pollution as well as the concerns over unavailability of some valuable components; as a whole it will directly influence the economic benefits to materialize the sustainable development of battery industry.

Keywords: Lithium-ion battery; Environmental pollution; Composition, Recovery; Recycle; Carbon

Abstract ID: EE-OP17

Comparative Study on Efficacy of Photo thermal Materials in Water Evaporationat Air-Water Interface

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Abstract
In current situation, the energy crisis, water management and climate change are three major burning issues those are considered worldwide. So solar driven photo thermal desalination technique can be an emerging technique to overcome all these issues through produce portable water from the saline water. In this technology the initial step is producing water vapor through interfacial heating using efficient photo thermal materials. The efficiency of the overall process depends on the performance of the photo thermal material to enhance theevaporation kinetics. Thus, here different kind's comparison study of photo thermal materials has been done to check the evaporation flux with both tap water and sea water. This experiment being inspired from the nature aims to provide new perspective about the use of photo thermal materials like graphite, CNS and CNS +MOF in desalination process by continuous water pumping by capillary rise actions. The solar based evaporator exhibits an evaporation rate of around 1kg/m^2/h to 2.5kg/m^2/h under

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a 60watt bulb. This will focus on the development of the society by solving the water scarcity issues in India and provides a better understanding about the use of photo thermal materials and energy conversion.

Keywords: Solar driven photo thermal; Desalination; Evaporation kinetics

Abstract ID: EE-OP18

Microplastic Degradation by Photocatalyst

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Abstract

Microplastic (MP) pollution has recently been recognized as a threat to the biosphere including humans due to its wide spread distribution, persistent nature and infinitesimal size. This study focused on the solid phase and degradation of microplastic residues (particularly low-density polyethylene LDPE) in water through photocatalysis process by designed photocatalysts of Titanium dioxide (TiO_2) and Platinum nanoparticles deposited on Titanium dioxide ($Pt\text{-}TiO_2$) under UV visible light irradiation. These photocatalysts were characterized using SEM. Deposition of different photo catalysts on TiO_2 for certain minutes has been found optimum that enhanced the photodegradation process under visible light irradiation by improving of both electrons-holes pair separation process and visible light absorption. Photocatalytic degradation of LDPE films was confirmed by FTIR spectroscopy. When LDPE film irradiated in presence of different photocatalysts, degradation was found quicker than TiO_2 alone of similar concentration which exhibited formation of a large number of wrinkles, cracks and cavities on the film surface. Thus, the present work provides a new insight about modified catalysts for the degradation of microplastics in water using visible light.

Keywords: Microplastics; Low Density Polyethylene (LDPE); Photocatalytic degradation; Visible light

Abstract ID: EE-OP19

Alternative Method of Lithium Extraction from Ore

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Abstract

The increasing demand for rechargeable batteries in various applications such as electric vehicles, modern electronics, and grid storage has led to a significant surge in the demand for lithium, which is an essential component of these batteries. However, the conventional method of lithium extraction, namely acid leaching, has been associated with significant environmental and economic concerns due to its high-water consumption and the use of toxic chemicals. Hence, there is an urgent need to develop sustainable and efficient methods for lithium extraction. To address this issue, a modified Hall-Heroult's process using a specific hydroxide as an electrolyte has been proposed for this research. This process has the potential to reduce the negative impacts of conventional lithium extraction methods and make it more sustainable. The proposed process involves the use of a hydroxide solution obtained from the respective ore as an electrolyte to produce molten lithium using similar experimental conditions. The study also involved the identification of lithium using appropriate chemical solutions to obtain satisfactory results. The development of sustainable and efficient lithium extraction processes can contribute significantly to the growth of the battery industry and support the transition towards a cleaner and greener future. The findings of this study can

provide valuable insights into the development of sustainable lithium extraction methods for commercial applications.

Keywords: Lithium extraction; Sustainable methods; Modified Hall Heroult's Process; Hydroxide solution; Molten lithium

Abstract ID: EE-OP20

Comprehensive Evaluation of Hydrogen as an Energy Storage Option for Transportation: Advantages, Viability and Feasibility

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Abstract
Transportation is among the most significant contributors to greenhouse gas emissions and air pollution. One proposed solution to reduce the detrimental impact of emissions is using hydrogen as a sustainable and eco-friendly energy source for transportation. However, the viability of hydrogen as a transportation energy storage option is still a topic of debate. This paper comprehensively evaluates the viability of hydrogen as an energy storage option for transportation. The study explores the various aspects of hydrogen, including its production, storage, transportation, and utilization. It also compares hydrogen fuel cell to other energy storage options, such as lithium-ion batteries, compressed air energy storage, and flywheels. The study finds that hydrogen has several advantages over other storage options, including high energy density, rapid refueling times, and storing large amounts of energy for long periods.

Keywords: Transportation; Hydrogen; Fuel cell; Energy storage; Production; Storage; Utilization; Lithium-ion batteries; Refueling times; Long-term storage

Abstract ID: EE-OP21

Thermal characterization and Performance Analysis of Thin-film Photovoltaic Solar Panels Adhered to Corrugated Surface

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Abstract
Sun is the primary source of all energy, be it conventional or non-conventional. All energy and power requirement of the world can be achieved from Solar radiation that reaches the Earth. Photovoltaic Solar technology is at the forefront of Renewable Energy innovation and global energy sustainability. The race to increase PV Solar cell efficiency has nurtured the development of new technologies like Perovskite and Copper buried contact solar cells, which are still under development. Thin-film type solar panel, a strong competitor to framed structured solar panel has recently reached a marketable stage. The increase in surface area of reactants is directly proportional to the rate of reaction; similarly, increasing the surface-area of the overall solar module per unit area will result in denser packing of PV cells and achieve higher installed capacity and ultimately improve efficiency. This paper aims to examine the impact of increasing packing density of solar cells in unit area by plotting the relation between thermal behaviour, cell performance and packing density of a Thin-film type solar panel adhered to a thermally conductive corrugated surface such that the surface area-to-volume ratio for the Solar panel increases. The conclusive effect of improved cell cooling, angle of light incidence, shadowing effect, global irradiance, reflected light component off of cells

and effect on seasonal tilt angle adjustments are established. Each variable mentioned above individually has either a positive or negative impact on the PV cell efficiency; the study determines the cumulative effect of these variable on the overall efficiency of the Thin-film Photovoltaic solar panel.

Keywords: Thin-film photovoltaic; Corrugated surfaces; Surface-area-to-volume ration; PV cell efficiency

Abstract ID: EE-OP23

Use of Chitosan as Bitumen Modifier and its Impact on Rheological Properties in Bitumen Modification

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Abstract

Bitumen is a viscoelastic material as it is composed of asphaltene and maltene. An increase in the concentration of asphaltene or a decrease in the concentration of maltene decreases the penetration by less than 20 dmm and increases the viscosity of the bitumen. High viscosity creates a big problem in making on-grade bitumen as per specification. Conventional bitumens are prepared by air-blowing but this bitumen is high temperature susceptible. To decrease the temperature susceptibility, synthetic polymers or additives are used to make polymer-modified bitumens. Polymer-modified bitumens have poor storage stability and phase separation and are costly. Chitosan has free amino and hydroxyl groups. Some of the studies showed that chitosan can be used as a bitumen emulsifier and it increases the emulsion viscosity. This paper used modified chitosan (deacetylated chitin) to improve the properties of the bituminous binder. An increase in the concentration of modified chitosan affects the physicochemical as well as rheological properties of the bituminous binder. It is observed that an increase in the concentration of modified chitosan increases the softening point with a slight increase in viscosity and complex modulus with the use of sulfur and small amounts of elastomeric styrene butadiene styrene polymer. Studies showed that the use of SBS in a small amount of 0.25 wt% along with modified chitosan improves the rutting resistance and shear modulus by more than 67°C at 1.1 kPa.

Keywords: Air-blowing; Bitumen; chitosan; Rheology; Rutting resistance; Polymer

Abstract ID: EE-OP29

Deep eutectic solvents for eco-friendly recovery of metals from E-waste

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Abstract

The accelerated depletion of metal from natural resources and exponential e-waste generation necessitates metal recovery from e-waste sources. In light of the circular economy, research into efficient, environmentally friendly metal recovery methods is crucial. This article presents a method for recycling e-waste that involves using deep eutectic solvents to separate valuable metals (copper and lead) from waste printed circuit boards (WPCBs) of desktop computers. Metal leaching efficiencies of more than 80% were obtained for copper and lead. Metal separation via electrodeposition was found to recover metal as well as recycle DES, allowing DES to be reused for multiple metal extraction cycles with negligible change in their leaching performance. Deep eutectic solvents (DES) may provide a green alternative to conventional e-

waste recycling methods because they are easy to prepare, highly biodegradable, and have low toxicity. Thus, deep eutectic solvents may offer cutting-edge, intensive metal extraction methods for the future process industry.

Keywords: Printed circuit boards; Deep eutectic solvent; Metal extraction

Abstract ID: EE-OP30

Enrichment of Low-Grade Indian Coal through Alkali Leaching followed by Acid Treatment

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Abstract
India, despite being the 2nd largest coal producer, is facing serious issues to cater the increasing demand for power due to majority of Indian coal is categorised as low-grade coal because of its high ash content and low calorific value. Chemical leaching is one of the most efficient methods for improving low-grade coal because it can efficiently remove inorganic (mainly SiO_2 and Al_2O_3) and organic minerals in an economic manner. In this work, high ash Indian coals were collected from Mahanadi Coalfield Limited, Odisha, pulverized to different particle sizes underwent simultaneous alkali (NaOH, KOH) and acid treatment (HCl, HNO_3) varying the parameters like the concentration of alkali and acids; Particle sizes of raw coal, the reaction time of the leaching experiment; the rotational speed of the stirrer. The quality of the treated coal was examined by proximate and ultimate analysis. The mechanism of demineralisation was evaluated using the XRD technique; the composition of the ash produced was measured using XRF Spectroscopy. The highest deashing and demineralization were obtained by 40 % (w/v) NaOH followed by HCl and HNO_3 solution in 1:3 ratio, for a particle size of 300µm. Approx. 75% reduction in Ash content, with 30% demineralization along with a 54 % improvement in GCV has been achieved in comparison to raw coal with similar particle size.

Keywords: Low-grade coal; Leaching; Ash reduction; Demineralisation

Abstract ID: EE-OP31

Assimilation of dissolved inorganic carbon (DIC) using microalgae: a biological route to tackle environmental challenges and production of essential bio-derivatives

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Abstract
It has been a widespread concern now that CO_2 emissions are projected to increase from 36,131 MT in 2013 to almost 51,883 MT in 2100, and it is about 52.9 % above 2010 levels, causing exponential rise in the global ambient temperature. So, it is required to reduce further introduction of CO_2 in the global atmosphere. Available chemical processes are mostly energy intensive & having adverse effect whereas biological process is stable, cost effective and environmentally friendly.

The present study demonstrates the capture and assimilation of dissolved inorganic carbon (DIC: Sodium Bi-Carbonate $NaHCO_3$) using microalgae. It includes collection, isolation, culture, characterization of the microalgae and environmental parameter optimization by Taguchi method for biomass productivity, synthesis of essentials biomolecules and feasibility analysis for biofuel production. Bicarbonates ion is converted into CO_2 by carbonic anhydrase enzyme excreted by microalgae in its metabolic pathway.

Keywords: Sodium Bi-Carbonate $NaHCO_3$; Carbonic Anhydrase; Microalgae; CO_2

Abstract ID: EE-OP32

Efficient Energy Consumption & Economic Growth

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Abstract

Energy plays a pivotal role in the development of a region. Increasing dependency on fossil fuels has caused serious concerns at the local and global levels. Harvesting of energy depends on the availability of resources apart from the economic viability and technical feasibility of meeting the demand. The energy requirement of India is mainly supplied by coal and lignite, followed by crude oil and petroleum products and electricity. However, energy consumption in rural India is largely dependent on non-conventional energy sources due to the availability, possibility of rapid extraction, and appropriate technologies. Globalization and consequent opening up of Indian markets has led to urbanization with the enhanced energy demand in the industrial and infrastructure sectors. Though the energy consumption per GDP (Gross Domestic Product) is higher, production of valuable goods is quite low in the country which shows that there is a need to improve the end-use efficiency. This paper entails the solution to the increasing energy consumption and possible ways to reduce energy consumption along with sustainable growth in socioeconomic aspects of the country.

Keywords: Energy Consumption; Sustainability; Energy Independency

Abstract ID: EE-OP34

Numerical simulations on Phase Change Material operated condenser fordomestic refrigeration system

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Abstract

Latent heat thermal energy storage (LHTES) has immense potential to decrease the consumptions direct and indirect use of fossil fuels especially for heating-ventilation-air-conditioning (HVAC). This cold energy storage system also reduces the cooling load of high-power electronic devices. In this study a phase change material (PCM) operated condenser design is proposed to be used in the refrigeration cycle. Paraffin wax is used as PCM to store the heat released by refrigerant vapor and this stored heat will then be recovered by cold refrigerant from the evaporator of a typical refrigeration cycle. The commercial software Ansys-fluent is used to study the simultaneous charging and discharging of PCM. The enthalpy-porosity model used to simulate the melting and solidification of PCM, and condensation-evaporation model is used to simulate vapor- liquid phase change. The study concludes that the coefficient of performance of the refrigeration

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cycle could be improved by preheating the refrigerant that is supplied to compressor. Therefore, PCM can be used as a condenser for technical, economical, and environmental improvements.

Keywords: Latent heat thermal energy storage (LHTES); Refrigeration; Enthalpy-porosity model; Evaporation-condensation model

Abstract ID: EE-OP35

The status of mineral deposits across the globe.

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Abstract
Since beginning of advent of fire, Homosapien on this planet earth, applied science hasprovided the access to survival of life. Since arrival of fire, stone, minerals, aggregate ofminerals, metal ore and further to industrial happenings.
Only 1% or less then that quantum of earth mineral resources was exhausted up to the beginning of industrial revolution. Thereby, first 50 years of that about 10 times of that getexhausted. Now the main onus is on beneficiation of mineral ore. First, initial few decades took care of the available mineral resources. By 1850, around 20% ofworld's available mineral got exhausted then started venturing into beneficiation. At this point, the role of chemical engineers started taking charge and converting low grade mineral resources into usable one.
A few examples will suffice the statement- Converting low grade coal into usable ore by washing coal, removing the excess content, reducing excess ash. Converting low grade into some sort of better grade ores. Any erstwhile low grade started interaction to get upgraded. The normal upgradation startedby mechanical conversion then by using additives and gradually came into being, reactive compounds just by reducing the inferior components. As an effect, all mineral resources havebeen put under rigorous studies for converting the low grade into a better grade by mechanical methods as well as chemical methods.
Then came the days of addition, example: - polymers, reactive agents, thus by reducing unusable waste. Then it has evolved into an unending process there is nothing as waste everyunusable waste can be used.
The theme is conversion of unusable waste into a usable ore. Today's industry is almost solelydepending upon thermal beneficiation. Every day, the previous day's waste is coming in to being use. And this theme is the only way out for increasing momentum towards reducing unusableitems into usable one.
The author has this experience by using unusable waste of yesteryear on regular basis. So, theterm waste should be very carefully used. Geologist are there to find out or locate the mineral resources, then found out resources should be put to chemical engineers to get optimum use.This should be undertaken to ensure optimum utilization of minerals. So, this session of chemical engineering conclave needs to be focused on the optimum utilization of mineralresources and there is nothing on waste.

Abstract ID: EE-OP36

Effect on Thermo-physical properties of phase change materials in ahelical type of heat exchanger: Theoretical study

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Abstract

Phase change material (PCM) has a great potential to store thermal energy as latent heat which will help to meet the energy gap during power off. The growing demand in concentrated solar power systems has been matched by the production of latent thermal energy storage (TES) system. Indeed, the constant temperature release allows the more compact heat exchanger designs. In this study, the charging process of helical heat exchanger(HEX) using three different PCMs (RT 50, RT 27, and RT 35) has been investigated. The inlet temperature of fluid was calculated by non-dimensionless number i.e., Stefan number (Ste). In our present study, the temperatures considered for high temperature fluid (HTF) forSte are 0.44,0.35 and 0.23. A three-dimensional model using Enthalpy-porosity model is usedto study the melting and solidification of various PCMs and the results were compared. Theeffect of various thermophysical properties of PCM on charging and discharging time was studied. The rate and the amount of energy were found to be improved. The study concludesthat the rate of energy storage depends on temperature difference between the HTF and initial temperature of PCM.

Keywords: Thermal energy storage; Stefan number; Helical HEX; Phase change materials

Abstract ID: EE-OP37

Biodiesel production from waste cooking oil: An efficient technique to convert waste to energy

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Abstract

In this study, biodiesel is produced from waste cooking oil using heterogenous catalysis which is known for its simplicity and low cost. Heterogenous catalysis is the most feasible biodiesel synthesis method and it's a viable alternative to homogenous catalysis overcoming its constraints. Fluorine doped Tin oxide (FTO) was synthesized as heterogenous catalyst and its physicochemical properties were characterized and evaluated using scanning electron microscopy (SEM), Energy dispersive X-ray spectrometer (EDX), X-ray Diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). The most special feature of heterogenous catalyst is its tuning characteristic that generate surface area, porosity and acidic-basicity which significantly enhances its process feedstock flexibility for catalytic transesterification reaction of triglycerides to biodiesel. Under optimum conditions, the prepared catalyst offered desirable catalytic performance. Thus, FTO can be used as catalyst material for biodiesel processing. The highest biodiesel yield using FTO is 90.25% which is achieved at a catalyst concentration of 1%. Furthermore, the investigated physical properties of the produced biodiesel demonstrated that they are in accordance with ASTM D6751 standard.

Keywords: Biodiesel; Heterogenous catalysis; Tin oxide; Waste cooking oil; Pilot plant

Abstract ID: EE-OP40

Pyrolysis and combustion studies of refuse derived fuel pellets having varying plastic compositions

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Abstract

The composition of refuse derived fuel (RDF) pellets, particularly the plastic fraction of RDF, influences fuel's physico-chemical, and mechanical properties, which in turn might affect the pyrolysis, and combustion behavior of RDF. In the present study, simulated RDF pellets were prepared by varying plastic content as 5%, 15% and 35%. Raw materials such as wood, paper, textile, food waste, and plastics were used for pellet preparation. It was observed that hot-pressing/ heating while pelletizing increased the pellet density by 15%. Contrary, an increase in plastic content in RDF pellets reduced the pellet density. This change in fuel property with plastic variation was studied on the pyrolysis, and combustion behavior of hot-pressed RDF pellets. Thermo-gravimetric analysis studied the pyrolysis behavior of simulated pellets and reported that the plastics degrades at higher temperature of 700-780 K. Also, devolatilization rate increases with the increase of plastic in RDF. Single particle studies highlighted the combustion characteristics of simulated pellets and reported that ignition mass flux increased by 2.4 times with the increase of plastic in RDF. Investigations involving effect of external conditions (temperature, Re) showed strong effect of temperature on burning rate of single RDF pellet as compared to particle Re. Also, it was observed that temperature of 1048 K would be sufficient for higher conversion/burning rate of high plastic RDF. Burning rate data at different plastic content, furnace temperatures, and flow rate conditions give estimate of the conversion time scales, which provide basis for the development and modelling of RDF pyrolysis/combustion/gasification systems.

Keywords: Refuse derived fuel; Plastic; Palletisation; Thermo-gravimetric analysis; Single-particle Combustion studies; Temperature

Abstract ID: EE-OP42

A Feasibility study on the screening of solvents for CO_2 absorption

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Abstract
Carbon dioxide (CO_2) content in the atmosphere has increased rapidly and exponentially as a result of human activity and industrialization, causing serious issues like global warming and detrimental consequences on human health. The primary sources of CO_2 emissions are power plants and automobiles, burn fossil fuels and gas to produce electricity. In the past few decades, numerous methods based on membrane separation, adsorption, and absorption have been developed for CO_2 capture. A successful method of CO_2 removal was the chemical absorption of CO_2 utilizing liquid amines such as mono-ethanolamine, diethanolamine, methyl diethanolamine, and amino 2-methyl propanol amine solutions. This study described the screening of solvents for CO_2 absorption by measuring their solubility at 313 K temperature and 10 kPa CO_2 partial pressure. The absorption equilibrium was ensured by monitoring the CO_2 concentrations in the off-gas stream using non-dispersive infrared (NDIR) CO_2 probes (VAISALA CARBOCAP GMT 221). CO_2 loading in the solvent (moles of CO_2 per moles of solvent) was measured by titration using methanolic NaOH (UOP method 829-82). Based on the screening, a few solvents were impressive and further analyzed elaborately at 303-323 K temperatures and CO_2 partial pressure in the 5 – 15 kPa.

Keywords: Absorption; Carbamate; CO_2 Capture; Amine; Non-dispersive infrared

Abstract ID: EE-OP43

Energy Saving Potential of a Solar Energy-Based Vapor Absorption Radiant Cooling System

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Abstract
The current study presents an Energy Plus simulation-based analysis to establish the potential energy savings offered by a novel design of solar energy-aided vapor absorption chiller (VAC) when integrated to radiant cooling system (RCS) and compression chiller-based dedicated outdoor air system (DOAS). Comparisons are made with conventional RCS where both radiant as well as DOAS chillers are operated by compression chillers. For analysis purpose, a medium-size building containing 15 zones with three floors having approximate floor area of 5000 m^2 is selected. Dynamic climatic conditions of a hot and dry region has been used. Necessary building configuration and system validations have been done with the prescribed benchmark standards. Performance evaluations are done in terms of save in grid-based electricity, load profiles, maintained comfort conditions ascribed to zone air temperature and humidity levels, and coefficient of performance (CoP). It is established that the VAC-based RCS is capable of saving nearly 14.42 % of electrical energy on annual basis, as compared to the compression-based RCS. The temperature and humidity levels acquired with the proposed design are found to vary within 20.1°C-26.92 °C and 47 % - 50 %, respectively, with yearly-averaged CoP of absorption and compression chillers as 0.36 and 2.83, respectively.

Keywords: Radiant cooling system; Solar energy; Building cooling; Absorption chiller; Compression chiller

Abstract ID: EE-OP44

Development of polymeric multifunctional additive to improve constitutional properties of bitumen

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Abstract
Currently, two types of bituminous binders are being used in the construction of flexible pavements. These are conventional and modified bitumens. Conventional bitumens are high temperature susceptible and thus causing failure due to its early aging. Many researchers have done tremendous work on polymer modified bitumens but are expansive and have settling problem with time and thus make two separate phases causing serious fretting on the roadside.
In this study, mono & di terephthalate additives were synthesized to improve the bituminous properties along with the synthesis of phthalamides' too of low temperature susceptibility and have comparatively high strength in hot and arid climatic conditions. Viscosity grade VG10 and VG30 base bitumens were used to make modified bitumens. Both VG bitumens and synthesized modified bitumens were characterized for physico-chemical, rheological, and instrumental analysis. The synthesis of the additives was confirmed by FT-IR and NMR spectroscopy. Rheological study showed that the values of rutting resistance found to be 1.1 kPa at more than 65°C. Study on multifunctional additives also revealed that the prepared modified bitumens marginally meet the properties of higher-grade VG and modified bitumen as per IS and IRC specifications.

Keywords: Bitumen; Polymer modified bitumen; Rheology; Rutting resistance; Viscosity grade bitumen

Abstract ID: EE-OP45

Steady-State Performance of Natural Circulation Loops

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Abstract
One of the most pressing challenges in the field of thermal engineering is the cooling of heat-generating devices. For this reason, today's world encourages the use of passive cooling systems, which are free of active components and have a high level of reliability and compactness. As a result, passive systems such as the natural circulation loop (NCL) are often employed to achieve cooling by transporting heat from one location (source) to another (sink). In many industrial applications, such as nuclear power plants, solar energy systems, thermosyphon reboilers, and the cooling of electronic systems, natural circulation is a preferred heat removal method. Passive systems are increasingly being used in the nuclear sector to improve operational dependability and safety while lowering costs. During upset conditions such as pumping power failure, single-phase Natural Circulation is utilized to remove decay heat from PWRs, VVERs, and PHWRs. A one-dimensional simplified mathematical model of a single-phase natural circulation loop with a heater and cooler in steady-state is described in the current work that theoretically explores the dimensional and non-dimensional forms of governing equations. The flow rate is required to determine the heat transport capability of natural circulation loops. A generalized correlation for steadystate flow is theoretically derived in this study for uniform and non-uniform diameter loops with different boundary conditions. Then, the correlation is extended to loops of other shapes such as toroidal, triangular, and trapezoidal. Subsequently, the correlation is extended to natural circulation loops operating in the centrifugal force field. Also, the correlation is tested for different working fluids Finally, the correlation is used to analyze open loops.

Keywords: One-dimensional study; Single phase natural circulation loop; Natural convection heat transfer loop; Steady state flow equation; Dimensionless constant

Abstract ID: EE-OP46

Photobioreactors for production of biofuels from microalgae: a concise review

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Abstract
Microalgal strains are potential cell factories capable of producing valuable biochemicals including biofuels. Photobioreactors are closed systems capable of producing large quantities of microalgae and high yields of biofuel under optimal operating conditions, namely, light, temperature and pH. The design configurations of these systems are horizontal or serpentine tube, flat plate, bubble column and stirred tank of which tubular and flat plate bioreactors show promising results in biofuel production. However, the separation of algal biomass from the treated wastewater poses a major challenge in the use of algae for wastewater treatment. To overcome this problem, biofilm-based photobioreactor, an immobilized algal cultivation reactor, has emerged as a promising strategy. In the present study, we discuss the different types of photobioreactors, the distinct advantages of using these reactors over the open pond technology, the microalgal growth dynamics, reaction kinetics, diffusional limitations, and challenges faced during reactor scale-up. The review finally tries to provide a perspective on how further developments can be made in this reactor technology for setting up an economical, controllable and efficient method of microalgae cultivation and biofuel generation.

Keywords: Microalgae; Photobioreactor; Kinetics; Diffusional limitations

Abstract ID: EE-OP47

Design of Passive Decay Heat Removal System for HLW Tank

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Abstract
The radioactive liquid waste generated from the fast reactor reprocessing plant containing nuclear fission products are often stored in large capacity underground horizontal storage tanks. A closed loop passive heat removal system designed based on the principle of thermo-syphon mechanism is employed for removal of decay heat. It comprised of a tank (heat source) located at a lower elevation and a fin-tube heat exchanger (heat sink) mounted at a vertical distance of 15m from the tank connected by steel pipes. The net density difference of the coolant between the heat source and the heat sink acted upon by the elevation is the driving force for the fluid to circulate within the loop. The heat exchanger is enclosed in a rectangular duct connected to a chimney of 20m height to create the necessary natural draft for air to flow. In this work, an integrated model of the cooling circuit is developed and its performance is examined using computer program under Station Black Out (SBO) Condition. Further, the unsteady behavior of the system is investigated under different combinations of the transient condition. Moreover, the case studies have also been performed to understand the system performance for various boundary and initial conditions for both steady and unsteady conditions.

Key words: Passive decay heat removal system; Station Blackout; High-level liquid waste; Thermosyphon

Abstract ID: EE-OP48

Valorization of Biomass-Based Residue Blended Options for Energy Cogeneration

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Abstract
Inherent to forestry and agricultural activities, the production of waste has grown to be a significant problem. Biomass is a major and sustainable source of chemical energy that can be transformed into other energy forms, either directly or indirectly. Worldwide, the use of biomass in the energy sector is constantly expanding because of a variety of factors, including low emissions, demand for cleaner sources of energy, increased government support for renewable energy technologies, and an extensive amount of untapped biomass potential. With a cropping intensity of about 140% and a net area under cultivation of over 180 million hectares, Indian agriculture produces a sizable amount of biomass, a substantial portion of which is made up of residues. In this research, the elemental analysis of some residue blend options was studied to ascertain and enhance the viability of the blend for energy cogeneration. Poplar wood, Eucalyptus globulus, sugarcane bagasse, and banana peel waste were studied using proximate and ultimate analyses. For Poplar and Eucalyptus globulus, ash content was 4.1% and 1.6%, volatile matter was 79.8% and 83.7%, and theoretical high heating value was 19.26 MJ/kg and 19.65 MJ/kg, respectively.

Keywords: Biomass; Cogeneration; Proximate analysis; Ultimate analysis; Theoretical analysis

Abstract ID: EE-OP50

Challenges with Using Aqueous Ammonia for Atmospheric CO_2 Capture

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Abstract
Global CO_2 emissions continue to rise annually because of the increasing energy demands in both developed and developing countries. This surge in emissions has resulted in the melting of Northern Hemisphere glaciers and a subsequent increase in sea levels worldwide. The alarming rise in global temperatures over the last few decades has necessitated urgent action to reduce emissions while fostering economic growth. Several techniques have been developed to capture CO_2 from industrial emissions and the atmosphere, such as chemical absorption, physical absorption, adsorption, and photochemical processes. However, these methods are limited by the high-energy requirements for capturing and regenerating CO_2. Electrochemical methods have attracted attention as promising alternatives owing to their flexibility, modularity, scalability, and reduced energy requirements. The last few years have witnessed the development of various electrochemical approaches for CO_2 capture with significant potential. In this review, we will be discussing various electrochemical approaches that have been established as well as those under consideration for CO_2 capture from the atmosphere, along with their status and future potential, while considering their merits and demerits for sustainable development.

Keywords: Electrochemical methods; Carbon dioxide; Atmosphere; CO_2 Capture

Abstract ID: EE-OP51

Synthesis of Waste Derived Supported TiO_2 for Sustainable Photocatalytic Application

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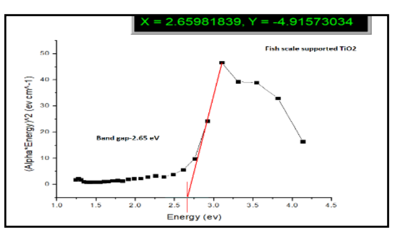
Abstract
This work presents a sustainable and simple approach for synthesis of inexpensive photocatalysts employing two municipal solid wastes, viz. chicken eggshell and fish (*Katla Katla*) scale to derive the support materials. Eggshell has been used as a support in two ways: with and without membrane. The support materials were prepared by alcohol [25% (v/v)] wash followed by drying. TiO_2 was incorporated over these support materials individually by sol-gel method. The band gap energy (E_g) of these three materials (Eggshell without membrane supported TiO_2, Eggshell with membrane supported TiO_2, Fish scale supported TiO_2) has been measured by UV-vis-Spectroscopy using Tauc equation and found 2.75, 2.81 and 2.66 eV respectively. X-ray diffraction (XRD), scanning electron microscopy (SEM), BET analyses were used to characterize the surface morphology, particle size and material phases. As, the prepared photocatalysts possessed band gaps (E_g) lower than the energy emitted by the visual spectra, these can be efficient in photocatalytic water splitting for hydrogen generation in visible irradiation.



Keywords: Fish scale-egg shell-supported TiO_2 photocatalyst; Visible irradiation; Water splitting; Hydrogen generation

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Abstract ID: EE-OP52

Single atom catalysts for efficient photoelectrochemical reduction of CO_2 towards valuable products

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Abstract
Photoelectrochemical (PEC) reduction combines the advantages of photochemical and electrochemical techniques for harvesting solar energy and utilizing it for reducing CO_2 into valuable products. The new frontier of single-atom catalysis (SACs) has drawn significant scientific attention owing to the rapid growth in research on isolated metallic atoms. SACs have attracted a great deal of attention as emerging developed materials in catalysis owing to their extraordinary activity from the perspectives of both scientific research and industrial applications. The major obstacles in the PEC process involve poor catalytic stability and insufficient selectivity toward valuable products. Incorporating SACs can sufficiently improve catalytic stability and enhance product selectivity by modulating the electronic and geometric configurations and regulating the single metal atom interaction with the support. The dispersed isolated metal atoms on suitable support material are utilized to confine, anchor, and coordinate the single metal atom with the support. The present research will focus on metal-phthalocyanine-based SAC, supported on graphene oxide, for enhanced PEC reduction of CO_2 to valuable products.

Keywords: Single-atom catalysts; Photoelectrochemical; CO_2 reduction; Solar energy

Abstract ID: EE-OP53

Intervention of Decarbonized Space Heating/Cooling for Net Zero EnergyBuildings

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Abstract
Global-warming is causing a rapid rise in temperature in high-altitude zones, including the Indian-Himalayan-region (IHR). Glacial melt will affect freshwater flows and adversely impact biodiversity, human settlements, and livelihoods. Unless the current emissions for space heating/cooling are profoundly confined, it is possible that the future average temperatures could rise even more.
Several renewable energy-based technologies can be implemented as building space heating/cooling solutions. Solar energy-based space heating solutions can be viable only for a few places in India. Renewable-based space heating/cooling technologies are sized as per demand and involve equipment sets that interact with buildings/spaces to create a comfortable environment. Building-design and choice of construction-material are key considerations in the operation of such systems to keep the heating/cooling

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demand low and control the overallcost. However, these systems require suitable backup from grid energy and indirectly produceharmful emissions.
The present-study focuses on sustainable solutions for residential, commercial, and institutional buildings and has been carried out keeping in mind that these solutions should provide the required thermal comfort in the built environment, meet the demand for space heating/cooling, while reducing CO_2 emissions, in sync with India's climate-action-plan. It discusses the potential of Geo-Thermal technology and its adoption for decarbonized space heating/cooling for Net-Zero-Energy-Buildings.

Keywords: Net zero energy buildings; Climate control; Geo-Thermal energy; Renewable energy

Abstract ID: EE-OP54

Overcoming the Challenges of Biodiesel Production: Utilizing Non-EdibleOils and Reactive distillation using Aspen Plus simulation.

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Abstract
The continued use of fossil fuels has resulted in major pollutant emissions and will soon havea negative impact on the world economy. The rapid depletion of fossil fuels and the rising demand for energy in the world have necessitated significant research focused on the creationof alternative fuels to address these issues. Due to the increasing demand for fossil fuels, theprice of fossil fuels is also increasing. Biodiesel is one of the alternative sources of energy asit generates less pollutants than petrol and diesel. The main challenge to producing and commercializing biodiesel is the high cost of production, primarily due to the expense of using edible vegetable oil as a feedstock. To lower the cost of feedstock, we can use non- edible oils in the production of biodiesel. Jatropha curcas seed oil is one of the non-edible oils that can be used in the production of biodiesel, which is environment friendly, renewable,and biodegradable. It can so replace fossil fuels as a clean energy source. In this work, we simulated three processes for the alkali-catalyzed continuous transesterification of biodieselfrom jatropha curcas seed oil using Aspen Plus v14. The first process involved a Continuousstirred-tank reactor (CSTR), the second process used a Plug-Flow reactor (PFR), while the third process involved reactive distillation in the place of reactor. The results showed that thefirst process achieved a methanol conversion rate of 47.59% and triolein conversion rate of 74.67%, second process achieved methanol conversion rate of 49.81% and triolein conversion rate of 98.72%, while the third process achieved methanol conversion rate of 60.02% and triolein conversion rate of 99.98%. Based on our findings, we recommend use reactive distillation in the production of biodiesel. The performance of the CSTR reactor, PFR reactor, and Reactive distillation was also discussed, along with the impact of key operational and design factors.

Keywords: Biodiesel; Jatropha curcas seed oil; Aspen Plus; Reactive distillation

Abstract ID: EE-OP55

Solid Oxide Regenerative Fuel Cell - Heat Recovery for High Temperature Steam Electrolysis

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Abstract
The emissions let out by automobiles directly account for the climatic changes that threaten the entirety of humankind. Many countries are tirelessly working to reduce their annual emission rates of various

undesirable gases to the environment in order to meet the sustainability goals and achieve net zero carbon emissions by 2050. Solid Oxide Regenerative fuel cells, with their power generation and fuel generation designs integrated into a single block, may thus prove to be a novel approach to address all of these issues. Solid Oxide Regenerative fuel cells could provide an alternative to the EV dominance of the transportation sector, which is expected to constitute 58% of all car sales by 2040. The dimensions of fuel cell stack and storage subunits of an RFC decides the energy capacity and the power output. Furthermore, the heat required for High Temperature Steam Electrolysis (HTSE) can be supplied by the excess heat generated by the integrated SOFC which would lessen the electricity requirements for the electrolysis process.
Keywords: Solid oxide regenerative fuel cells; HTSE; Electrolysis; Fuel cells

Abstract ID: EE-OP58

Carbon Dioxide Capture using Functionalized Structured Adsorbents

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Abstract
Metal and alloy have high malleability and ductility properties. They can easily be transformed into structures like a monolith and are, therefore, employed in manufacturing metallic monoliths to support sorbents. However, due to their smooth surfaces, incorporating the active sorbents on the metal substrate restricts their uses in the gas sorption process. Therefore, suitable coating procedures are to be adopted to use such metal substrates in fabricating honeycomb monolith structured sorbent for CO2 gas sorption. In this study, the stainless steel (SS304) Al and FeCr alloys sheet were treated thermally and chemically, coated with zeolite 13X, and impregnated with polyethyleneimine (PEI) using the conventional wet impregnation method. This material was then characterized by XRD, N_2 physisorption (BET), adherence test, FESEM, and EDX. FESEM results showed the homogenous and rough surface of all metallic sheets. The mass loss recorded by the adherent test was less than 6%, suggesting zeolite 13X and the metal sheets adhered well to one another. Overall PEI loading over the sheets was estimated to be about 22%. The CO_2 gas adsorption capacity of the PEI-impregnated metallic sheet was studied by thermogravimetric analysis (TGA) at 750C and atmospheric pressure with a simulated flue gas containing 10% CO_2/N_2. The result showed 1.3 mmol CO_2 per g sorbent, the same as PEI-impregnated zeolite 13X powder.

Keywords: post-combustion; monolithic; adsorbents

Abstract ID: EE-OP59

Effect of kaolin catalyst on yield of various products obtained from pyrolysis of waste LDPE and reaction kinetics

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Abstract
The pyrolysis study with waste LDPE has been carried out in a batch reactor and the various products are categorized as gaseous, liquid, and solid. The yield of multiple products at 5 different heating rates (5-25^{o}C/min) in the temperature range of 475-525^{o}C with and without kaolin catalyst (10, 15 & 20% w/w) has been investigated. The best operating conditions for maximum yield of gaseous, liquid, and solid fuels have

been identified. The influence of the catalyst on the reaction kinetics is investigated by estimation of activation energy from the experimental mass loss data in TGA. The activation energy for the degradation of LDPE lies in the range of 480-525 kJ/mol, while it shifts to 475-510 kJ/mol in the presence of a catalyst. The pyrolysis experiment with a 25% catalyst provides the maximum liquid yield with lesser solid residue at 550°C. At a temperature of 500°C with 5% catalyst shows the least amount of liquid product with more solid residue. FTIR analysis of the resulting oil shows the presence of alkane, alkene, and methyl groups in the oil. GC test confirms the presence of hydrocarbon (flammable) gases like hydrogen, propane, and propylene. The present endeavor aims to utilize the waste LDPE to produce clean energy effectively and create a plastic-free green environment.

Keywords: Waste LDPE; Kinetics; Product yield

Abstract ID: EE-OP60

Storage Stability of Waste Nitrile Rubber and polyethylene Modified Bitumen for Road Construction: Preparation, Morphology, and Rheological Properties

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Abstract
Bitumen is a viscoelastic engineering material. The hot storage stability of base bitumen is very poor and can be enhanced either by chemical modification or adding polymeric additives. This study successfully prepared two modified bitumens OB1 and OB2 using waste nitrile rubber (WNR) and compatibilizer. The hot storage stability of base bitumen can be improved considerably by blending of reactive WNR/polyethylene under high shear mixing at high temperature with the use of compatibilizer. The storage stability, morphology, and rheological properties were measured for the modified bitumens and evaluated by means of the hot storage test, optical microscopy, and conventional and dynamic mechanical analysis using a dynamic share rheometer (DSR). The test results indicated that not only storage stability but also rheological properties of blended modified- bitumens were enhanced by reactive blending of WNR with compatibilizer. Moreover, the addition of compatibility accelerator resulted a better adhesion between polymer and bitumen milieu with no phase separation. It established a better storage stability between a continuous bitumen phase with dispersed polymer particles that remain interlocked in a single continuous phase. Study showed a decrease in phase angle from 83.47 to 80.15°, 78.21 to 75.92 and 77.37 to 73.99° for base bitumen, OB1 and OB2 at 52°C respectively. It also showed that the addition of WNR with compatibilizer making the modified bitumen more stable with high deformation resistance. Study also showed that there was minimum change in softening point, and penetration of OB1 and OB2 while short term aging.

Keywords: Bitumen; polymer-modified asphalt; Storage stability; Waste nitrile rubber; Rheological properties

Abstract ID: EE-OP61

Co-synthesis of H_2-rich gaseous fuel and nanometal carbon hybrids from liquid and solid waste

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Abstract

In this study, a novel hydrothermal gasification process for the simultaneous treatment of simulated aqueous metal effluent (Ni and Zn) and pine needles was designed and investigated. Temperature is the significant parameter that decides the product yields, and the same was varied from 300 to 600 ^{0} C to optimize gaseous fraction and solid products. During supercritical water gasification (SCWG) of metal effluent (Ni and Zn) with pine needles, the metal (M) present in wastewater gets dehydrated to form the metal oxide (MO), which further gets reduced to pure metal ($M^{(0)}$). The result shows that the in-situ generated particles of nanometal act as catalysts and promote the water gas shift reaction and methanation reaction, resulting in increased yield of H_2 and CH_4. The maximum hydrogen (17.2 mmol. g^{-1}) and total gas yield (17.2 mmol. g^{-1}) were obtained for Ni-pine needles at supercritical temperature (600 ^oC), biomass to effluent ratio 1:10 with a reaction time of 60 min. In addition, the quasi-spherical and cubical-shaped morphology of hybrids were identified by Field scanning electron microscope (FESEM) and Transmission electron microscope (TEM) analysis, while the vibrating sample magnetometer (VSM) analysis was performed to determine the superparamagnetic characteristics of Zn and Ni carbon hybrids.

Keywords: Hydrogen; Supercritical water gasification; Biomass

Abstract ID: EE-OP62

Bimetallic transition metal chalcogenides as electrode material for supercapacitor application

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Abstract

The demand for flexible energy storage devices is increasing with the growing wearable technology. To fabricate such flexible devices, electrode materials must meet the energy storage demand and be compatible enough in terms of flexibility and mechanical stability. Supercapacitors have emerged as potential devices for storing energy over other electrochemical energy storage devices, owing to their excellent cyclic stability, compact size, and high-power density. However, their low energy density has always been the primary research concern. In this context, various nanomaterials have been investigated for supercapacitor applications to enhance the energy-storing capacity. Among various emerging nanomaterials, transition metal chalcogenides have been extensively explored owing to their outstanding physical, chemical, and electrochemical characteristics. In addition, it has been amply reported that bimetallic nanomaterials provide enhanced performance than monometallic nanomaterials. The present research, therefore, focuses on bimetallic transition metal chalcogenides for supercapacitor application, exhibiting good specific capacitance and high cyclic stability.

Keywords: Supercapacitor; Transition metal chalcogenides; Energy density; Specific capacitance

Abstract ID: EE-OP63

Trend analysis of precipitation under climate change scenario

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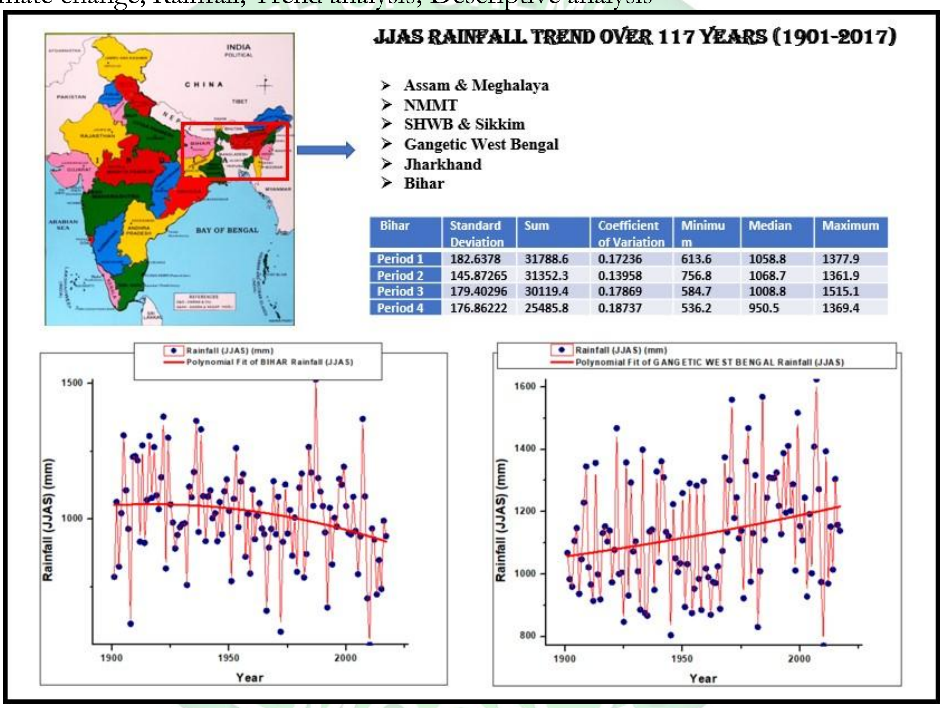
Abstract

The climate change is a natural phenomenon. But it has been hastened by the anthropogenicactivities. As of its obvious consequence the extreme weather events like cyclone, heavy rainfall, floods have been increased. On the contrary desertification also taking place in otherparts of the country. So, the disaster management and water management are essential for each part of the country even in the areas not effected still now.

This paper analyses the June-July-Aug-Sep (JJAS) rainfall pattern over 117 years (1901- 2017) for six meteorological subdivisions in East & North-East India. A rainfall trend with polynomial curve fitting has been shown for individual region. The descriptive analysis alsodone to compare the overall rainfall and variations over the periods.

Keywords: Climate change; Rainfall; Trend analysis; Descriptive analysis



Abstract ID: EE-OP65

Characterization of Organic Pollutants in the Ambient Aerosols of Dhaka Megacity during Wintertime

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Abstract

According to the world air quality report 2021, Bangladesh is the 1st ranked polluted country and Dhaka city is the 2nd ranked polluted city in the world.[1] Thus, air pollution is a big concern for Bangladesh. In the last few decades, air pollution has emerged as a major threat to human health (e.g., showing carcinogenicity, immunotoxicity, reproductive toxicity and genotoxicity). Not only that, some air pollutants are found to be

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influencing global climate directly or indirectly via altering radiative forcing or of cloud microphysical properties. Organic air pollutant is comprised of a wide variety of organic compounds such as n-alkanes, hopanes, steranes, aromatic hydrocarbons (AHCs), polycyclic aromatic hydrocarbon (PAHs), carbonyl compounds (CCs), sugar compounds, polyacids, aromatic acids, fatty acids and phthalates, lignin/resin acids, volatile organic halogenated compounds (VOHCs), organophosphorus compounds (OPCs) and SOA tracers. They can be both particulates and aerosols[11] with primary and secondary in nature. Organic pollutants are mainly emitted from incomplete combustion of both fossil fuels and biomass burning (BB) which can be further photo-oxidized into SOA by reacting with different atmospheric oxidants like ozone or hydroxyl radicals.

Keywords: Air pollutants; Aerosols; Particulate matter

Abstract ID: EE-OP67

Carbon Footprint Reduction from Construction Industry: A Review

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Abstract
The building sector is one of the largest contributors to greenhouse gas emission in urban areas. Quantitative assessment of the carbon footprint of urban buildings is needed for advance research and policy debates on building carbon emission reduction and sustainable architectural planning. Companies are now trying to minimize environmental impacts by integrating environmental concerns into their supply chain operations. The review emphasizes the significance of optimizing construction processes to minimize energy consumption and waste generation. The use of low-carbon materials such as recycled and locally sourced materials, as well as the implementation of energy-efficient designs, can significantly reduce carbon emissions. Additionally, the incorporation of renewable energy sources, such as solar and wind power, can further minimize the environmental impact.
With a variety of problems faced by designers and planners, the practices taken to reduce carbon footprints are very diverse. As global concerns about environmental sustainability grow, there is an urgent need to reduce the carbon footprint associated with construction activities. This review explores various strategies and technologies that have been employed to mitigate carbon emissions throughout the construction lifecycle. By adopting sustainable practices and technologies, the construction industries can play a vital role in carbon footprint reduction.

Keywords: Carbon footprint; Construction lifecycle; Supply chain operations
Abstract ID: EE-OP70

Effect of Zr-Ru promotion on SBA-15 supported Fe catalysts for Fischer-Tropsch production

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Abstract
An Iron supported on SBA-15, (a mesoporous structured silica synthesized from coal fly ash) catalyst with Zr and Ru promoters has been synthesized and tested in the fixed bed tubular reactor for the Fischer-Tropsch synthesis. The SBA-15 is synthesized under an acidic condition using triblock copolymer Pluronic

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(P-123) as a template and coal fly ash (CFA) derived supernatant as a silica source. The catalysts with Iron, Zr and Ru loading 15 wt. %, 5 wt % and 0.1 wt % respectively are prepared by wetness impregnation. The obtained catalysts are characterized by X-ray diffraction (XRD), Nitrogen adsorption-desorption, Field emission scanning electron microscopy (FESEM), and H_2-Temperature programmed reduction (H_2-TPR). The EDX analysis is also performed to verify the impregnated metal contents. The synthesized catalysts are activated in pure H_2 and catalytically tested with a syngas (H_2: 28.7%, N_2: 47%, CO: 14.18%, CO_2: 9.11%, and CH_4: 1.01%) having H_2:CO molar ratio = 2:1, T = 220°C, and P = 30 bar. Maximum CO conversion (~ 53 %) is observed for Fe/SBA-15 catalysts. The CO conversion variation with respect to time for all the catalyst has also been discussed.

Keywords: Coal fly ash; Fischer-Tropsch synthesis; Ultra clean fuel; Mesoporous materials

Abstract ID: EE-OP73

Estimating Energy Loss and Endothermicity of Hydrocarbon Fuels under Supercritical Conditions: A new Approach

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Abstract
In recent years, supersonic combustion ramjet missiles gained significant attraction worldwide specifically for security reasons. Thermal load on a supersonic engine structure is a critical issue in air-breathing engines. One of the effective methods for reducing heat loads is regenerative cooling, which involves the circulation of endothermic fuel around the combustion chamber through cooling channels. Fuels with higher endothermicity can provide a better cooling effect to the engine. The endothermicity of fuel is calculated by subtracting the sensible heat from the total heat sink value. Heat loss plays a crucial role in the estimation of the total heat sink capacity of a fuel. In most of the literature, either the authors assumed that the energy input by the direct heating instrument is equal to the total heat sink by the fuel. We believe the assumption is not true for a majority of scenarios. In the present work, a new methodology has been established to find the heat loss quantity in estimating the endothermicity of hydrocarbon fuels. A thermally stable compound, namely toluene, was considered as a model fuel in estimating the heat loss values. Pyrolysis experiments were carried out with toluene under supercritical conditions with a temperature range of 300 °C to 600 °C under 55 bar pressure. Various techniques, such as ASTM-D86 distillation, gas chromatography, etc., were used to characterize the feed and product properties. At 600 °C, the heat absorption capacity of toluene is 1656 kJ/kg. The estimated heat loss percentage lies between 6 to 10 % of the total energy input for the studied temperatures.

Keywords: Pyrolysis; Heat absorption capacity; Endothermicity; Heat loss percentage

Abstract ID: EE-OP74

Investigation of water retention in sandy soil using chemical treated and untreated walnut shell char

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Abstract
The soil in the Union Territory (UT) of Jammu and Kashmir has poor water retention quality, due to its sandy nature, that affects agriculture in the region. This problem can be solved by additives that would help to increase water retention within the soil. In addition, Jammu and Kashmir is the largest producer of walnuts in the country. Walnut shells tend to have low market value and therefore are discarded as wastes within the UT. The current study deals with increasing water retention in the soil by using walnut shell biochar. Walnut shells were converted to biochar by thermal treatment under three different conditions i.e., nitrogen, air, and under vacuum at 500◦ C. The biochar thus formed was treated with acid and bases in order to change is morphology. This has a considerable effect on the water retention capacity of the char. The chemical composition of the char was analyses using FTIR and CHNS whereas the surface morphology was analysed using SEM. It was found that biochar treated with sodium carbonate (for N2 and vacuum synthesied char) and untreated air synthesied char shows the best water retention. This biochar was then added to solid in a weight ratio of 2%, 5% and 10% to determine the water retention in soils. It was observed that there was a mild enhancement of water retention in soil by addition of char and depends of the char loading.

Abstract ID: EE-OP75

Electrochemical Detection of Nitrite at Co (II)-based metallo-Supramolecular Polymer Modified Glassy Carbon Electrode and Study the kinetics of Electron Transfer

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Abstract
In this work, we report the synthesis of a new monometallic supramolecular polymer (SMP) for fabricating an electrochemical nitrite sensor, and proposed a mechanism for sensitive detection of nitrite. The symmetrical ligand bearing terpyridine moieties [4',4''''-(1,4- Phenylene) bis(2,2':6',2''-terpyridine)] was coordinated with Co (II) salt (Co: Ligand-1:1) (polyCo) for synthesizing the new SMP. UV/Vis spectrophotometric titration, SEM, EDS, FT-IR, EIS, and CV techniques were utilized to characterize the structural morphologies and electrochemical properties of the designed polyCo/GCE sensor. Glassy carbon electrode (GCE) was used as the base electrode for fabricating polyCo/GCE which was exploited throughout the experiment. The kinetics of the irreversible oxidation mechanism was studied via analyzing scan rate and pH variation. CV, DPV and amperometry techniques were used for studying the electrochemical behavior of the polyCo/GCE for detecting the nitrite analyte at different concentrations. The amperometry technique showed a linear range of 5 – 542 μM and limit of detection (LOD) of 0.28 μM. The sensitivity of this sensor was calculated as 5.9472 μA mM^{-1}. The proposed sensor was also tested for interference, stability and reproducibility. CV technique was demonstrated to confirm the applicability of the nitrite sensor to real sample analysis. The findings confirmed excellent reproducibility with low value of standard deviation.

Keywords: Supramolecular polymer; Nitrite; Electrochemical detection

Abstract ID: EE-OP76

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Modelling and Simulation of a PEM Fuel Cell vehicle driven by Permanent magnet synchronous motor to achieve constant speed

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Abstract
Fuel cell vehicles are becoming more and more attractive as alternatives to the conventional automobiles due to their lower carbon emissions and greater economy as they are the cleanest energy source right now. They are more efficient and can travel hundreds of kilometres after single refuelling. As PEMFC fuel cells are the most popular fuel cells due to their low weight and compact area compared to other fuel cells, we are analysing a PEMFC vehicle in this work. In this MATLAB simulation, a permanent magnet synchronous machine has been used in place of a DC motor. An interleaved boost converter and a voltage source inverter are both developed in this simulation to transform DC voltage into AC voltage and to power a PMSM machine, respectively. After starting the simulation at 0.5 second, the model reached a constant speed of 763 RPM and a mechanical power of 4.65 kilowatts. The elaborated MATLAB model and graph illustrates all of the simulated results in this work.

Keywords: PEMFC vehicle; PMSM; MATLAB; VSI

Abstract ID: EE-OP77

Global Energy Transition for Sustainability- Opportunities and Challenges

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Abstract

The world is moving towards sustainable energy options faster as global CO_2 levels have reached unprecedented levels. The United States aims to reach 100 percent carbon-pollution-free electricity by 2035 and net-zero greenhouse gas emissions by 2050 to limit the global temperature increase to 1.5°C. Carbon-neutral/low-carbon power generation utilizing nuclear batteries (micro nuclear reactors), solar, wind, and biomass, and increased EV usage for transportation are crucial to achieving this target. solar and wind primarily aid the decarbonization of the power sector. Carbon capture, storage, and utilization will play a vital role in decarbonizing the power sector. The industrial and transportation sectors are the most difficult of the three main sectors to decarbonize. In addition to process energy efficiency, and improvement, green hydrogen and micro nuclear reactors in the industrial sector will play a key role. For the transportation sector, electricity storage in batteries is very critical. This along with materials for solar panels, and magnets for wind energy will place a high demand on some rare earth and critical elements Currently China dominates the global supply of these minerals. While obtaining these minerals from primary domestic mineral deposits is crucial for national security, secondary sources, including byproducts of coal mining and other energy-based waste products, are equally vital to developing a reliable supply chain. Recycling and reuse of lithium-ion and other batteries along with E-waste are essential for a successful transition to a sustainable energy future. This presentation will discuss recent developments and ongoing efforts at Penn State in multi-metal extraction from secondary sources and global/regional opportunities and challenges.

Keywords: Sustainable Energy; Environment: Critical minerals; carbon sequestration

Abstract ID: EE-OP82

Novel Distillation Engineering Aspects for Futuristic Second Generation (2G) Ethanol Bio-Plants

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Abstract
Mitigation of global warming and issues of India's energy security & self-sufficiency are key factors to propagate need for future alternative clean fuel like Bio-Ethanol. Government has been implementing Ethanol Blended Petrol (EBP) Programme throughout country, wherein OMCs sell petrol blended with 10% -20% ethanol. To increase indigenous production of ethanol, Government is setting up 12 Bio-ethanol plants across India.

Present paper critically reviews spectrum of engineering challenges in the Novel distillation tower used for Bio-ethanol distillation. Besides ethanol, Acetic acid, Fuel oil, technical oil are produced as side cuts in distillation. Quality is as per specification - IS15464:2004 of anhydrous ethanol for use in automotive fuel. Process of ethanol production involves pre-treatment of biomass followed by enzymatic hydrolysis of fermentable sugars (C-5 & C-5). Sugars are fermentation by common yeasts to ethanol. Ethanol broth is distilled using Novel distillation tower and it consists of micro-lignin produced during steam explosion of biomass.

It is discussed that due to micro-lignin in ethanol broth, valve & sieve trays are bound to choke frequently & needs quick cycle of column cleaning of each tray. This cleaning cycle is function of biomass used & higher the lignin % (as case of bamboo & sugarcane bagasse in comparison to lower lignin biomass like rice and wheat straw), higher will be cleaning cycle time. To achieve this, spacing between each tray is increased to accommodate manhole between each tray which can be opened with confined space entry for mechanical scrap cleaning. Increase in distillation tower height affects seismic & wind loading & therefore altered thickness of shell & disturbed flow patterns in downcomer with instantaneous ΔP, that too tray dependent. Soluble micro-lignin with ethanol broth causes complex flow patterns on trays, altered tray efficiency, intermittent leakage through tray deck, altered sieve size & altered % opening of downcomer. Tailored Design of tray internals to handle micro fibrous lignin & factors contributing to mal-operation of distillation tower are elaborated.

This Study encompass Robust capturing of innovation in distillation design of Bio-ethanol Technologies & their demonstration in-situ oil & gas refineries with coupled bio-refineries. This study may set role model for oil & gas industry with focus on CO_2 Footprint Reduction with holistic goal of addressing challenges of distillation in Bio-ethanol plants.

Keywords: 2G Ethanol; Ligno-cellulosic Biomass; Distillation

Abstract ID: EE-OP83

An Efficient method to produce Green Hydrogen by Electrolysis Method

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Abstract

Green hydrogen is called the fuel of the future as it has the ability to power the hard to electrify sectors like industries, transportation and building contributing around 65% of yearly greenhouse gas emission. It is produced through a process called Water Electrolysis. The technique involves "breaking" of the water molecules using electricity in an electrolyser in order to extract the dihydrogen (H_2). The electricity must itself be carbon-free in order to consider this hydrogen as green or renewable. Green hydrogen is a clean energy source that only emits water vapour and leaves no residue in the air, unlike coal and oil. The produced hydrogen is ready for use in direct applications like transport and steel production and also in direct power applications like fuels, fertilizers and is a great replacement for natural gas. India is well positioned to be a major green hydrogen production center on account of its ample and low-cost renewable resources that allow for some of the lowest green hydrogen prices in the world.

Keywords: Green hydrogen; Electrolysis; Renewable; Dihydrogen; Electricity; Electrolyser

Abstract ID: EE-OP84

Optimization, kinetics, thermodynamics, and economic analysis of a new, sulphonic-acid functionalized Limonia acidissima carbonaceous catalyst for biodiesel synthesis from Millettia pinnata oil

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Abstract
Biodiesel has been accepted as a promising substitute for petro-fuels in many countries because it can fulfill the requirements of the transportation industry. The present research introduces biodiesel production from *Millettia pinnata* (Karanja) oil utilizing waste wood apple (*Limonia acidissima*) shell in deriving carbonaceous catalysts. The feedstock had a high free fatty acid (FFA) concentration based on proximate analysis, which indicated that an acid catalyst was required for fuel production. Analysis of the prepared catalyst was done by SEM, EDAX, FTIR, XRD, and BET. The optimization of esterification was performed with the RSM central composite design (CCD) experimental matrix, while the reaction time was 1.5 h at 55 °C with 4 wt. % catalyst under 650 rpm and 50% w/ w alcohol concentration. The actual yield was reported to be 98.95% under ideal conditions. The fuel characterization revealed that KOME (Karanja oil methyl ester) possesses physico-chemical characteristics suitable for biodiesel as per ASTM standards. Kinetic studies showed that the esterification follows pseudo-first-order kinetics with an activation energy of 62.61 kJ mol^{-1}. The thermodynamic study confirmed that the acid-catalyzed esterification reaction is endothermic and non-spontaneous.

Keywords: Biodiesel; Catalyst reusability; *Limonia acidissima*; *Millettia pinnata*; Central composite design

Abstract ID: EE-OP87

Catalytic CO_2 utilization for syngas production

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Abstract

Because of the use of fossil fuels, energy and the environment are inseparably linked. Apart from decreasing reserves, environmental restrictions that are becoming increasingly stringent are another reason why cleaner and more effective ways for utilising natural reserves must be developed. Human-caused GHG emissions and production have been identified as major contributors to global warming. Dry reforming of methane (DRM) would be advantageous which is like killing two birds with the same arrow because it utilizes two greenhouse gases i.e. carbon dioxide and methane also produce syngas ($CO+H_2$) which can be the feedstock for several chemical production like methanol, dimethyl ether etc. It also plays important role in Fisher Tropsch synthesis where several hydrocarbons are produced. Syngas production by DRM, which uses the most major greenhouse gases CH4 and CO2, has recently gained scientific attention. For this purpose, a Ni-based catalyst is developed which is cheap and effective as compared to noble metals but it suffers from carbon deposition. For high-activity catalysts, we are using Ceria-Zirconia based which provides high oxygen storage capacity (OSC) and thermal stability. The catalyst synthesis method used is a one-pot synthesis method with $NaBH_4$ as a reducing agent where Boron gets deposited on the catalyst surface and prevents coking due to similar chemisorption as Carbon. It was observed that catalyst activity was increased for the catalyst with Boron doping as compared with the catalyst prepared without B. Catalyst deactivation was also reduced by incorporation of B which increases the stability of DRM.

Keywords: Hydrogen production; Dry Reforming of Methane; Catalyst deactivation; Ceria-Zirconia; Nickel

Abstract ID: EE-OP88

Kinetic studies on the degradation of polymers by hydrothermal liquefaction for conversion of plastic waste to fuel oil

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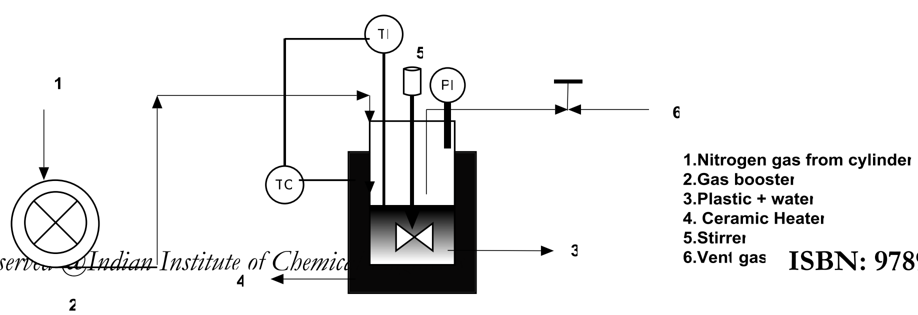
Abstract

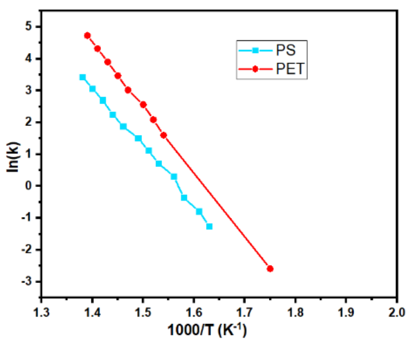
Plastic products from various polymers have become an integral part of our life, and waste plastics created by human activities pose serious threat to the environment. Liquefaction technology is emerged as one of the future perspectives for conversion of plastic to value added products. Hydrothermal liquefaction (HTL) is a thermochemical technology used for the conversion of plastic waste into crude-like oil, which breaks down the polymer structure into liquid components within a temperature and pressure range of 250-450 °C and 40-250 bar respectively in the presence of a water.

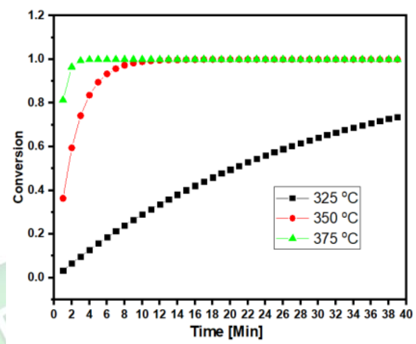
To study the process, an integrated small-scale setup with necessary subsystems is designed and currently under realization. Degradation kinetic studies is carried out using COMSOL Multiphysics software on widely used polymers such as Poly Ethylene Terephthalate (PET) and Poly Styrene (PS) to optimise the reaction time, rate of conversion, temperature and pressure parameters. Under these optimised conditions , water present in the system becomes either subcritical or supercritical, and acts as a solvent, reactant and catalyst to facilitate the breakage of macromolecules (long chain hydrocarbons) to fuel oil. Hydrothermal liquefaction has added advantages including moderate process temperature, higher conversion and clean process that doesn't produce harmful compounds, such as ammonia, NO_x, or SO_x when compared to Pyrolysis.



HTL Reactor setup

ISBN: 9789310 000719





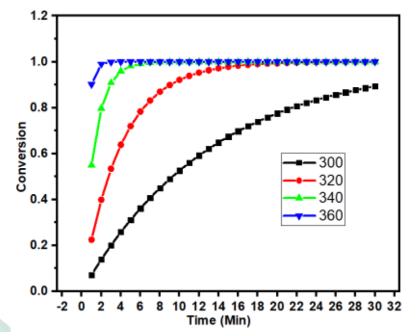


Figure 1. Plot of lnk versus 1000/T at different temperature for PS and PET

Figure 2. Conversion Vs Time for degradation of PS 250 bar and 325°C, 350°C and 375°C.

Figure 3. Conversion Vs Time for degradation of PET at 250 bar & 300°C, 320°C, 340°C and 360°C

Keywords: HTL; Kinetics; Polystyrene; PET

Abstract ID: EE-OP89

Studies on the Development and Performance of Natural Dye-Sensitized Solar Cell

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Abstract

Dye-sensitized solar cells (DSSCs) have achieved significant attention as a promising alternative to traditional silicon-based solar cells due to their low-cost fabrication processes and potential for high efficiency. In the present study, titanium di-oxide (TiO_2) has photoelectrode material and natural pomegranate fruit extract as the photosensitizes are used to develop dye-sensitized solar cell. To photoelectrode (TiO_2) was obtaines by sol-gel process from titanium iso-propoxide and it was characterized by X-Ray Diffraction, BET Surface analyzer and Scanning Electron Microscope. The solar cell was developed through a series of few steps including deposition of anatase TiO_2 nanoparticles onto a transparent conducting glass (Indium Tin Oxide (ITO) glass) to compact and uniform anatase TiO_2 film and incorporation of natural fruit extracts were incorporated on the anatase TiO_2 film as photo sensitizers (anthocyanin). The selection criteria of specialized fruit extract based on uniqueness in their chemical composition mainly focused to expand the range of light adsorption of DSSC. The synthesized anatase TiO_2 film and the counter electrode were then assembled together with a redox electrolyte filling the space between them. The fabricated DSSC examined using current-voltage measurements under simulated solar irradiation. The efficiency of the DSSC is varying from 10 to 18% based on the generated photocurrent and the incident light intensity.

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Keywords: Dye-sensitized solar cell (DSSC); Sol-gel method; Anthocyanin dyes; Natural photo sensitizers; Indium tin oxide (ITO) glass; Anatase TiO_2 electrode

Abstract ID: EE-OP91

Effect of process parameters on activity enhancement ratio for supported Ni-Fe and Rh catalysts in CO_2 hydrogenation to methane

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Abstract
The hydrogenation of CO_2 to methane (CH_4) has gained attention as a method to store renewable hydrogen and utilize CO_2 for synthetic fuel such as methane production. In our previous study, catalytic turnover frequency for CH_4 formation (TOF_{CH4}) was enhanced for γ-Al_2O_3 supported 15wt.% Ni-Fe and 3wt.% Rh catalysts than 15wt.% Ni catalyst. Activity enhancement ratio defined as $TOF_{CH4}X/TOF_{CH4}Ni$ (X = Ni-Fe, Rh) was determined to be ~ 3.0 for the catalysts at 523 K, 1 atmospheric pressure and 10.4 g_{cat}-h/g-$mole_{CO2}$ contact time. The current study aims to verify whether this enhancement ratio is caused purely from catalytic effects or not, therefore a series of reactions will be carried out by varying process parameters, (i) reaction temperature (498 – 623 K), (ii) partial pressure of CO_2 (CO_2:H_2 molar feed ratio from 1:4 - 1:24) and (iii) Gas-Hourly Space Velocity (GHSV) using the said catalysts. It is argued that similar catalytic activity for Ni-Fe and Rh catalysts might originate from their proximate electronic properties prevailing at the surface of the said catalysts where CO_2 activation could be enhanced to a similar extent than Ni. Moreover, effect on enhancement ratio is further scrutinized by developing suitable kinetic model and comparing activation energy values.

Keywords: CO_2; CH_4; Enhancement ratio; GHSV; Reaction Temperature

Abstract ID: EE-OP94

Modelling And Simulation of Reverse FlowReactor for Environmental Application

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Abstract
Increase in surface temperature of earth is due to greenhouse effect. Greenhouse effect is due to the emission of harmful greenhouse gases like Methane and Nitrous Oxide. These gases are found in very low concentrations in form of emissions from industries. These gases must be oxidized or decomposed to form environmentally less harmful compounds. As these gases are found in very low concentration, we would require an efficient reactor that would maintain the temperature for long period of time so that these trace gases would react efficiently. As the conventional sources of energy are depleting day by day,it is our responsibility to save energy for future. So, the reactor with energy saving capability would be icing on the cake. Here comes the reverse flow reactor which is a fixed bed reactor which reverses the inlet flow periodically to create temperature front which moves on the direction of gas flow. This flow reversal phenomena of RFR helps the reaction to sustain for longer time and the reactor would not exhaust. If

the reaction is exothermic, the heat of reaction is used by reactor which helps the reaction to proceed efficiently. Ignition temperature is needed for reactor to start, after that the reactor operates in auto-thermal mode. In this study, we simulated a reverse flow reactor and checked it with reactions like oxidation of Methane, decomposition of Nitrous Oxide and Claus Reaction and found that the conversion of these trace gases was 99.5% and the temperature profile suggested the reaction to be energy efficient.

Keywords: Reverse flow reactor; Exothermic; Auto-thermal; Oxidation; Decomposition

Abstract ID: EE-OP96

Utilization of CO2 from Coal Fired Power Plant

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Abstract
India emits around 2.88 gigatons (Gt) CO2 & has committed to cut India's total projected carbon emission by 1 billion tons by 2030, reduce the carbon intensity of the nation's economy by less than 45% by the end of the decade and net-zero carbon emissions by 2070 in CoP 26 (26th Conference of Parties). Towards this end, NETRA – the R&D wing of NTPC, has undertaken Flue Gas CO2 to Methanol (FG-CTM) Demo Plant. This will be the first of its kind in the world, where CO2 is captured from waste flue gas of a fossil fire powered plant – and thereafter catalytically hydrogenated to produce methanol. Setup of demo plant is undergoing in (500 MW) at NTPC Vindhaychal, India. FG-CTM demo plant is comprises of three interconnected blocks: (i) Carbon Capture Block in which flue gas for CO2 Capture plant is tapped from downstream of Flue Gas Desulphurization (FGD) Plant. (ii) Hydrogen Generation Block with Proton Exchange Membrane (PEM) Electrolyser is used to generate the Hydrogen. (iii) Methanol Synthesis Block, where methanol is produced through catalytic hydrogenation process. The methanol would be of Grade-A and the capacity of the plant will be 10 TPD.

Keywords: CCU; Thermal power; Methanol

Abstract ID: EE-OP98

Borophene based heterostructured catalyst for alkaline oxygen evolution reaction

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Abstract
The rapid depletion of fossil fuels and the environmental problems caused by its over-utilization as a source of energy over the past few decades necessitate the development of some sustainable and green energy alternatives. Hydrogen (H_2) fuel has been proven to be a promising alternate energy. Electrochemical water splitting is considered to be an efficient and clean technology to generate high purity H_2. The overall efficiency of water splitting is governed by the comparatively more kinetically sluggish OER (a four-electron transfer reaction) than two-electron transfer HER, hindering its practical application. A borophene based heterostructured catalyst was developed through hydrothermal route. The developed catalyst showed an overpotential of 430 mV at high current density of 500 mA/cm^2. Tafel slop of the developed catalyst was 52 mV/dec which is comparable to the benchmark electrocatalyst. Through electrochemical circuit fitting,

the charge transfers resistance (R_{ct}) was found to be 0.69 Ω. The material showed good long-term stability in chronopotentiometry suggesting its suitable applications in real life. There is a negligible change in overpotential after performing the long run stability of the catalyst.

Keywords: Borophene; Electrocatalyst; OER

Abstract ID: EE-OP99

Role of transition metal dichalcogenides for catalytic reactions

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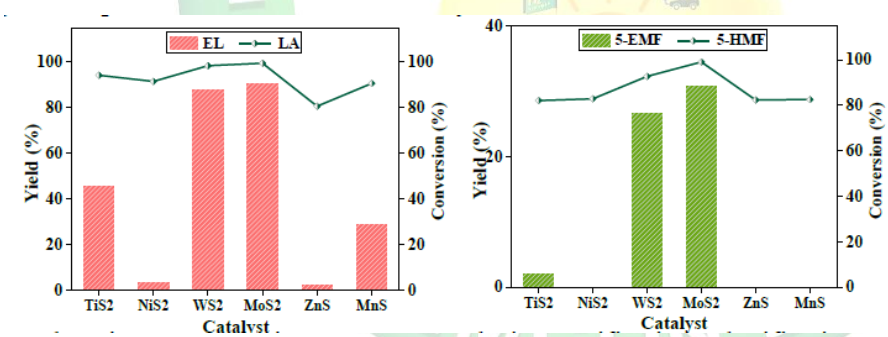
Abstract
Biomass derived compounds can be converted into value-added chemicals possessing properties worth being drop-in biofuels for diesel. In catalysis, application of transition metals dichalcogenides (TMDCs) have been studied for hydrogen evolution reaction. However, TMDCs behave as Lewis acids and also facilitate the generation of Brønsted acidity from surface protons and polar protic solvents and notably, acid catalyst directed pathway would allow the transformation of bio-renewable compounds via catalytic reactions. In this study, series of catalysts WS_2, MoS_2, TiS_2, NiS_2, MnS and ZnS have been explored for esterification of levulinic acid (LA) and etherification of 5-hydroxymethylfurfural (HMF). As a result, WS_2, MoS_2, TiS_2 and MnS resulted in more than 90% LA conversion and with highest 91.18% ethyl levulinate (EL) yield as shown in figure (left). Similarly, for etherification reaction, WS2 and MoS2 were highly active followed by TiS_2 with 99% 5-HMF conversion and 30.85% 5-EMF yield as shown in figure (right). Further the mechanistic insights into performance of individual catalysts were also studied.



Keywords: Microwave reaction; TMDCs; Catalysis; Esterification; Etherification

Abstract ID: EE-OP100

Low temperature bleaching of cellulosic fiber by APS as a catalyst.

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Abstract
Cellulosic fibers are bleached at high temperatures (98–100°C), which causes significant fabric degradation and substantial energy usage. This study uses ammonium persulphate as a catalyst to lower the bleaching

process' temperature. Utilizing a statistical model, low temperature bleaching was optimized. The bleaching formulas were developed using Design Expert 7.0 software and the Box Behnken numerical optimization technique. When the performance of the optimized sample was compared to that of the sample bleached using the conventional approach, the optimized sample produced comparable whiteness indices for the fabric at a lower bleaching temperature of 65 to70 °C.

Keywords: Low temperature bleaching; Catalyst; Statistical method

Abstract ID: EE-OP101

Tri-reforming of methane over mesoporous ZrO_2 supported monometallic Ni, Zn, and bimetallic Ni-Zn catalysts

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Abstract
Tri-reforming of methane is a promising process for the conversion of CO_2 and CH_4 to synthesis gas in the presence of O_2 and steam. In this study, monometallic Ni, Zn, and bimetallic Ni-Zn catalysts supported on mesoporous ZrO_2 were synthesized by the precipitation followed by the wetness impregnation technique. The tri-reforming activity of these catalysts was tested in a downflow tubular packedbed reactor. The catalyst was characterized by various techniques including BET, X-ray diffraction (XRD), temperature- programmed reduction (TPR), temperature-programmed desorption (TPD), etc. The characterization results confirmed the formation of monometallic and bimetallic catalysts over ZrO_2, and strong metals-support interactions. The tri-reforming reaction was carried outwith an optimized feed (CH_4: CO_2: H_2O: O_2: N_2) volumetric feed flow ratio 1: 0.5: 0.02: 0.1:0.1 at atmospheric pressure, and at 600-800 °C. The results indicated that the bimetallic catalyst supported on ZrO_2 exhibited more promising outcomes compared to the monometallic catalyst. At 800°C, approximately 40% CO_2 conversion and 66% CH_4 conversion were achieved. The enhanced catalytic activity was attributed to the incorporationof Zn, which increased the basicity of the catalyst and consequently improved the CO_2 conversion.

Keywords: Ni-Zn bimetallic catalysts; Perecipitation techniques; Tri-reforming; CO_2 conversion; Synthesis gas

Abstract ID: EE-OP104

An Integrated Approach for Solar Photovoltaic Waste Management

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Abstract
In a race for fulfilling the world requirement of green energy for sustainable development, a serious issue of solar photovoltaic waste management has alarmed to be handled well in advance. The study investigates potential remedies and techniques to deal with the problem through an integrated solid waste management practice for solar PV panels. The assessment starts out by focusing on the ingredients that make up solar

panels, emphasizing the inclusion of both valuable and dangerous materials including silicon, metals, glass, and potentially poisonous compounds. The effectiveness and constraints of currently used solar panel recycling methods and procedures are assessed. In addition, modern fabrication and sorting strategies, robotic dismantling systems, and resource recovery techniques are examined as novel approaches. The finest programs and methods are highlighted, offering useful suggestions for creating efficient plans along with the analysis of regulatory frameworks and laws. The present study summarizes the evaluation of problems, possibilities, and possible routes towards a more sustainable and circular approach. To create effective waste management methods and reduce the environmental impact of solar panel disposal, role of stakeholders including manufacturers, policymakers, recycling sectors, and research organizations have been proposed.

Keywords: Solar photovoltaic waste; Integrated waste management; Resource recovery

Abstract ID: EE-OP105

Development of Bio-electrode for reduction of CO_2 to formate using *Escherichia coli*

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Abstract
The increasing concentration of carbon dioxide (CO_2) in the atmosphere due to anthropogenic activities has raised significant concerns about global climate change. To mitigate this issue, there is an urgent need to develop sustainable technologies for the conversion of CO_2 into valuable products. In this study, bio-cathode was developed for reduction of CO_2 to formate using *Escherichia coli* as a biocatalyst. When grown aerobically in Luria-Bertani (LB) medium, *Escherichia coli* demonstrated its ability to catalyze the reduction of CO_2 as a whole-cell biocatalyst. Investigated the performance of the bio-catalyst under various operational conditions electrode potential (-0.75 to 1.25 V vs Ag/AgCl) and pH study for microbial growth. The system was optimized to achieve enhanced CO_2 conversion rates and product selectivity. Produced formate shows maximum Faradic efficiency of 65% at -1.0 V vs Ag/AgCl. The results presented in this study highlight the remarkable efficiency of *Escherichia coli* as a whole-cell biocatalyst for the conversion of CO_2 into formate. These findings have significant implications for the advancement of technologies aimed at CO_2 sequestration and the generation of value-added products from CO_2.

Keywords: Formate; *Escherichia coli;* Carbon dioxide

Abstract ID: EE-OP106

Acoustics Decibel of Divine World Breaks the Slumber of Evil Spirit

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Abstract

Music is the art of arranging and combining sounds in order to create a harmonious melody while noise is an unwanted sound that is usually very loud and meaningless. Keeping a shankh or conch shell in the house helps get rid of Vastu dosha and bring good luck and prosperity. A shankh is considered auspicious and its sound invites peace, prosperity and luck at home. Ulu-dhwani is the Bengali custom of ululating. While most believe it is done to ward off evil spirits, it is also done as a signal for the beginning/end of important occasions and events. Ulu dhwani is usually accompanied by the blowing of the conch shell. Hindu socio-religious ethos deeply embeds its importance of Shank. In religious rituals, Shankh is used to announce the beginning of a prayer or arrival of a deity, and in some places, sacred water is collected and distributed in it. This is one art that is mastered by all Bengali women. A Bengali wedding is incomplete without the overwhelming sound of Ululudhvani and conch shells and it definitely gives everyone goosebumps. Written musical notation was the first mark of a literate society. During the time of prehistoric music, people had a tendency to primarily convey their music and ideas through oral means.

Keywords: Decibel-Sound; Harmony; Shankha; Uvula; Ear drum

Abstract ID: EE-OP108

Value Addition of Plastic Waste to Fuel

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Abstract
The accumulation of plastic waste has risen tremendously in the last few decades and is posing a significant threat to the environment. To reduce its negative impact various methods of developing biodegradable plastics are underway but there have not been many conclusive steps for the existing problem. The conversion of plastic waste into valuable fuels offers a compelling solution that simultaneously tackles the pressing issues of plastic waste accumulation and the scarcity of traditional fuel sources. The process described here is Pyrolysis. Plastic Pyrolysis is the thermal degradation of plastic waste at different temperatures (300 - 900°C), in the absence of oxygen. The valuable products obtained from this technique are fuel oil, syn gas, and a solid residue of carbon black. As the calorific value of the fuel oil produced is similar to that of conventional fuels, it can be used as a great alternative. The fuel oil produced needs to be refined before it can be used as a fuel for domestic purposes, vehicles and industries. Plastic pyrolysis is a promising technology for the conversion of plastic waste into needed fuels but further research is required in this field to optimize the process and increase its efficiency.

Keywords: Alternative fuel; Plastic pyrolysis; Energy recovery

Abstract ID: EE-OP109

Hydrogen rich syngas using steam gasification of mixed food waste via nickel-based catalyst

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Abstract

This study focuses on use of Ni as a catalyst in steam gasification of food waste to enhance syngas production. 5% Ni was loaded on food waste ash using the traditional impregnation method. Food waste ash was produced by heating ground food waste in muffle furnace up to 800°C. Prepared catalyst was mixed with Food waste in equal proportion and then used as feedstock for steam gasification. 100 gm of such mixture was used in steam gasification which was conducted in a fixed bed gasifier at 800 ^{o}C with steam flow rate varying from 0.5 to 1.5 ml/min. Several parameters for evaluating the gasification performance of food waste in presence of 5% Ni catalyst was determined such as syngas yield, syngas composition, hydrogen yield, High Heating Value and Carbon Conversion Efficiency. The use of catalyst increased the syngas yield from 0.94 to 1.05 m3/Kg. It was also observed that hydrogen fraction increased by 20% and CO fraction increased from 11.8% to 22.65%. The increase in high heating value and carbon Conversion efficiency was found to be 17% and 63% respectively.

Abstract ID: EE-OP111

Effect of Biomass Char and other Catalysts for Tar Reduction and Production of Hydrogen Rich Syngas

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Abstract

The presence of tar content in the product gas is a major problem with the biomass gasification process as it prevents its further utilization. Heterogeneous cracking of tar using catalyst is the most effective way to overcome this problem. The present study provides specially a method for converting biomass to hydrogen rich syngas in a two-stage process. The heterogeneous experiments of rice husk tar cracking were performed in a two-stage gasifier using different catalysts. The products of heterogeneous tar cracking were evaluated for optimizing hydrogen rich syngas formation considering the effects such as moisture content of biomass, temperature of carrier gas and type of catalyst. The moisture content of 5% was found better, as it yields more hydrogen and less carbon dioxide emissions than higher moisture content. Moisture content in biomass found to promote methane formation, but inhibits the formation of carbon monoxide. The reduction of 63% was investigated in carbon dioxide emission using calcium oxide mixed with rice husk. Increasing the quantity of calcium oxide, methane formation and hydrogen formation both doubled. The air gasification resulted in 95% yield of syngas when rice husk char was used for tar cracking. Tar cracking at higher temperatures resulted in the formation of hydrogen rich syngas.

Keywords: Gasification; Pyrolysis; Catalytic cracking; Hydrogen

Abstract ID: EE-OP115

A waste generation and consumption potential of India to increase thermal substitution rate (TSR) by co-processing activity

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Abstract
The rise in global average surface temperature over the past century is very high at present. It is mostly caused by greenhouse gases (GHGs) that are emitted when fossil fuels are burnt. Global warming and climate change are major consequences of the rise in global surface temperature. This needs to be diminished by increasing the earth's capacity to absorb CO2 or reducing GHG emissions. India is the world's largest democracy and has a population of over 1.4 billion people. As a result, that India is now the third-largest energy consumer in the world and heavily relies on fossil fuels for energy production, leading to substantial carbon emissions. Substantial increase in population, rising earnings, and expanding living standards, municipal solid waste, hazardous waste, and other waste generation is huge in India having potential for resource or energy recovery. Co-processing is a sustainable way to reduce CO2 emissions by using waste as an alternative fuel and raw material. Study shows how the Cement Industry offers a sustainable solution for waste management through co-processing. This paper study shows although India has huge potential to utilize waste as a resource, the thermal substitution rate (TSR) of India is very low as compared to other countries. The findings will help to identify the constraints to improve the TSR of Indian cement industries.

Keywords: Global warming; Waste management; Co-processing; Thermal substitution rate

Abstract ID: EE-OP118

Uranium Oxide Facility: Feed, Product, Effluent Analysis for Process Optimisation

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Abstract
Deeply depleted uranium generated in spent fuel reprocessing facilities was converted to its oxide form through a chemical precipitation route in uranium oxide facilities of the back-end fuel cycle. The facility's product quality and effluent characteristics concern the energy and environment perspective. With the above concern, the article details the analysis of feed, product, and effluent and optimized parameters for sustainability. The primary characteristics of feed, $[UO_2(NO_3)_2]_{aq}$, effluent $[NH_4NO_3]_{aq}$, and product $[UO_x]_s$ are summarised in the below Table.

Sample	Feed	Effluent	Unit	Product	Unit
Gross α	370	1.03	Bq/mL	1.04	Bq/g
Gross β	5550	1.08	Bq/mL	14.54	Bq/g
Gross γ	337	<1.0	Bq/mL	0.89	Bq/g
Uranium	291.55	<0.01	g/L	0.846	g/g

Further, the effect of pH during ADU precipitation concerning reducing radioactivity content in effluent solution has been carried out, and based on the results (10 times reduced at pH 8.5), the optimized methodology has been proposed for industrial use. The results of alpha and gamma spectrometry supported the above findings. Impurity analysis with respect to fission/decay products of UO_x was analyzed using HP-Ge gamma spectrometry.

Keywords: Uranium Oxide; Deeply Depleted Uranium; Ammonium Diuranate; HP-Ge gamma spectrometry

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Abstract ID: EE-OP119

Characteristics of coffee husk blending with Indian coal and study the thermal behavior for power generation

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Abstract
Biomass is accessible and affordable source of energy particularly in rural areas in India. However, Worldwide biomass ranks 4th as an energy resource, providing about 12 to 14% of world's energy needs of all human and industrial process. The use of biomass as fuel provides substantial benefits to the environment is concerned. Biomass absorbs carbon di-oxide during growth, and emits it during combustion. Utilization of biomass as fuel for power generation offers the advantage of a renewable and CO_2 neutral fuel.
In this paper, Coffee husk, coal and the blends of different proportion (5%, 10%,15% and 20% by weight) are characterized for proximate analysis, Ultimate analysis, Sulphur analysis and Gross calorific values. The proximate and ultimate analysis shows that blending can reduce ash disposal, increase volatile content to optimum combustible levels and CHN level with increase in carbon content.
Study of the combustion behavior of Coffee husk, coal and the blends through thermo-gravimetric analysis (TGA) to explore the effects of the blending viz. Ignition temperature, residence time and thermal conversion. The derivative thermogravimetric (DTG) analysis of Coffee husk, coal blends shows combustion from 430^{0}C to 520^{0}C and burn out time in linear relation with coal. The DTG analysis for Coffee husk shows good burning profile for 10 to 15 % blend ratio. This study will provide prospect scenarios for co-firing of Coffee husk with Indian high ash coals.

Keywords: Biomass; Coffee husk; high ash coal; Thermo-gravimetric; Burning profile.

Abstract ID: EE-OP120

Single-step catalytic oxidation of methane into methanol

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Abstract
Natural gas, which consists of approximately 70-90% methane, is an important part of the energy system for decades. Transpiration of methane from its source to the end user via a pipeline network is a capital-intensive and challenging task. So, an alternative method for its transportation and effective utilization is required. One solution of this problem is the conversion of methane into liquid fuel such as methanol. In nature, Direct Methane to methanol (DMTM) is possible by an enzyme called Methane monooxygenase (MMO)[1]. In this study, we try to mimic the properties of MMO enzymes, copper & iron-based catalyst supported on zeolite ZSM5.
Copper and iron-based catalyst supported on zeolite were synthesized using the incipient wetness impregnation method and ion exchange method. For the activity test, a continuous high-temperature and high-pressure multiphase-packed bed reactor system is used. The catalyst was tested with different oxidants (H_2O, N_2O, & O_2) at a moderate pressure of 10 atm and for the reaction temperature range of 200 to 600 ℃. The mole ratio of CH_4/O_2 was maintained to 10. Along with this, encapsulated copper nanoparticles

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were explored for the DMTM process.

Keywords: Methane; Methanol; Nano-catalyst; Gas to liquid

Abstract ID: EE-OP121

Synthesis of secondary diamine-impregnated Zeolite Imidazolate Framework-8 and its application in post combustion CO_2 capture

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Abstract
Carbon capture using amine impregnated solid adsorbents is a promising strategy due to convenient operation, low regeneration cost, outstanding cycle efficiency, and economic viability. In this work, a metal organic framework (MOF) ZIF-8 is hydrothermally synthesized and modified using wet-impregnation process with a secondary diamine to enhance CO_2 adsorption capacity in wide range of CO_2 partial pressure at optimum temperature. The CO_2 adsorption was carried out using Automated high-pressure gas sorption equipment and Versa-Win software for data analysis. Both primary (R-NH) and secondary groups (R-NH_2) on same site enhances the ability of CO_2 adsorption in secondary diamine due to more active amine sites than primary amines. The materials were also presented good structural and thermal stability. The CO_2 adsorption capacity decreases with increase in temperature. The CO_2 molecules are found to be energetically active with higher kinetic energy and the specific molecular orientation for nucleophilic attack might not be possible at elevated temperature. The adsorption isotherm models are used to correlate experimental CO_2 adsorption data. The isosteric heat of adsorption was also calculated to understand the degree of heterogeneity and the surface energy distribution of the adsorbents.

Keywords: Carbon capture; MOF; ZIF-8; Secondary diamine

Abstract ID: EE-OP122

The Embedded Energy in Food Waste: Enabling Development of Circular Economies

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Abstract
Food waste is a global problem caused by population expansion and a variety of sources suchas homes, restaurants, and food facilities. Waste has emerged from industrialization and population growth throughout production, storage, processing, and consumption. The biofuelsector produces food scarcity, emphasizing the food-energy relationship. Food waste can beconverted into energy via biological and thermal/thermochemical techniques. Food waste isdifficult to convert to energy due to its composition, wetness, and low energy content, whichimpedes industrial processes. It emits dangerous greenhouse gases in landfills, exacerbatingglobal warming and climate change. Food waste is a resource waste as well as an underutilized energy source. There has been little research towards turning it to renewable energy. This review summaries existing knowledge about technology for turning food wasteto energy. In landfills, anaerobic digestion turns organic waste into biogas, which contains CH_4 and CO_2, as well as other gases such as nitrogen, oxygen, and H_2S. Ethanol generation from food waste involves a novel waste-to-energy conversion process that employs a varietyof waste materials such as banana peel, sugar beetroot pulp,

pineapple, grape and potato peelwaste. Incineration is a developed process for converting trash into heat and energy for industrial output. Gasification and pyrolysis are both heat reactions. In an oxygen-free atmosphere, pyrolysis turns food waste into bio-oil, syngas, and biochar. At high temperatures, gasification turns food waste into a flammable gas combination. Less food waste benefits both the environment and communities. A circular economy strategy generatesnew business models and financial incentives by repurposing previously discarded resources. It conserves resources, decreases material extraction, and helps society, industries, and the environment. Food waste reduction through the circular economy benefits all stakeholders. Converting food waste to energy is appealing for both economic and environmental reasons.Professional supervision is essential for optimal benefit.

Keywords: Food-energy relationship; Circular economy; Optimal benefit

Abstract ID: EE-OP123

Performance evaluation of a single stage annular centrifugal extractor for the extraction of Nd (III) in TODGA-TBP/*n*-dodecane system

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Abstract
The extraction and stripping of Nd (III) in a solution composed of 0.2 M *N, N, N', N'*- tetraoctyl diglycolamide (TODGA) + 0.5 M tri *n*-butyl phosphate in *n*-dodecane is not a diffusion-controlled reaction [1]. In view of this, a study was undertaken to evaluate feasibility of using annular centrifugal extractor (ACE) for the extraction of Nd (III) in 0.2 M TODGA-0.5 M TBP/*n*-dodecane from nitric acid medium. The extraction of Nd (III) (0.05 M) in 0.2 M TODGA + 0.5 M TBP/*n*-dodecane from 4 M nitric acid was carried out in a single-stage ACE of bowl diameter 40 mm. The stripping of Nd (III) from loaded organic phase (0.047 M Nd (III)) was performed using 0.1 M nitric acid. The Nd (III) concentration in aqueous and organic outlets were determined by standard EDTA complexometric titration. Based on these experimental results, the Murphree efficiency of the given ACE was computed to be ~100% in both extraction and stripping runs, indicating the possibility of ACE for the extraction of trivalent f-ion from nitric acid medium in TODGA-TBP/*n*-dodecane.

Keywords: Annular centrifugal extractor; Lanthanide; Separation; TODGA; Extraction

Abstract ID: EE-OP124

Design and development of innovative solar thermal pond power by solar energy to accelerate the evaporation rate of brine and yield of solar salt

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Abstract
The salt industry is a major contributor to the global economy, and it is also a major consumer of energy. In recent years, there has been growing interest in using solar energy to power salt production. This is due to the increasing cost of fossil fuels, the growing awareness of the environmental impact of the salt industry, and the government's support for renewable energy. This paper presents the design and development of an innovative solar thermal pond that to accelerate the evaporation rate of brine and increase the yield of solar salt. The paper also presents the results of an exploratory study that was conducted to assess the performance

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of the solar thermal pond. The results of the study show that the solar thermal pond can significantly accelerate the evaporation rate of brine and increase the yield of solar salt. The solar thermal pond is also more efficient than traditional methods of salt production, which leads to reduced costs and a lower environmental impact. The successful development of the solar thermal pond has the potential to revolutionize the salt industry. The solar thermal pond can help to reduce the reliance on fossil fuels, increase the efficiency of salt production, and reduce the environmental impact of the salt industry.

Keywords: Salt yield; Brine; Evaporation rate; Solar energy; Solar pond

Abstract ID: EE-OP125

Nuclear Waste Management

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Abstract
In the recent years the waste management has become a huge challenge to the global community. The nuclear waste which has radioactive components are causing a tough challenge to dispose. In various countries they have adopted methods like dumping the waste in sealing cans and burying in underground or below the sea bed which is very harmful to the environment and habitants. The radioactive waste has to be treated but without the human handling. So we can do it with the help of AIML and data science, where we can program the machinery to carry out the neutralizing process. As there is remains of radiation in the nuclear waste we can use it to form energy resources. Though it's very hard to manage but we still haven't found the safest way and with the current measure taken to dispose are very uncertain and do not ensure complete safety. Why bury it when we can convert it into some form of energy or useful resource.

Abstract ID: EE-OP129

Effect of concentration polarization in Pd-Ag membrane and enhance H_2 recovery

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Abstract
Using fossil fuels emits a large amount of CO, CO_2, and NOx into the environment, which is a major concern for global warming. Hydrogen is a clean energy with a high energy-to-weight ratio, making it the best solution. As hydrogen is highly flammable, transporting it to the on-site application is a major challenge. Because of its compactness, wide temperature, pressure range, and ease of use, membrane separation technology is best suited for on-site hydrogen separation. Pd-Ag membranes have a high hydrogen flux over a wide range of temperatures and pressure. The hydrogen flux generally increased with increasing transmembrane partial pressure difference and temperature. Hydrogen flux decreases rapidly because of the concentration polarization in a mixture of gases. Concentration polarization describes the phenomenon in which a thin gas layer of non-permeating gases forms on the membrane surface, causing a decrease in hydrogen flux. The current work investigates the effect of concentration polarization on palladium alloy membranes at different temperatures and pressure. The results of using GHSVs with different values and

gas mixtures compositions (50/50 H_2 and N_2, 60/40 H_2 and N_2, 70/30 H_2 and N_2, 80/20 H_2 and N_2, and 90/10 H_2 and N_2) are also analyzed.

Keywords: Palladium alloy membrane; Hydrogen Separation; Concentration Polarization

Abstract ID: EE-OP132

Heterogeneous base catalysts: Synthesis and application for biodiesel production – A review

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Abstract
Recently, much research has been carried out to find a suitable catalyst for the transesterification process during biodiesel production where heterogeneous catalysts play a crucial role. As homogenous catalysts present drawbacks such as slow reaction rate, high-cost due to the use of food grade oils, problems associated with separation process, and environmental pollution, heterogenous catalysts are more preferred. Animal shells and bones are the biowastes suitably calcined for the synthesis of heterogenous base catalyst. The catalysts synthesized using organic wastes are environmentally friendly, and cost-effective. The present review is dedicated to synthesis of heterogeneous basic catalysts from the natural resources or biowastes in biodiesel production through transesterification of oils. Use of calcined catalysts for converting potential feedstocks (vegetable oils and animal fat) into biodiesel/FAME is effective and safe, and the yield could be improved over 98%. There is a vast scope for biowaste-derived catalysts in green production of biofuel.

Keywords: Biofuel; Heterogeneous catalyst; Organic wastes; Transesterification

Abstract ID: EE-OP133

Studies on Hydrogen Generation from Scrap Aluminium

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Abstract
Hydrogen has the potential to replace carbonaceous-based fossil fuels. Numerous novel solid metals have been explored to understand their compatibility to store hydrogen reversibly. In this work yield and kinetics of hydrogen generation from the reaction between scrap aluminium and water have been investigated systematically. This exothermic generation reaction can be viewed as a renewable approach to generating hydrogen, but the presence of a passive oxide layer on the aluminium surface hindered significantly the performance of the reaction in the later stage. The effect of different reaction parameters such as temperature, stirring speed, pH of the solution, and the effect of different promoters on the reaction rate are studied experimentally to increase the rate and yield of the reaction. It is found as some of the promoters speed up the generation of aluminum hydroxide by providing hydroxide ions, which aid in the breakdown of the aluminum oxide passivation layer. Gas chromatography of gaseous products shows highly pure near about 99.99% hydrogen generated. Additionally, by-products of the reaction were studied for further reuse.

Keywords: Hydrogen; Aluminium; Promoters; Hydrogen storage

Abstract ID: EE-OP134

A Holistic Design for Effective Energy Utilization of Hydrodealkylation of Toluene (HDA) Using Pinch Analysis

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Abstract
Efficient and sustainable energy utilization in chemical processes is a critical aspect of industrial engineering. The hydrodealkylation of toluene (HDA) is a vital reaction for manufacturing valuable fuels and chemicals, but its high energy requirements pose a sustainability challenge. The present study encompasses a groundbreaking approach to optimizing energy consumption in HDA through Pinch Analysis. The method involves considering both the process and utility systems concurrently to identify energy integration opportunities. It encompasses process heat integration, selecting the optimum temperature, and utilizing utilities efficiently. The application of this method yields impressive results, including reduced energy demand (approximately 30% in heating load), decreased greenhouse gas emissions, and lower operational costs. The approach shows significant potential for energy savings and has the potential to revolutionize the energy utilization landscape of HDA. Overall, this study provides a comprehensive strategy for achieving enhanced process sustainability, reduced environmental impact, and improved economic feasibility. The approach proposed in this study is a significant step towards a more sustainable future in industrial engineering.

Keywords: Holistic design, effective energy utilization, hydrodealkylation of toluene (HDA), Pinch Analysis

Abstract ID: EE-OP135

Biodiesel Additive for Low Oxide of Nitrogen (NO_x) Emission

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Abstract
High cetane fuel results smooth combustion in a compression ignition engine. Diethyl ether and n-Butanol when added to diesel, oxygen content increases, the cetane number increases. Biodiesel fuel structure has more oxygen content hence offers a better combustion scenario in a diesel engine. It is important to evaluate the biodiesel performance along with another oxygenated additive in laboratory. Here in this study diesel is mixed with n-Butanol and diethyl ether upto 15% where every blend resulted higher cetane number than commercial diesel. Later coconut oil biodiesel is considered for blending with diesel in 20%, 30% and 50% (volume basis) where n-Butanol and diethyl ether are also added 10% to 15% (volume basis) respectively. Diesel-biodiesel blend when mixed with n-Butanol resulted least unburnt hydrocarbon (28 ppm) and carbon monoxide (~0.02%) for 20% blend at full load. Among the blends the 30% biodiesel blend which is also having 15% n-Butanol results maximum efficiency of ~33% (~24% more than diesel) at full load but least NO_x emission of 333 ppm (~115 ppm less than diesel).

Keywords: Cetane Number; Biodiesel combustion; Turbidity; NO_x emission

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Abstract ID: EE-OP136

Thermodynamic Equilibrium Analysis of Oxidative Dry Reforming ofEthanol for Syngas Production

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Abstract
Oxidative dry reforming of ethanol is a promising route to utilize CO_2, a greenhouse gas and ethanol, a renewable feedstock in the production of synthesis gas (syngas-a mixture of H2+CO). It is a value-added feedstock for Fischer-Tropsch (F-T) process in chemical industry. Syngas is mainly produced by dry reforming of methane, but its continuous deployment urges to find an alternative feedstock such as Ethanol. The present work aimsto simulate syngas production from ethanol focusing on the reduction of carbon formation and energy requirement. Thermodynamic equilibrium analysis for dry reforming and oxidative dry reforming of ethanol were carried out following Gibbs free energy minimization method using Aspen Plus. The reaction temperature and feed molar ratio (ethanol/CO_2/O_2) were varied to obtain equilibrium moles of different products including solid carbon at atmospheric pressure. Syngas yield increased from 1 to 5.2 moles with a desirable ratio of H2/CO when temperature increased from 773 to 1073 K at ethanol/CO_2 mole ratio of 1:1. The addition of oxygen did not affect syngas yield but drastically removed carbon formation and helped to reduce the amount of energy required. At 1048 K, introducing 0.2 moles O_2 in feed deposited carbon becomes negligible and there is 14% reduction of energy requirement, while in the absence of oxygen 0.392 moles carbon was formed at same condition.

Keywords: Syngas; Oxidative dry reforming; Ethanol; Thermodynamic Analysis; Aspen plus

Abstract ID: EE-OP140

Co-synthesis of Biofuels and Alumina-Carbon Nanocomposite via Solvothermal treatment using Tetra Pak Waste

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Abstract
The present study focuses on a novel technique for the solvothermal valorization of Tetra Pak waste (TPW) for the simultaneous generation of bio-oil and alumina carbon nanocomposite (ACN). In the following study, the impact of temperature varying from 240 °C to 360 °C on the liquefaction of TPW using supercritical ethanol was investigated. The increase in temperature positively influenced the yields of bio-oil and reduced the formation of ACN. However, a decline in yield was seen beyond a certain point. The optimum condition for the highest bio-oil yield (34.41 %) was obtained at 320 °C, 30 min, and a 1:10 substrate-to-solvent ratio. The obtained bio-oil was subjected to various characterizations such as GC-MS, NMR, and FTIR for the identification of various organic species. The presence of aluminum in the TPW led to the formation of in-situ generated active hydrogen upon reaction with supercritical ethanol which enhanced the bio-oil yields and minimized the residue formation. The transformation of $Al^{(0)}$ to $Al^{(+3)}$ was further confirmed from the XRD and XPS analysis to produce the ACN which shows a potential to be utilized as a catalyst.

Keywords: Tetra pak; Liquefaction; Bio-oil; Supercritical ethanol; Aluminium

Abstract ID: EE-OP141

Microbes Control and Sustain the Energy Based Climate Change

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Abstract
You cannot underestimate the power of microbes" it was mentioned 100 years ago by Prof. Louise Pasture, one of the legendary scientist and microbiologist. These microbes are recimizing our daily life and the mankind positive and negative manner. Had there been no microbes, there would have been no evolution, as per Darwin. The negative example of microbes is the corona, historically collapsed/ damaged the part of mankind's activities globally, killing millions of lives. The positive side of microbes is the development and engineering of Algae, (micro and macro-algae (weeds), involved potentially in development of energy and capturing C02(carbon dioxide). All microbial mechanisms involved in energy conservation, are characterized by bioconversion, bioremediation and bio augmentation. Algae (Eukaryotes) are more important compare to bacteria (Prokaryotes) in development of Hydrogen. Despite the facts to handle bacteria and its adaptively in environment in reactor design, the pathogenic nature of microbes cannot be avoided and can be resolved by. Genetic Engineering. The concept came after the discovery of DNA double Helix by Nobel laureates Watson and Crick in 1975.subsequently replication, transcription, translation and the functions of genetically engineering Escherichia coli K-12 Yale/USA strain as hybrid, where Algae use is only possible as eukaryon by searching mutant variations and reactor design, where natural and artificial light could be used on increasing surface area recirculation of water.1993, Brahma. ICE.The possible physiochemical and unit-operational development in reactor design potentially used in capturing CO2 and growth micro-, macro algae will be discussed in this paper.

Keywords: Algae; Energy; Climate; Microbes

Abstract ID: EE-OP142

Developments in Hydrogen Separation Using Pd-Ag/TiO_2/α-Al_2O_3 Membranes

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Abstract
Hydrogen, as a renewable energy source, is essential for solving the world's energy and environmental problems. The effective purification and generation of hydrogen relies on the advancement of high-performance hydrogen separation membranes. However, such membranes suffer from low permeation when high hydrogen selectivity is maintained. By increasing stability and hydrogen adsorption, the intermetallic layer of TiO_2 nanoparticles boosts the Pd-Ag membrane's performance. In this research, a TiO_2-based intermetallic layer was combined with a Pd-Ag membrane to provide a unique method for effective hydrogen separation. TiO_2 particles are deposited on the membrane surface by using the vacuum dip-coating technique and Pd-Ag is deposited by using the electroless plating method. After each deposition, the thickness of the membrane was measured by using SEM images. A targeted thickness of 7 micron is maintained for all the membranes. The prepared membranes are tested in a specially designed membrane separator by using pure hydrogen and hydrogen-nitrogen mixture gases. The permeability and selectivity

obtained through the membrane is measure by using Gas Chromatography data of feed, permeate and retentate side. The currently prepared membrane permeation is 4.59×10^{-4} mol m^{-2} s^{-1} $Pa^{-0.5}$. Selectivity of the membrane H_2/N_2 556 at the 1 bar and temperature 300 ^oC.

Keywords: Pd-Ag membrane; TiO_2 intermetallic layer; Electroless plating; sol-gel

Abstract ID: EE-OP143

Utilization of THF and SDS for flue gas separation by gas hydrate

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Abstract

The worldwide research community has been focusing on developing various technologies for carbon capture and storage. The current study focuses on applying gas hydrate technology to separate the flue gas mixture of CO_2 and nitrogen (N_2). Gas hydrate technology (Conversion of gas into solid ice crystals with the help of hydrogen-bonded water molecules) is one of the unconventional and optimistic way to capture and separate the CO_2. The flue gas composition of 85 % N_2 and 15 % CO_2 was used as a feed into the process, aiming to separate CO_2. The bottleneck in gas hydrate technology is the mass transfer limitation at the interphase. As one of the possible solution, chemical additives like tetrahydrofuran (THF) were used that act as thermodynamic hydrate promoters (THPs), and sodium dodecyl sulfate (SDS) was used as kinematic hydrate promoters (KHPs) which increases the rate of hydrate formation. THPs are responsible for shifting the thermodynamics phase equilibria, enhancing the CO_2 storage in the gas hydrate, while KHPs are used for the enhancement of gas hydrate formation without taking part in the process. This study demonstrates the systematic use of THF and SDS to compare the final CO_2 mole consumption and understands the separation efficiency of CO_2 from the flue gas mixtures. The gas compositions were analyzed during every experimental run-in order to optimize the physical parameters. The findings from this study play a positive role in advancing CO_2 capture techniques from flue gas emissions.

Keyword: Gas hydrate; Carbon capture; Thermodynamic promoters; Kinematic promoter

Abstract ID: EE-OP144

Recycle, Regeneration and Reuse of Anode Material from Spent Lithium-Ion Batteries

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Abstract

Technological advancement in energy storage systems and exploiting lithium-ion batteries result in large waste batteries. However, cradle to cradle system is needed for sustainable development in energy storage systems and the corresponding resources management. Recycling plays a crucial role in sustainable resource management for future generations. In this work, we demonstrated the recycle, regeneration, and reuse of graphite anode from spent lithium-ion batteries and reuse the same for energy storage material. XPS analysis revealed the purity of the recycled material. The disordered graphite material was regenerated and reuse as energy material. Raman and XPS, analysis confirm the morphological improvement of the processed graphite in comparison to spent graphite. The regenerated graphite exhibited a discharge capacity of 364 mAh/g after 50 cycles at 0.1C rate. The calculated apparent diffusion coefficients of lithium ions (D_{Li}) corresponding to the anodic and cathodic electrochemical reactions are comparable with the values reported in the literature.

Keywords: Recycle; Regeneration; Reuse; Anode Material; Spent Li-Ion Batteries

Abstract ID: EE-OP145

Synergistic effect of Zn2GeO4 nanorod decorated metal-organic framework ZIF-67 and its metal-ligand charge transfer effect towards thephotocatalytic CO2 reduction and C-C coupling

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Abstract
Metal-organic framework (MOF) especially zeolitic imidazole framework (ZIF-67) has showntremendous efficiency in the field of CO_2 adsorption, storage, and conversion due to its huge surfacearea and metal ligand charge transfer effect. A metal organic imidazole framework-based heterojunction, Zn_2GeO_4/ZIF-67 nanocomposite has been successfully synthesized where Zn_2GeO_4 nanorod deposited on the surface of high crystalline ZIF-67 to form an electronic Z schememechanism. The Zn_2GeO_4/ ZIF-67 nanocomposite containing 20% Zn_2GeO_4 nanorod exhibit at about 1.62 times higher methanol production (41.16 μmol g^{-1}) than pure ZIF-67 (25.39 μmol g^{-1}) andthe highest ethanol production was 1.53 times higher (32.66 μmolg^{-1}) than pure ZIF-67 (21.34 μmolg^{-1}) after 8 h of light irradiation. The electronic interaction of ZIF-67 and Zn_2GeO_4 has been studied theoretically using density functional theory calculation. Molecular orbital transition and excitation states were also calculated using time-dependent density functional theory calculation. The reaction pathway for CO_2 reduction was determined by calculating free energy for each charge transfer intermediates.

Keywords: Photocatalytic CO_2 reduction; Metal-organic framework; Photocatalysis; Z-scheme

Abstract ID: EE-OP146

Studies on the effect of chemical additives on the stability and rheological properties of coal water slurry prepared from Indian high ash coal

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Abstract
Coal is a significant fossil fuel and imparts to many of the energy sectors. It is abundantly present in the earth's crust. But there are certain problems related to its eco-friendly use and proper transportation. Direct combustion of coal generates many harmful greenhouse gases. The use of coal in slurry form can be a way to overcome the problems mentioned above. In this work, the slurry is prepared using high-ash Indian coal, water, and chemical additives. Chemical additives are critical in imparting proper stability and apparent viscosity to coal water slurry (CWS). Characterizations were proximate and ultimate analyses, PSA, BET, HGI, SEM, Calorific value, XPS, XRD, FTIR, and contact angle. Rheological studies at 60% concentration and 75 μm particle size were done, and apparent viscosity was determined at a shear rate of 1-1000 s^{-1} using an Anton par rheometer, showing pseudo-plastic behavior. The effect of time, temperature, and pH was also investigated on the rheology of this coal-water-additive slurry. Further, a comparative stability and rheological analysis was done between the above slurry and simple CWS using the above parameters. Results

show that CWS with additives have better stability and rheological behavior compared to those without additives CWS and match the literature.

Keywords: Coal water slurry; High ash Indian coal; Rheology; Stability; Chemical additives

Abstract ID: EE-OP148

Two-stage anaerobic digestion of fruit and vegetable waste

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Abstract
Anaerobic digestion (AD) is one of the environments friendly technologies for treating huge quantum of fruit and vegetable waste (FVW). Fruit and vegetable waste and food waste constitute 70% of total production of Municipal solid waste. Anaerobic digestion of FVW waste will not only reduce the burden on landfill but also mitigate the energy crisis. Present study was undertaken to AD of FVW, which was conducted in two step process viz. hydrolysis followed by methanogenesis in two different bioreactors. The feed was chosen in first reactor in batch mode. The leachate formed in first reactor was taken in second reactor continuously. The amount of gas formed was found more as compared to conventional single reactor, in which both hydrolysis and methanogenesis performed in same reactor. Two stage process was found easy to maintain required operating condition to get maximum gas production.

Keywords: Anaerobic digestion; Biogas; Fruit and Vegetable waste; Two step anaerobic digestion

Abstract ID: EE-OP149

Site Selection framework for Renewable Energy production in India by adopting Artificial Intelligence Techniques in context of IFS And MADM

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Abstract
The need of renewable energy is increasing rapidly due to depletion of fossil fuel and uncontrolled growth of population. The higher living standard need electrical energy for homes, office, factory, vehicle, etc. Forecasting of renewable energy Sources (RES) and their site selection is complex. The most important task is to obtain the maximum output from the renewable energy sources, where it is installed. The importance of Data science is increasing in every area of engineering and technology. So, we can use Artificial Intelligence (AI) with Multi Attribute Decision Making (MADM) and Institutive Fuzzy Set (IFS) techniques for site selection of renewable energy sources from an Indian perspective. This is the first study that use AI in Institutive Fuzzy Set (IFS) and Multi Attribute Decision Making (MADM) for Site selection of renewable energy sources. In the literature there are 39 main criteria and many sub criteria for selection of renewable energy resources. It is not favorable to take the more criteria for optimization of site selection. The goal of MADM is to select a most satisfying alternative from a set of alternatives based on prioritized attributes. A survey is used to evaluate and rank the RES sources on experts' opinions. AI is utilized in this study to handle very large datasets efficiently and predict attributes and the behavior of the source. AI has proven potential to be a part of the solution for challenges faced in the wider adoption of solar in the renewable energy sector. First, it transforms the linguistic terms presented into Fuzzy values and implements systematic techniques to compute missing values in the decision matrix using the AI technique. This method is applied

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to select RESs in Uttar Pradesh, India, and the obtained results show that Solar energy is the most suitable for Uttar Pradesh, India.

Keywords: Artificial Intelligence (AI); Intuitionistic Fuzzy Sets (IFS); Multi Attribute Decision Making (MADM); Renewable Energy (RE); Renewable Energy Source (RES)

Abstract ID: EE-OP150

Sustainability of Nanocellulose Production from Biomass: A Comparative Life Cycle Assesment of Pathway Technologies

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Abstract
Nanocellulose is a promising bionanomaterial with many exceptional properties and a broad spectrum of potential application but high energy input required along with use of chemicals (or) heat in some pretreatment in production has been described as critical view for future. As a result, a complete understanding of its environmental impact across the entire life cycle assessment (LCA) of nanocellulose provides the cornerstone for its long-term sustainable success. In this current study, attempts a comparitive LCA study of five different technological routes (fully mechanical route, ionic liquid route, sulfuric acid route, hydrocholoric acid route and deep eutactic solvent route) for nanocellulose production from cellulose which is extracted from lignocellulosic woody biomass. The system boundary is defined as cradle to gate with a functional unit of 1 kg production of nanocellulose. The life cycle impact assesment (LCIA) has been evaluated with different impact categories referring global warming potential (GWP), fossil resource scarcity, freshwater eutrophication, human toxicity, terrestrial acidification (TAP) and terrestrial ecotoxicity potential are analysed.

Keywords: Nanocellulose; Life cycle assessment; Environmental impact; Cradle to gate; Suatainable

Abstract ID: EE-OP152

Application of Response surface methodology on performance and emission characteristics of a diesel engine fueled with diesel, Pentanol and Biogas

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Abstract
The current investigation's objective is to compare various diethyl ether/biogas/diesel fuel blends' performance and exhaust characteristics in a dual fuel engine. The varied biogas flow rates and Pentanol fractions in conventional diesel at various engine loads were studied. Response surface approach was used to assess the researched variables in order to get the best model. All of the proposed multivariate models were statistically significant in the current analysis, demonstrating the great accuracy of the models. Additionally, the values of the independent parameters were defined using the desirability technique to get

the highest performance and the lowest engine-out emissions. According to the modeling results, the ideal engine operation condition occurs at an engine load of 78%, a Pentanol ratio of 15%, and a biogas flow rate of 20 LPM. The projected values for the relevant reaction parameters at the recommended point were 19% BTE, 62 ppm UHC emissions, 0.11% CO emissions, 99 ppm NOx emissions, and 22% emitted smoke. The response surface approach might be utilized to properly model and optimize a diesel engine that runs on a ternary mix, as demonstrated by the high desirability of 0.76 for derived models.

Abstract ID: EE-OP153

Nitrogen and Phosphorus doped rGO supported MoS_2 Electrocatalyst for Water Splitting

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Abstract
The separation of water electrochemically is a novel strategy for developing renewable energy sources. The development of doped nonprecious electrocatalysts for water splitting has recently attracted attention. Therefore, we attempted to evaluate the effect of doping of nitrogen and phosphorus towards the potential efficiency of rGO supported MoS_2 for water splitting. Hydrothermal synthesis was used to synthesize an effective N, P-rGO/MoS_2 electrocatalyst. For both the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER), the synthesized electrocatalyst showed good performance. To obtain 10 mA/cm^2, low overpotentials of 212 and 264 mV for the HER and OER are required. Similar to the HER, the OER also required lower Tafel slopes to be stable over time in an alkaline medium (1 M KOH). A water-splitting Electrochemical potentiostat can generate a current density of 10 mA/cm^2 at 1.60 V utilizing a N,P-rGO/MoS_2 electrocatalyst. Their increased catalytic activity was further demonstrated by the fact that they remained stable over time at varied potentials, which was an exceptional outcome. The synthesis of materials for efficient and affordable H_2 production electrochemically is not difficult, and this electrochemical assembly can aid in the construction of a clean, renewable energy infrastructure.

Keywords: Hydrogen energy; Water splitting; Sustainable energy

Abstract ID: EE-OP154

Solubility Parameter estimation of Waxy Crude

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Abstract
Hansen Solubility Parameter is an important parameter for solubility analysis of materials, and is essentially required to analyze the rheological characteristics of crude. Study of interaction of crude oil with different solvents is an important aspect for designing novel pour point depressants (PPD). For simple organic materials, solubility parameter can be easily determined based on group contribution method. However, for complex materials such as crude oil and for novel inorganic materials, determination of solubility parameter is a challenge. Present work aims at determination of solubility of Waxy Crude exploiting the concept of solubility sphere. This will help in selecting appropriate PPD material and the corresponding solvent for dissolving the it. Interaction of the solute with various solvents is quantified by assigning solubility index. The radius of the sphere is initially determined using the solubility index of the good solvents and then is continuously refined using the solubility sphere with the help of desirability function. This method gives all the three components (dispersion, polar, and hydrogen bonding) of the solubility sphere along with the overall Hansen Solubility Parameter.

Keywords: Hansen Solubility Parameter; Waxy crude; Solubility Analysis; Pour point depression

Abstract ID: EE-OP156

Performance of Microbial Electrochemical Technologies for Electricity Generation

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Abstract
The ongoing use of non-renewable energy sources, such as fossil fuels, has negative effects on the environment, including resource depletion, air pollution, and climate changes. Microbial fuel cells (MFCs) are one of the prospective options for supplying energy needs in a sustainable and ecologically sound manner. Microorganisms are used in these fuel cells to produce energy from a variety of organic resources, such as wastewater, agricultural waste, and other types of biomasses. MFCs are a promising technology because biomass, as opposed to fossil fuels, is a resource that is renewable and easily accessible. Our study seeks to investigate the electricity production through the process of electro genesis, in order to investigate the potential of MFCs as an alternative energy source. Using the substrates rice powder solution and pond water, the MFC (electrolyte volume 1 liter) was fabricated with the help of copper and zinc electrodes and investigated for 20 days. The maximum current densities were calculated as 4 A/m^2 and 6 A/m^2 respectively. The maximum power densities were calculated as 0.65 mW/cm^2 and 0.75 mW/cm^2 respectively.

Keywords: Microbial fuel cell; Micro-organism; Organic resource; Current density; Power density

Abstract ID: EE-OP157

Bio-oil conversion in a Delayed Coker Unit: A Green Solution for Energy Transition

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Abstract
Global energy related CO_2 emissions grew by 321 MT in 2022 to reach staggering level of over 36.8 GT. Petroleum refiners worldwide are adopting new technologies for transitioning to 'Net Zero' and conversion of carbon neutral Bio-oils in existing refinery units is a solution to achieve the Net-Zero goals. For enabling conversion of Bio-oil in a cost-effective manner, it is essential to understand its characteristics. A study was carried out in which different types of Pyrolysis derived Bio-oils were characterized and they were observed to have a Conradson Carbon Residue of ~20 wt% akin to the Vacuum Residue (VR) from crude oils and also possess a high Total Acid Number of >60 mg KOH/g of oil. A Delayed Coker Unit of a refinery converts the VR feed and its high severity thermal cracking conditions can be potentially utilized for de-carboxylating and converting Bio-oils also. To understand the thermal cracking of Bio-oils, Kinetic studies and thermal decomposition behavior of Bio-oils has been investigated and compared vis-à-vis VR through Thermo-gravimetric Analysis and Kinetic parameters estimated by Ozawa Flynn Wall method. Further,

bench scale study was carried out to assess the impact of Bio-oil co-conversion with VR on product yield and property.

Keywords: Energy Transition; Bio-oils; Delayed Coking; Sustainable Environment

Abstract ID: EE-OP158

Continuous Catalytic Reforming Unit Re- usable Low Coke Content Catalyst Separation from Heel Catalyst and its Utilization

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Abstract

Continuous Catalytic Reforming (CCRU) process employs Pt/chlorinated alumina-based spherical catalyst. In this process, some part of the catalyst is held up at the bottom and along the wall side of reactors. This catalyst does not circulate through the reactor and regenerator. Over a period of time, the coke continuously builds up on this portion of the catalyst. This non-circulating high-coked catalyst is termed as the heel catalyst. The heel catalyst is normally sent for precious metal recovery and disposal. The heel catalyst contains a substantial amount of low coke catalyst content which can be reused during normal CCR operation.

A rotating fluidization apparatus was set up to recover the low-coke content catalyst from the heel catalyst. Extensive experiments were conducted with different heel catalyst samples having coke content in the range of 15-35 wt% to study the effect of rotation of the fluidization column. After each experiment, low coke content catalyst is recovered from top of the column. From the analysis results, it was observed that the recovery of low coke content catalyst (< 10 wt%) is in the range of 10 – 60 wt%. This recovered catalyst can be directly re-used in the commercial CCR unit which saves significant cost.

Keywords: Heel catalyst; catalyst separation; fluidization; CCRU etc.

Abstract ID: EE-OP159

Development of Modified Solid sorbents for CO_2 Capture at high Temperature using MgO, CaO and Industrial wastes

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Abstract

The atmosphere's rising concentration of greenhouse gases, particularly carbon dioxide (CO_2), which is brought on by increased energy demand and other human activities, has a substantial impact on global warming. The available technology at present for CO_2 capture (CC) is working at low temperature (0 to 50°C) which is not cost effective due to extra cooling cost. Research is going to capture CO_2 at higher temperature using solid sorbent to meet the requirement of sorption enhanced reaction. Among solid sorbents, modified MgO and CaO based sorbents considered as the promising candidate for CC at high temperature. Due to their comparatively high theoretical adsorption capacity, low cost, and ubiquitous availability, magnesium oxide (MgO) based adsorbents for CO_2 collection at intermediate temperature (200-

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450℃) have been viewed as a very promising sorbent. Alkali metal nitrates acts as promoters which enhanced CC rate when impregnated with MgO. CaO based sorbents operates in the temperature range of 500-900℃. The theoretical uptake capacity of CaO is less than MgO, but actual CC and rate of reaction is higher at their respective operating temperature. The purpose of infusing industrial wastes with MgO and CaO is to optimize the sorbent. Research is going on to utilize Industrial wastes (like fly ash and blast furnace slag) for carbon capture.

Keywords: CO_2 Capture; MgO; CaO; Industrial Wastes

Abstract ID: EE-OP160

Valorization of the Fractionates of the Rice Straw

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Abstract
Rice straw is one of the major agricultural biomass residues produced in rice-producing countries. In the absence of a suitable use of rice straw, it is typically burned or discarded in open fields, causing a negative environmental impact. The major constituents of rice straw are 30 – 45% cellulose, 20 – 25% hemicellulose, 15 – 20 % lignin, and 10-15% silica. This work explores the fractionation of rice straw using NaOH solution at elevated temperature into three fractions, namely polymeric carbohydrates, lignin, and silica. Further, detailed characterizations of all these fractions are done using FTIR, SEM, XRD, TGA, and CHNS to study the effectiveness of the fractionation method and to facilitate further utilization of these fractions. Also, the cost of recovery is well justified. The study demonstrates that the polymeric carbohydrates fraction can be used to produce cellulosic ethanol, paper pulp, or bio-oil using existing technology. The lignin fraction can be used as a precursor for creating biocomposites, adhesives, and aromatic chemicals. The silica fraction can be isolated and purified for various applications such as catalysts, glass production, water filtration, paints, wall coatings, etc. Thus, promoting the use of a circular economy by adding value to each component of biomass.

Keywords: Cellulose; Lignin; Silica; Biorefinery

Abstract ID:EE-OP161

Valorization of Industrial waste into surface engineered biochar: A sustainable solution for abatement of emerging contaminants from wastewater and green energy production

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Abstract
The global escalation of population has triggered the demand for food, fresh water and energy which may further exacerbates solid waste generation from several industrial activities, surface water pollution due to emerging contaminants and depletion of fossil fuels etc. Therefore, for the past few years, researchers have motivated to delve into revolutionary technologies for converting different industrial waste into value added products, facilitates the United Nation Sustainable Development Goals (SDGs). Hence, the present study is

designed to introduce a sustainable technology to convert post-industrial textile waste (PITW) into surface functionalized biochar which may serve as an efficient adsorbent for several emerging pollutants present in surface water and subsequently a potential electrode material for green energy storage device even after contaminants removal. This kind of closed loop approach is attempted for the first time to the best of authors' knowledge.
PITW generated from Textile dyeing industries of Kolkata, India was successfully converted into surface engineered biochar and nanocomposite through slow pyrolysis followed by impregnation of phyto assisted Copper oxide nanoparticles into the biochar matrix. Several functional groups with hierarchical pore structure enhanced the adsorption capacity towards different reactive dyes (285-300 mg g^{-1}) and pharmaceutical component (450 mg g^{-1}). Furthermore, the pollutant loaded biochar and its composites showed its excellence as a potential precursor for electrodes with specific capacitance value of 220-350 F g^{-1} at 1 mV s^{-1} in line with several hetero atom doped carbonaceous material reported earlier.

Keywords: Post industrial textile waste; Surface engineered Biochar; Emerging pollutant; Spent biochar utilization; Green energy storage device

Abstract ID: EE-OP162

Development of activated hydro char from waste for combustion and their degradation characterstics

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Abstract
In this investigation, the activated hydro char was derived from the municipal sewage sludge and key lime peel bio mass. The activation energy (Ea) is a key parameter in thermochemical processes, and it can be calculated via thermo gravimetric analysis (TGA). The activation energy of the developed activated hydro char can be determined by using various model free kinetic models such as KAS, OFW and Starink models. These models are effectively used to predict the activation energy at various conversions. Furthermore, machine learning models like linear regression, support vector regression, random forest, Gaussian process regression, and artificial neural network models were used to make predictions on the degradation of prepared activated hydro char. The weight fraction of sewage sludge, the heating rate, and the temperature were the input parameters, and the mass loss of the sample was the output parameter. The developed machine learning algorithms can reliably forecast TGA data based on experiments.

Keywords: Municipal sewage sludge activated hydro char; TGA; Degradation kinetics; Machine learning models

Abstract ID: EE-OP163

Expanded Graphite Based Solar Salt for Thermal Storage Systems and Their Degradation Characteristics

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Abstract
The thermal energy storage systems used phase change materials (PCM) to store energy. Although its limited application is due to its low thermal conductivity. Heat transfer is greatly improved when using carbon-based phase transition materials. This study shows that expanded graphite (EG) can improve the thermal characteristics of solar salt-based phase change materials. However, addition of expanded graphite particles not only improves the thermal conductivity but also effects the onset degradation temperature of PCM material. This investigation deals with the thermal degradation kinetics analysis of the pure solar salt PCM as well as composite solar salt PCM containing 20 % of expanded graphite. Pure PCM selected for the analysis is a mixture of $NaNO_3$ + KNO_3. To increase thermal conductivity expanded graphite were added to this PCM, which forms a composite PCM.TGA analysis of the pure PCM and composite PCM at different heating rates of 10, 15, 20, and 25 ^{o}C/m were done. Using a TGA data thermal degradation kinetics of both the samples were performed. from the analysis the Activation energy value evaluated at different conversations. With the inclusion of expanded graphite, the PCM's onset degradation temperature was reduced. Thermal degradation kinetic Analysis shows that activation energy value is affected at each conversion of the samples with addition of EG particles.

Keywords: Phase change material (PCM); Thermal degradation; Activation energy; TGA analysis

Abstract ID: EE-OP164

Screening of Symbiotic Bacteria in Algae Growth for Biodiesel Production

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Abstract
A novel symbiotic bacterial strain has been isolated from the algae culture itself which is further analysed for sequence identification to know about the nature of the species. In this study, a 3 to 4 months old algae culture was grown up in non-axenic condition. Sample was taken to identify the presence of cross contamination in culture system like bacteria and other species. In microscopic analysis, it conforms that the presence of *C. pyrenoidosa* and *S. abundans* in the culture system. Additionally, bacterial identification techniques identified the stable colony survived in the culture system. Several times purification of two isolated pure colonies was carried out and growth curves are plotted for isolated colonies (white and yellow colony) which show the maximum absorbance value of 0.467 and 0.154 at 660 nm. Moreover, the isolated bacterial colonies were co-cultured with pure axenic culture of *C. pyrenoidosa* and S. *abundans*. Studies have proved that yellow colony supports the growth of algae. Hence, the isolated and purified yellow colony has been given for morphological, biochemical, 16S rRNA sequencing analyses and FAME analysis using Gas-Chromatography. This analysis report confirms that the isolated symbiotic bacterium was *Stenotrophomonas maltophilia*. The consensus sequence deposited in NCBI genbank KX768757.

Keywords: *Stenotrophomonas maltophilia*; Algae; *Chlorella pyrenoidosa*; *Scenedesmus abundans*

Abstract ID: EE-OP165

Microbial Fuel Cell as Power Source of Unified Power Quality Conditioner

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Abstract
The present study demonstrates Microbial Fuel Cell (MFC) as the potential power source of Unified Power Quality Conditioner (UPQC) system. A laboratory scale MFC was designed using *Escherichia coli* strain 0A03 as substrate and the performance of the MFC was evaluated for pure *E. coli* media as well as raw effluents (comprising of *E. coli*). The molecular characterization, nucleotide sequence analysis and growth rate of the *E. coli* were evaluated in the study. The voltage, current and power outputs for the pure culture *E. coli* based MFC were 499 mV,3.08 mA and 1.53 mW, respectively. Simultaneously, the MFC application could accomplish the biological treatment of the wastewater (raw effluents). Further, the power quality in the transmission system was validated in MATLAB Simulink both for (i) passive power filters and (ii) MFC integrated UPQC (consisting of active filters). For the same transmission system, the active power filter-based system outperformed the passive power filter system in terms of frequencies and load. The performance of MFC integrated UPQC system was equivalent to that of the conventional source based UPQC system. The total harmonic distortion (THD) in the system for the MFC powered UPQC was 0.7 of fundamental which is as per the requirement of the IEEE-519.

Keywords: Microbial Fuel Cell (MFC); Unified Power Quality Conditioner (UPQC); Wastewater Treatment; *E. coli*; Total Harmonic Distortion (THD)

Abstract ID: EE-OP167

Preparation and characterization of PVA-lignin composite membrane electrolyte by physical crosslinking method for fuel cell application

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Abstract
In the present study, low cost and biodegradable PVA-lignin membrane electrolyte was synthesized for the fuel cell application. The physical crosslinking method was adopted to synthesize the membrane electrolyte as it helps in better interaction between PVA and lignin. The physical crosslinking method is easy, cheap and no toxic chemical agents are used. The lignin loading was varied from 10 wt. % to 20 wt. %. The formation of PVA-lignin bond was confirmed by FTIR and the surface morphology was examined by SEM analysis. The XRD analysis showed an increase in the amorphous nature of the PVA-lignin membrane by the addition of lignin as well as by physical crosslinking. The addition of lignin into PVA increased the mechanical strength. The highest tensile strength of 44.12 MPa was obtained for PVA-lignin having 15 wt. % lignin. The PVA-lignin membrane showed an acceptable water retaining ability, which is essential for any membrane electrolyte to be conductive and hence, for the fuel cell application. The protonation of the PVA-lignin membrane was done by immersing the membrane in 3 M H_2SO_4 solution for 1 hr and then cleaning it by distilled water. The ionic conductivity was measured by electrochemical impedance spectroscopy (EIS). The highest ionic conductivity of 4.52×10^{-3} S/cm was observed for PVA-lignin having 15 wt. % lignin.

Keywords: PVA; Lignin; Physical crosslinking; Ionic conductivity; Fuel cell

Abstract ID: EE-OP168

Review on production of ultrapure hydrogen via PEM based electrolyser

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Abstract
Hydrogen is often touted as next generation fuel due to its high gravimetric power density and it being an efficient energy carrier. An excellent way for production is the employment of PEM-based electrolysers to produce ultrapure hydrogen. The intermittent nature of renewable energies like solar and wind can be overcome by coupling them to produce hydrogen, which can then be stored and used to generate electricity with the aid of PEM-based fuel cells. This coupled system of electrolytic cell and fuel cell is known as a regenerative fuel cell (RFC) system. PEM based electrolysis is one of the most promising techniques for the production of renewable fuel without carbon emissions as the products produced during electrolysis are ultrapure hydrogen (H_2) and oxygen (O_2). The main issue while producing hydrogen lies in its economics namely it is the construction cost of the electrolytic cell. As the demand for various alternatives for fossil fuels increases, interest in the production of hydrogen from electrolysis has increased considerably, therefore considerable research has been done to reduce the construction cost of electrolytic cell by developing various non noble metal catalysts for anode and cathode, optimizing the operating conditions of electrolytic cells, reducing degradation of the PEM based electrolyser and other methods. This review will contribute to the viability of producing ultrapure hydrogen with a PEM-based electrolyser.

Keywords: Ultrapure hydrogen; Electrolysis; PEMEC

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A Sustainable Agricultural Framework: Development of Fuzzy Based Decision Support Tool

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Abstract
Process System Engineering approach has tremendous potential to create a sustainable and profitable outfit for marginal and small-scale farming. Marginal (< 1 ha land) and small farmers (1-2 ha land) comprise nearly 78 % of the farm-families in Sundargarh district, West Odisha. 25% of the lands here possess irrigation facility and overall farm mechanization in Odisha is found to be only 35-36%, hence, more than one crop can't be grown in many instances. Small scale producers (SSPs) here find it unaffordable to attempt paradigm shifts in their Agri-methodology and averse in taking even meaningful risks to grow multiple crops. Unforeseen interruptions like climatic fluctuations, variation in market demand, non-availability of mechanized cultivation tools, high yielding variety of seeds and terrain matching seeds are the impediments to sustainable and profitable agriculture. This article presents a Fuzzy decision support tool developed using inputs from farmers and local agriculture specialists of Sundargarh District, West Odisha. Takagi and Sugeno's approach are used for the design of Fuzzy logic-based Decision System (DSS).

Keywords: Agriculture; Decision support system; Fuzzy logic; Marginal farmer; Takagi and Sugeno approach

Abstract ID: EE-OP171

Prediction of plastic pyrolysis product yield by machine learning

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Abstract
Due to its abundance and durability in the environment, plastic garbage has emerged as a serious environmental problem on a global scale. Plastic pyrolysis has become a promising method in recent years to deal with these problems. A potential method for trash management, resource recovery, and energy production, the process involves heating plasticwaste in the absence of oxygen and turning it into useful products. Pyrolysis is a thermochemical process that depends on several parameters such as temperature, heating rate, plastic composition, volatile matter, carbon content, etc. Investigation of the individual parameter effects on the final product yields (i.e., gas, oil, and char) is a complicated procedure. Investigation of this system with complex reaction mechanisms by either experimental or computational modeling is difficult. Therefore, machine learning (ML) techniques are implemented to investigate the effects of various experimental operating conditions and feed properties on product yield. ML's adaptable learning improves accuracy, and its data handling capability detects trends in product quality and identifies irregularities. This enhances process understanding and quality assurance.
In this study, we analyze how machine learning (ML) approaches might be employed for predicting the yields of various products that result from plastic pyrolysis. A vast dataset is gathered from various sources of literature and includes a variety of plastic kinds, pyrolysis conditions, and yields. Plastic qualities such as polymer type, molecular weight, and chemical composition are among the input features employed in ML models. The three main byproducts of plastic pyrolysis are solid residue (or char), synthetic gas (or syngas), and pyrolysis oil (plastic oil). ML modeling of the plastic properties predicts the yield, which mitigates the unwanted and complicated experimental pyrolysis studies on the fresh feedstock. The ultimate analysis provides a quantitative composition of the plastic sample according to its elemental constituents. Proximate analysis provides information on the physical and chemical properties that affect the combustion behavior of a plastic. Since the existing ultimate (Carbon, Hydrogen, and Oxygen composition) and proximate (Volatile, Fixed carbon, and Moisture composition) analysis information can be used as input featuresto predict the product yield. The Pearson correlation coefficient (PCC) is used to examine the correlation between the input variables as a preprocessing step. ML techniques such as random forests, regression, artificial neural networks, and XGBoost will be applied for the data modeling. This modeling study aids in discovering the complex relationship between plastic characteristics and product yield.
The objective of this work is to develop accurate and efficient machine learning models to predict oil, syngas, and char yields with the minimal information obtained from ultimateand proximate analysis.

Keywords: Plastics; Pyrolysis; Machine learning; Syngas; Char

Abstract ID: EE-OP172

Small modular nuclear reactors and energy transition in India

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Abstract
Quest for energy has led to exploitation of traditional sources like fossil fuels as well as emission of huge amount of Green House Gases (GHG's). India along with other nations has made commitments at UN convention on climate change for adopting energy transition strategies and decarbonise the environment by harnessing potential of renewable sources like solar and wind along with nuclear which are clean energy sources compared to fossil fuels. Renewable sources exhibit a significant potential to fulfill the energy gap in the wake of depleting fossil fuels but their practical deployability, usability is limited due to their

intermittent availability, larger footprints, dependence on geographic location, climatic conditions and huge costs involved for excess energy storage to meet base load requirements of the grid. Small Modular nuclear Reactors (SMR's) due to their smaller footprints, factory built nature and transportation as a unit has multifold advantages like: lower gestation time, lesser capital costs, phase wise capacity addition for increased demands without compromising on safety and base load requirements of the grid. SMR's posses the promising capabilities, features to be utilized along with renewable energy sources to meet future energy demands. Present work highlights the scope, potential advantages, challenges and deployment design philosophy of SMR's in India.

Keywords: Greenhouse gases; Nuclear reactors; Renewable energy

Abstract ID:EE-OP173

Hydrogen Storage in Rock Salt Caverns: A Renewable Energy-Powered Approach for Short-Term Storage and Flexible Extraction

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Abstract
This paper presents a novel approach for effective storage of hydrogen in rock salt caverns available in the Mandi district of Himachal Pradesh. The main objectives are to assess the viability of using renewable energy, specifically hydropower, to generate electricity for water electrolysis and store the hydrogen produced in the salt caverns. The scope incorporates the application of simulation software and computer modeling to evaluate the storage potential, simulate injection and extraction scenarios, and analyze the cavern's behavior during energy demand periods.
Our approach involves utilizing Himachal Pradesh's plentiful hydropower resources to generate electricity for water electrolysis, which turns water into hydrogen. The produced hydrogen will then be stored in the rock salt caverns within the Mandi district, taking advantage of their impermeable nature for safe storage. Simulation software and computer models will then be utilized to simulate several operational conditions, such as injection rates, storage capacities, and possible hydrogen leakage risks.
Results of preliminary simulations have shown promising results, indicating that the suggested method is theoretically and practically possible. Our model shows the cavern's ability to store hydrogen efficiently and securely, with minimal chance of leakage or penetration. Additionally, our findings demonstrate that this storage method can be adjusted for flexible extraction and short-term storage, aligning with dynamic energy demand patterns.
This research provides additive information to practicing engineers by presenting a thorough analysis that integrates renewable energy sources, electrolysis technology, geological formations, and hydrogen storage simulations. The innovative component is the integration of renewable energy-powered hydrogen production and geological storage with flexible hydrogen extraction during high energy demand. These insights guide efficient hydrogen storage in rock salt caverns, advancing sustainable energy systems.

Keywords: Green Hydrogen; Rock Salt Cavern; Hydrogen Storage; Computer Simulation

Abstract ID:EE-OP174

Exploring the Fuel Properties of Tire Pyrolysis Oil through the Synergistic Blending of Used Cooking Oil Biodiesel with Oxygenated Additives

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Abstract
A comprehensive assessment of fuel properties using neat UCO biodiesel, neat tire pyrolysis oil, biodiesel–tire oil blend and biodiesel–tire oil–dimethyl ether blends were investigated in this study. Different proportions (10 vol% and 20 vol%) of waste tire oil were mixed with a reference biodiesel fuel. Various ratios, including 10 vol% and 20 vol% biodiesel blended with tire pyrolysis oil (TPO) and DME blends to examine the fuel properties with a target to use the different fuel blends in the variable compression ratio (VCR) engine's fuel. The reason for blending used cooking oil biodiesel and DME is to improve the waste tire oil fuel properties and investigate the influence of fuel oxygen on different fuel properties. For the testing, binary and ternary blends including tire oil-biodiesel, tire oil-DME, and biodiesel-tire oil-DME—were created. In this inquiry, many features including density, viscosity, higher and lower heating values, smoke limit, flash point, fire point, pour point, cloud point, proton nuclear magnetic resonance (1H NMR), Fourier transform infrared (FTIR) spectroscopy, and elemental analysis (CHONS) were tested. The full fuel property results revealed that, when compared to reference diesel, all binary and ternary blends exhibit the same attributes. They can be utilized as fuels for compression ignition engines even though the binary blends of tire oil and biodiesel show slightly poorer properties than reference diesel fuel.

Keywords: Tire pyrolysis; Biodiesel; Dimethyl ether

Abstract ID: EE-OP175

Intensified High Temperature Carbon Capture using Various Amine Solvents

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Abstract
In the modern industrialised world, amine-based solvent post-combustion carbon capture is most efficient and cost-effective. DiProPylenetriAmine (DPTA) and AminoEthyl Piperazine(AEP) are the main solvents in CO_2 capture research. Aqueous Mono-Ethanol Amine(30wt%) is used as a standard solvent. Process intensification improves CO_2 capture and process conditions which can be predicted from the calculation of the vapour liquid equilibrium for the CO_2 capture in these solvents.
In the present study, the experimental data for 30 wt% DPTA, MPZ, AMP, MEA, and AEP solutions at 120°C is presented. The present work also compared the utilization of the 30% MEA with the other researchers work available in the published literature. It is verified thatthe a more precise VLE models have supported the increased CO_2 capture capacity, rich loading, etc. through process intensification.

Keywords: Vapor-liquid Equilibrium; Process Intensification Technique; Carbon Capture;Amine Solvent

Abstract ID: EE-OP176

Utilization of agricultural waste for the production of paper pulp

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Abstract
Sustainability is of paramount importance in today's world, as it represents our commitmentto preserving the well-being of our planet and ensuring a harmonious coexistence between human society, the environment, and future generations. It is the key to addressing pressing global challenges such as climate change, resource depletion, loss of biodiversity, and socialinequality. Sustainability not only safeguards the delicate balance of ecosystems but also fosters economic stability and resilience.

The utilization of agricultural waste for sustainable production processes is a burgeoning areaof research, offering a twofold solution to waste management and resource conservation. Thisstudy delves into the potential of prominent agricultural waste materials, groundnut shells and rice husks, as viable sources for paper pulp production.

The present research work investigates the suitability of groundnut shells and rice husks for pulping, assessing their chemical composition and fiber characteristics. Pulping methods, including chemical, mechanical, and hybrid approaches, are employed to extract fibers fromthese waste materials. The effects of various pulping parameters on pulp yield, fiber morphology, and paper properties are examined systematically. Results indicate that both groundnut shells and rice husks possess cellulose and lignin contents suitable for pulping.

Keywords: Sustainability; Environment; Groundnut shells; Paper pulp

Abstract ID: EE-OP177

Study of gasification behavior of High ash Indian Coal and biomass blends in an indigenously designed and built Fluidized-bed Gasifier

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Abstract
Gasification is a clean coal technology that can be employed to achieve sustainable polygeneration of energy and products. In the present study, we have used coal and different biomass blends to study their fluidization ability and gasification characteristics inside a fluidized bed gasifier. Air is used first for the fluidization study of coal-biomass blends in a cold model setup at different bed heights and air velocities to determine the conditions at which smooth fluidization occurs. Then the air-steam mixture is used for gasifying the feedstock in an in-house indigenously developed fluidized bed gasifier (FBG). The particle properties such as particle size of the feedstock and operating parameters such as gas velocity and temperature play an important role in the entire thermo-chemical conversion process and performance of the entire system. It is observed that as the gasifying temperature increases the Hydrogen content and calorific value of the product gas increases. Based on the parameters obtained in the experimental study Cold Gas Efficiency (CGE), Calorific Value (CV), and Carbon Conversion Efficiency (CCE) were studied for different percentage blends of the biomass with coal.

Keywords: Gasification; Fluidized Bed Gasifier (FBG); Cold Gas Efficiency (CGE); Calorific Value (CV); Carbon Conversion Efficiency (CCE)

Abstract ID: EE-OP180

Simulations, Economic Analysis and Sustainability Impacts of Renewable Bioresources Towards Net Neutrality

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Abstract
Agricultural waste is abundant and readily available as an energy source in countries with agrarian economies, such as India, the United States, Brazil, China, etc. Despite advancements in technology, there are still several obstacles to utilizing biomass as an energy source, and these include the impact of logistical factors. This research endeavors to find and analyze such elements from supply and usage logistics that could facilitate the commercial use of agricultural leftovers for energy production. The processes of maize and wheat straw conversion using a dual fuel engine, gasification using a gas-steam cycle, and combustion using a steam turbine cycle are all assessed on a scale between 5 and 50 kW. Through the development of various models, this work seeks to construct cost-based analytical simulations that will allow for a comparative assessment of ultimate power generation costs. The total amount includes both one-time capital costs and ongoing operational and maintenance costs. The proposed models enable a wide range of scale and performance variable values to be used in sensitivity assessments and individual-effects analyses targeted to specific scenarios.

Keywords: Biomass; Energy production; Steam turbine cycles; Simulations; Cost analysis; Agricultural waste, Renewable energy; Sustainability

Abstract ID: EE-OP181

Review on Structural modification of Alkaline membrane fuel cell

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Abstract
PVA has been widely investigated as a membrane matrix because of its excellent film forming capacity, highly hydrophilic nature, and good chemical stability. Though PVA is difficult to use as a fuel cell membrane due to its poor proton conductivity, numerous studies have been conducted to modify PVA using sulfonation and cross-linking techniques. Inorganic fillers can also be introduced to improve the proton conductivity and durability of the PVA membrane. Inorganic materials like silica, zirconia and ceria have been used to modify membranes and enhance the membrane properties. It also improved the thermal stability, mechanical strength, water retention capacity and proton conductivity of the membrane. Some of the standard methods used for the structural modification of membranes are grafting copolymerization, physical and chemical cross-linking and blending of polymers. PVA membranes have a wide range of potential applications, including auxiliary power units, stationary power generation, water desalination etc. PVA membranes have attracted increasing attention due to their relatively low cost. This review aims to study the structural modification of alkaline membrane fuel cell and to improve their performance, durability and cost-effectiveness.

Keywords: PVA; Alkaline membrane; Cross-linking; Blending; Grafting polymerization

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A Comprehensive Review on Sustainable Biodiesel Production from Various Renewable Energy Sources

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Abstract
The switch to sustainable energy systems has enhanced interest on the production of biodiesel from various renewable sources. Biodiesel is one of the sustainable and ecologically alternative to traditional diesel fuel, which has an ability to mitigate climate change and reduce reliance on limited fossil resources. This review focus on microwave and ultrasonic assisted processes for biodiesel production from diverse renewable energy sources, including vegetable oils, animal fats, microalgae, and waste cooking oil. Thorough analysis on feedstock selection, transesterification procedures, catalysts, optimization and environmental issues for each source is presented in this review. Furthermore, this review highlights the economic feasibility and sustainability of biodiesel.

Key words: Biodiesel; Catalysts; Vegetable oils; Animal fats; Microalgae; Waste cooking oil

Abstract ID: EE-OP184

Geopolymerization: A novel technique for the development of new class cementitious materials

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Abstract
Geopolymerization, or in broader terminology, the alkali-activation technique in its current state, is emerging as cutting-edge technology with applications in many fields. The word "geopolymer" was initially coined by French scientist and engineer Prof. Joseph Davidovits in the 1970s to describe solid materials containing aluminosilicate developed by combining them with alkaline activators to generate a three-dimensional gel-like microstructure. This process is known as geopolymerization. The geopolymers are inorganic polymers initially created as alternatives to fire-resistant materials. Since then, the application of geopolymers has shifted to the construction sector due to their superior mechanical and physical properties and, most importantly, low greenhouse gas emissions compared to ordinary Portland cement (OPC). Despite these advantages, it is still not recognized. The main reasons behind this are (1) The absence of standardized frameworks/codes and lack of technical personnel; and (2) Inadequate knowledge of geopolymers among the general population. This article aims to provide an overview of geopolymer technology and its use in the actual world to broaden our understanding of this novel method. The information is supplied with particular emphasis on the process involved in geopolymer production, factors affecting geopolymer chemistry, and barriers to its adoption and commercialization.

Keywords: Geopolymer; Alkali-activation; Stone waste; Building material; Reactivity

Abstract ID: EE-OP185

Characterization Of Biochars Derived From Vegetable Wastes

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Abstract
The ever-increasing human population associated with high rate of waste generation may pose serious threats to environment considering the global issue of wastes generation and its impact on the environment and resources. Food waste is one of society's highest volume and most environmentally impactful waste streams. The development of new methods to up cycle food waste into usable materials is integral to mitigating the substantial greenhouse gas emissions associated with wasted food. Chemical or biological conversion of food waste into valuable materials is currently limited by the in homogeneous nature of post-consumer food waste, making it challenging to economically convert post-consumer food waste into valuable materials. In this present study, food waste like cauliflower waste, pumpkin peels obtained were used to generate biochars with slow pyrolysis techniques focusing on reducing the waste disposal by incineration, landfills which creates harmful impacts on environment like infectious diseases, climate change – CO_2 emissions, soil fertility depletion and crop cultivation depletion. Characterization studies like moisture content, ash content, and volatile content, pH,SEM and FTIR for each biochars were studied and the yield of bio chars were estimated. The result indicates the biochars generated from the wastes were found to be effective for industrial, agricultural and domestic applications.

Keywords: Food waste; Pyrolysis; Biochars; Particle size

Abstract ID: EE-OP186

Solid waste management of wheat and rice straw/root in Punjab and Haryana: Application of Bioprocess Engineering towards utilization of agro waste into bioenergy production

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Abstract
The crop production process is modernized with increasing varieties of high-yielding crops, which has made leveraging the crop residue production and its management challenging. In the northern part of the country, especially Haryana and Punjab usually witness the burning of rice and wheat root residue in large swathes of agricultural land (burning of "Parali"), leading to the huge formation of dense fog and air pollution. The discussed hotspot burning issues are linked with rising greenhouse gas emissions and cause global warming. The agricultural wheat and rice residues can be the potential substrate for fermentative biohydrogen production. The present research reports regarding the utilization of agricultural wheat and rice residue by (i) novel delignification process, (ii) bioreactors configurations, (iii) the controlling of key parameters (pH, temperature, organic loading rate, retention time, C/N ratio, VFA estimation, maintaining the stability of hydrogenase and nitrogenase activity) and their impact on biohydrogen production, (iv) Microbial-substrate interaction mechanism, (v) Techno-economic analysis. These essential parameters are supported by performing kinetics modeling to predict the maximum yield of biohydrogen under specific conditions. Operational conditions, process factors, and design of the bioreactor all impact on substrate conversion efficiency and biohydrogen production competency of microbial biocatalysts during the fermentation process.

Keywords: Agro Crop residue; Air pollution; Biohydrogen; Techno-economic analysis

Abstract ID: EE-OP187

$NiCo_2O_4/NiCoSnS_4$ Nanocomposite based Asymmetric Supercapacitor Device for Energy Storage Application

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Abstract
Transition metal-based materials possess enhanced electrochemical performance through multiple redox reactions, sparking considerable interest in the realm of energy storage devices. In this work, nanocomposite of $NiCo_2O_4/NiCoSnS_4$ with well-defined morphological structure was prepared via two-step hydrothermal synthesis. The synthesized material was characterized by X-ray diffraction and field emission scanning electron microscopy suggesting the formation of polycrystalline coral type of nanostructures. The supercapacitor cathodes with varying mass loadings were fabricated and electrochemical properties were investigated. The supercapacitor cathode prepared with optimum mass loading showed an excellent specific capacitance of 1511.7 F/g at 1 A/g which was decreased significantly with increasing mass loading. An asymmetric device was fabricated by using activated carbon anode and composite cathode containing highest mass loading. The fabricated device exhibited specific capacitance of 42 F/g at 1 A/g with energy and power density of 12.26 Wh/kg and 725 W/kg, respectively.

Keywords: Supercapacitor; Nanocomposite; Transition metal sulfide; Transition metal oxide; Electrochemical performance

Abstract ID: EE-OP188

Amine Functionalized Zn/C NPs for Electrochemical CO_2 to Syngas

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Abstract
Over the recent years, Electrochemical CO_2 Reduction (ECR) using heterogeneous electrocatalysts has gained a lot of interest for the conversion of CO_2 to valuable products. Moreover, CO_2 to CO conversion is the most attractive industrial reaction choice due to the high efficiency and techno-economic feasibility. Zn is an abundant and cost-effective metal. It offers relatively high selectivity for CO production at moderate current densities, making it a cost-effective alternative to Au and Ag. However, it has poor stability.
This study focuses on the development of "Amine-functionalized Zn nanoparticles on a carbon support" based electrocatalyst with high stability with a run time of about one day or higher. Oleylamine functionalize Zn/C electrocatalyst prepared using wet chemical method have shown the stability for couple of hours in the liquid phase ECR. Post reaction analysis has indicated that the poor stability is due to the restructuring of the electrocatalyst under the applied potential. Preliminary studies confirm the formation of syngas at different potentials with prepared electrocatalyst.

Keywords: Electrochemical CO_2 reduction; Zn; F.E.; CO

Abstract ID: EE-OP189

Dangling Carboxylic Group Participates in O-O Bond Formation Reaction to Promote Water Oxidation Catalyzed by a Ru Complex:An Oxide Relay Pathway

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Abstract
Two mononuclear ruthenium (II) complexes of types $[Ru(trpy)(HL^1)(OH_2)]^{2+}$ (1^{Aq}) and $[Ru(trpy)(L^2\text{-}\kappa\text{-}N^2\text{-}O)]$ (2) [where trpy = 2,2':6',2''-terpyridine, HL^1 = 2-(2-pyridyl) benzimidazole, H_2L^2 = 2-(pyridin-2-yl)-1*H*-benzo[*d*]imidazole-4-carboxylic acid] have been synthesized and thoroughly characterized by analytical, and spectroscopic (UV- vis, NMR, HRMS, IR) techniques. Complex 1^{Aq} has been further characterized by X-ray crystallography. In acidic aqueous medium (pH 1), complex 2 undergoes carboxylate/water exchange readily to form an aqua-ligated complex $[Ru(trpy)(H_2L^2\text{-}\kappa\text{-}N^2)(OH_2)]^{2+}$ (2^{Aq})having a dangling carboxylic group. This exchange phenomenon has been followed by IR, ^1H NMR and UV-vis spectroscopic techniques. Electrochemical analyses of 1^{Aq} and 2^{Aq} (Pourbaix diagram) suggest the generation of a formal $Ru^V{=}O$ species that can potentially promote the oxidation of water. A comparative study of water oxidation activity catalyzed by 1^{Aq} and 2^{Aq} is reported here to see the effect of dangling carboxylic group in catalytic performance. Complex 2^{Aq} shows enormously higher rate of reaction than 1^{Aq}. The pendantcarboxylic group in 2^{Aq} participates in an intramolecular O-O bond formation reaction with reactive formal $Ru^V{=}O$ unit to form percarboxylate intermediate, and provides an electron deficient carbon center where water nucleophilic attack takes place. The isotope labelling experiment using ^{18}O-labelled water verifies the attack of water at the carbon center of carboxylic group, rather than direct attack at the oxo of formal $Ru^V{=}O$ unit. The present work provides experimental evidence of uncommon functionality of carboxylic group, the oxide relay, in molecular water oxidation chemistry.

Keywords: Ruthenium complex; Water oxidation; Catalysis; Oxide relay mechanism

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Technoeconomic Analysis of CO_2 Capture using Deep Eutectic Solvent and the Study of their Thermodynamic Properties

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Abstract
Deep eutectic solvents of the different hydrogen bond acceptors of large alkyl chain length and acidic hydrogen bond donors of different molarities were synthesized in this work. CO_2 solubility in DES was studied in the SETARAM PCT PRO High Pressure Sorption Analyser. The absorption experiment was carried out at three different temperatures 30, 40 and 50℃. The Clausius Clapeyron equation was used to calculate the enthalpy and entropy of the DES-CO_2 system. Using the Lee Kessler approach and the modified Lydersen-Joback-Reid (LJR) method, the critical properties of each DES were predicted. FTIR, DSC and NMR of deep eutectic solvents were carried out before and after CO_2 absorption. Thermodynamic modelling of the DES-CO_2 system using the Peng-Robinson and COSMO-SAC equation of state was carried out in ASPEN PLUS software and correlated with experimental work. Cost estimation of the simulation of

absorption of CO_2 was carried out in aspen plus and compared with traditional amine solvents such as MDEA, MEA, DEA.

Keywords: Deep Eutectic Solvent; CO_2 capture; absorption; Amine solvents

Abstract ID: EE-OP193

Translational Research in Sonochemistry

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Abstract
Appropriate practices of Translational Research (TR) enhance the potential of leveraging the knowledge-based available in different domains including sonochemistry. TR tools, appliedto sonochemistry, can help in developing several useful applications in fields such as materialprocessing, engineered materials, healthcare and food processing. The interdisciplinary research perspective is needed to develop, demonstrate and commercialize impactful applications in the aforementioned fields. The authors plan to share insights relevant to translational research in sonochemistry, including the methodologies for assessment of Technology Readiness Levels (TRLs) in technology upscaling chain, identifying gaps at different TRLs, and adopting flexible strategies to forge required collaborations right from ideation to technology transfer and commercialization.

Keywords: Translational research; Sonochemistry; Technology readiness level (TRL); TRL-based collaborative strategies in technology upscaling process

Abstract ID: EE-OP191

Microwave heating: An Energy efficient melting of Glass with Significant Change in Properties

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Abstract
Small-scale glass melting using microwave (MW) heating significantly impacts energy and time-saving. Power consumption in a microwave furnace was ~ 5 kWh with a maximum power demand of 1.5 kW. Electrical power consumption in resistance heating furnaces was studied in three different capacities of furnaces and compared with that of microwave furnaces. Energy saving in the range of ~ 60% was recorded in microwave heating compared to resistance heating furnaces. Further, the time needed to melt the glass in a microwave furnace was recorded as less than 2 h compared to 6-7 h needed in a resistance heating furnace. Thus, Microwave heating yields identical glass, consuming substantially less electrical power and time, signifying the possibility of a drastic reduction of cost in glass melting and reduction in greenhouse gas generation.
The study investigates the capability of MW heating in retention of higher Fe[II] in glass, eliminating the stringent reducing atmosphere requirements in conventional heating. Stabilization of higher Fe[II] in glass under the influence of MW irradiation has been demonstrated, measuring absorbance at > 1000 nm in UV-Vis-NIR spectra and maintaining identical conditions in MW and conventional heating. Enhanced iron

redox ratio (Fe^{+2} /∑Fe) in microwave processing may be advantageous in preparing heat-absorbing filter glass.

Keywords: Microwave heating; Energy efficient process; Heat absorbing glass; Fe-redox ratio

Abstract ID: EE-OP194

Electrochemical Reduction of CO_2 to Syngas Using Amine Functionalized Carbon Supported Zinc Nanoparticles

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Abstract
Nowadays Electrochemical reduction of carbon dioxide to valuable products (fuels and chemicals) has gained more attraction towards heterogeneous catalysts. It can help in mitigate the environment CO_2 as well as store the renewable energy in chemical form. This study aims at conversion of CO_2 using amine functionalized Carbon supported Zn nanoparticles towards selective formation of syngas. Amine functional groups enhance the selective adsorption of CO_2 on the Zn/C nanoparticle thus facilitating the syngas formation. Carbon supported Zn nanoparticles were synthesized by using wet chemical method with Ethylenediamine and triethanolamine as surfactants as amine functionalized group. The physical and electrochemical properties of the synthesized electrocatalysts were determined using XRD, FTIR, SEM, BET, DLS, EDX, LSV, CV, and EIS. CO_2 reduction experiments were carried out in an H-type cell using potassium bicarbonate as the supporting electrolyte and Nafion membrane. Syngas formation was determined using gas chromatography. The electrocatalyst properties are modified to achieve catalyst stability up to 6 hours at high current densities and Faradaic efficiencies.

Keywords: Syngas; Zn; carbon support; Ethylenediamine; Triethanolamine

Abstract ID: EE-OP195

A comparative study on energy harvesting using different wastewater using a Bacterio-algal fuel cell

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Abstract
To fulfill the criteria of sustainability goals, the generation of clean energy through the utilization of waste water can serve as a promising option. Under this present study, energy harvesting from waste water and agro-wastes through hybridization of catalytic thermal treatment of mustard straw and bio-electrochemical process is studied using a microbial fuel cell (MFC). This bio-electrochemical system is a vertical concentric duoble-chambered microbial fuel cell (MFC) which also continuously sequestrates CO_2, generated in the anode chamber after anaerobic digestion of carbonaceous molecules in presence of an electro-active bacteria (EAB) *Shewanella putrefaciens* MTCC8104 and also produces electron acceptors in the form of oxygen by algal-photosynthesis by an algal strain, Leptolyngbya subtilisJUCHE1. An earthen column having 100ml volume serves as the anode chamber and the wall of the column is working as the proton exchange membrane (PEM), which minimizes the cost of this bacterioalgal fuel cell (BAFC) unlike the conventional MFCs. In this study, the BAFC has been operated in fed-batch mode using lactic acid in whey and glucose from

lignocellulosic hydrolysate as the carbon substrates. The performance of the BAFC has been optimized with respect to total lactic acid: hydrolysate ratio; feeding interval and quantity of algal inoculum.

Keywords: Bacterio-algal fuel cell (BAFC); microbial fuel cell (MFC); Bio-electrochemical system (BES); MATLAB; *Leptolyngbya subtilisJUCHE1*; *Shewanella putrefaciens MTCC8104*

Abstract ID: EE-OP196

Optimizing Reformer Performance for Integrated Blue Hydrogen-Methanol Production: A Multi-Objective Optimization and A Techno-Economic Study

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Abstract
Utilizing CO_2 as a potential feedstock for producing methanol is an essential field of research both from environmental and economic perspectives. To achieve sustainable methanol synthesis from CO_2, a substantial external supply of green hydrogen is required, which remains an emerging technology. An alternative approach that involves on-site hydrogen generation through methane reforming using various oxidants such as steam, carbon dioxide, oxygen is explored in this work. This approach aims to optimize the reforming process within a network consisting of reformer and methanol reactors. Mathematical optimization is employed to estimate the reformer operating conditions and the fractions of CO_2 directed into these reactors while addressing a multitude of conflicting objectives, including an ideal H_2/CO ratio, maximum CH_4 conversion, CO_2 utilization, energy efficiency, and minimum coke deposition on the catalyst. The trade-offs associated with these objectives are addressed using advanced multi-objective optimization algorithms such as NSGA-2 which results in a Pareto front, offering decision-makers a wide range of solutions to choose from, depending on their requirements. Additionally, the research includes comprehensive techno-economic evaluations conducted under the optimized conditions. The insights derived from this work will guide the selection of optimal reformer operating conditions for utilizing CO_2 as a feedstock to produce methanol.

Keywords: CO_2 Utilization; Multi-objective Optimization; Methane Reforming

Abstract ID: EE-OP197

Morphologically Tuned CuO-ZnO-CeO_2 Catalyst for CO_2 Hydrogenation to Methanol

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Abstract

Rapid industrialization increases the necessity for the consumption of fossil fuels, which enhances CO_2 emissions into the atmosphere. According to Earth System Research Laboratory, the average global atmospheric CO_2 concentration is about 422 ppm, which is nearly increased by 6.1% during the last decade. The direct catalytic hydrogenation of CO_2 into methanol is most effective approach to reduce greenhouse gas emissions. In the current study, a different morphology of CuO-ZnO-CeO_2 catalysts is synthesized using the hydrothermal synthesis method. The physico-chemical properties of the catalysts are examined using XRD, FE-SEM, BET, XPS, H_2-TPR, CO_2-TPD, and other characterization methods. A nanowire-like morphology of catalysts is confirmed from the SEM analysis. The BET analysis indicates that the catalyst exhibits a specific surface area of 51 m^2/g. Afterwards, the performance of the catalysts is evaluated at 225 °C, 30 bar pressure, and a space velocity of 6000 cm^3/g_{cat} h using a bench-scale fixed-bed reactor. The catalyst showed 13.6% CO_2 conversion, 74.1% methanol selectivity, and 25.9% CO selectivity at 225 °C and 30 bar pressure. A time-on-stream investigation was carried out for 50 hours at 225 °C and 30 bar to evaluate the stability and amount of coke formation of the catalyst.

Keywords: CO_2 conversion; Methanol synthesis; Bench-scale fixed bed reactor; CeO_2 support; Oxygen vacancies

Abstract ID: EE-OP198

Techno-economic Analysis of Post-combustion CO_2 Capture Technologyin Cement Industry: A Comparative study using MEA and Ammonia Solvent

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Abstract

Cement industry plays a vital role in a country's economic development, but it also contributes significantly to carbon emissions. Carbon capture technology is mandatory to decarbonize cement industry today. This study focuses on the design of the post-combustionCO2 capture technology with the goal of integrating with cement industry. It presents the results of process simulations of a carbon capture plant that captures CO2 from a 3000TPD coal-fired cement plant's flue gas stream. From literature, separate rate-based models are developed for two absorbents, MEA and ammonia using, Aspen Plus. Simulations are performed incorporating a wide range of process conditions to evaluate the performance of these solvents. Key metrics such as capture efficiency, total energy consumption, solvent regeneration, and so on are analyzed. An in-depth economic analysis is also carried out for both the capture technologies which includes the levelized cost of CO2 capture. The analysisprovided insights into the cost-effectiveness and financial viability of implementing these technologies in the cement industry, and will be vital to the industry practitioners. On the basis of the findings and analysis, this study would identify, evaluate and compare the advantages, disadvantages, and implementation challenges associated with aforementioned CO2 capture technologies, and make suitable recommendations.

Keywords: Carbon emissions; Carbon capture; Post-combustion; Process simulation; MEA;Ammonia

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Growth Kinetics of CO_2 hydrate with CO_2-philic Additives: Relevant for Carbon Capture and Sequestration (CCS)

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Abstract
The energy transition poses a number of challenges, the most pressing of which is the urgent need to minimize anthropogenic carbon emissions. Carbon capture and sequestration (CCS) is considered an effective short-term strategy to mitigate the effect of climate change. CO_2 capture and sequestration via gas hydrates is a viable option due to its various advantages. Slow kinetics, low water-to-hydrate conversion, and gas recovery rate are major concerns that must be addressed to commercialize CCS through clathrate hydrates. In this regard, kinetic promoters for CO_2 hydrate are used to improve CO_2 hydrate growth kinetics. Recently, several CO_2-philic additives have been found to enhance CO_2 uptake by the hydrate. These chemicals have high binding energies for CO_2 and physically interact with the CO_2 molecules to facilitate hydrate nucleation and growth. Important kinetic metrics like gas uptake, gas-to-hydrate conversions, t_{90}, and gas storage capacities provide valuable insights into comprehending the influence of these additives on CO_2 hydrate growth. However, hydrate nucleation and growth are a highly stochastic phenomenon. Therefore, anticipating the growth kinetics of CO_2 hydrate with these additives through a kinetic model is challenging. A gas hydrate growth kinetic model based on the Englezos-Bishnoi model can be modified to capture the CO_2 hydrate growth during the post-induction period for a batch reactor. The combined rate parameter is the only tuneable parameter in the model estimated from the gas uptake data. The prediction accuracy depends on several factors, including estimating gas diffusivity, water-additive interactions, and replication of mass transfer limitations during hydrate growth. The model is beneficial for developing clathrate hydrate-based CCS technologies.

Keywords: CO_2 hydrate; Growth; Kinetic model; Promoters; Rate constant

Abstract ID: EE-OP200

Resource efficiency and carbon recovery with oleaginous fermentation

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Abstract
Yeast-mediated oleaginous fermentation from renewable carbonaceous feedstock as an alternative source for nutraceuticals, fuels, and chemicals has attracted significant attention in the recent past over the 2G bioethanol-based refinery concept. While 2G or even 1.5G bioethanol technology offers a ready and near drop-in fuel solution, the end product has less energy due to C_2 carbon, whereas the lipid/fatty oil derived from oleaginous yeast, harbors energy content similar to middle distillate hydrocarbon. Further, yeast single cell oil has been proven competent to algal/tree-born oil due to similar fatty acid composition. However, any integrated processes for producing fuels and oleochemicals from yeast lipids by accumulating biomass-derived sugars at an industrial scale are not yet ready. To address the demand and supply of renewable fuels necessitates large-scale fermentation. We established a process scale up from 500 mL to 500 L. The accumulated SCO was established to produce application products viz: biodiesel, bio-ATF, lube base oil,

aromatics (BTEX), and short-chain olefins, along with pigments and glycolipids. LCIA was carried out for the process on a cradle-to-gate basis. TEA to estimate the total energy consumption for a 150 Kg/d 2G feedstock processing plant was developed to support material resource efficiency and cradle-to-gate carbon recovery.

Keywords: Single cell oil; Edible oil; LCIA, ReCiPe; Techno-economic analysis; Lignocellulosic biomass

Abstract ID: EE-OP201

Inexpensive and Stable Single-atom Catalysts (SACs) for Sustainable Energy

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Abstract

Atomically dispersed active sites have attracted great attention as a new frontier in the catalysis. Single-atom catalysts (SACs), well-defined mononuclear active sites, have demonstrated to be indispensable materials in catalysis. Both experimental and theoretical studies suggest that decreasing particle size is the most effective approach to improve the atom utilization and tune the physicochemical properties of these active centers, further leading to the enhancement of catalytic performances. Another advantage of the SACs is that the SACs have the ability to break away from the scaling relationship and this can lead to a high catalytic performance beyond the scaling relationship. Based on this concept, inexpensive and stable single-atom catalysts (SACs) have gained remarkable research interests due to their maximum atom utilization efficiency. Using a variety of fundamental understanding of their structure-property relations and electronic properties from density functional theory (DFT) calculations we will discuss the rational design and screen of single atom catalysts (SACs) based on low-dimensional macrocyclic molecules for both the ORR catalysts for fuel cells applications and heterogeneous catalysts for the activation of small gas molecule for the liquid feedstock under mild conditions.

Keywords: Single atom catalysts; Energy; Density functional theory; Oxygen reduction reaction

Abstract ID: EE-OP203

Understanding GHG emissions of HEIs of India: Framework and case study

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Abstract

India announced its commitment for becoming net zero by 2070 at COP26. Measurement remains the primary activity to be performed for achieving net zero emissions. Tools such as LCA, GHG etc. are providing a robust methodology for measurement of carbon footprint for industries. The number of higher education institutions have surged in India with around 43796 colleges around 1113 universities generating teaching employment of around 11 lakhs. HEIs consume a significant number of resources thereby generating emissions. Frameworks such as QS World university ranking are emerging to evaluate the overall sustainability of the HEIs. The present work aims at providing a GHG accounting framework for HEIs. To illustrate the framework a case study of Laxminarayan Innovation Technological University is presented. Results show for year 2022-2023-Scope 1 emissions (10738.76099±322.1628 kg CO_2 equivalent)) includes stationary combustion, Scope 2 emission (712322.100±3561.610 kg CO_2 equivalents) includes electricity

sourced from grid. Scope 3 emissions (161733.8282±4852.8010 kg CO_2 equivalents) include employee commute. The work also discusses various sources of emissions and mitigation strategies specifically for HEIs. The framework can be utilized by Indian HEIs for their GHG evaluations in sustainability reporting.

Keywords: GHG; Methodology; Scopes; Carbon sequestration; Mitigation strategies

Abstract ID: EE-OP205

Comparative assessment of Pyrolysis and HTL with respect to valorization of digestate from Co-Digestion of Indian Grass and cattle dung

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Abstract
To exploit the full potential of anaerobic digestion, valorization of digestate is essential. In this regard, various thermochemical processes are gaining attention. This study investigated the potential of HTL and Pyrolysis for valorizing anaerobic digestate generated from co-digestion of Indian grass with cow dung. Use of grass has been chosen for our experiment for the development of biomass energy on account of their advantageous characteristics of high yield, large abundance, strong adaptability and no direct competition with food crop. A 6L digester was operated in batch mode and daily gas production was observed for 40 days. The cumulative biogas yield was observed to be 345.41 ml/g VS_{input} with 62% methane content. Pyrolysis was operated in three different temperatures 300, 450 and 600°C. And HTL was operated at 300°C for 60 mins. Mass yields and biocrude composition by GC-MS analysis are shown. Pyrolysis results showed better biochar yield compared to direct use of feedstock in pyrolysis. The potential market value of hydro char/biochar-derived products makes both strategies, integrating Anaerobic digestion with pyrolysis and HTL, promising.

Keywords: Pyrolysis; Hydrothermal liquefaction; Digestate; Waste valorization; Biofuel

Abstract ID: EE-OP206

Catalytic Upgradation of Used Cooking Oil (UCO) into AromaticHydrocarbons on Imidazole-Supported Zeolite Catalyst

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Abstract
The demand for eco-friendly and sustainable technology has made it imperative to find alternative energy sources. Reducing dependence on petroleum products and prioritizing biodegradability and renewability is important for economic and energy safety. One potentialsolution is using used cooking oil (UCO) as a renewable carbon source to produce sustainableenergy. UCO is already being used in hydro-processing for bio-aviation fuel/biodiesel. Unlike coal, oil, or natural gas, UCO can be transformed into energy, fuels, and fine chemicals instead of being discarded. It can also be a feasible feedstock for synthesizing petrochemicals,

including crucial aromatic platform molecules for high-value chemicals. Given that, the direct conversion of UCO into aromatic hydrocarbons on an imidazole- supported zeolite catalyst (ISZ) was investigated. The formation of aromatics was found to depend on the pore structure and acidity of the catalyst. The addition of metal oxides over ISZ enhances the Lewis acidic sites, which predominantly enhances the dehydrogenation reaction and yields more aromatic hydrocarbons. In addition, it was found that the average pore size of the catalyst is 6.3 nm, which effectively helps diffuse monoaromatics (C6-C8). To investigate the changes occurring on the catalyst surface during the reaction at different temperatures (25–500°C), formed surface intermediates and products were closely monitored using in situ DRIFTS. The ZnCr/ISZ showed excellent stability and good selectivity of C6- C8 aromatic species (65.9%) at 430 °C under atmospheric pressure and promised itself as a suitable catalyst candidate for high yield aromatics from UCO.

Keywords: Used Cooking Oil (UCO); Aromatics; Imidazole-Supported zeolite catalyst; In-Situ DRIFT

Abstract ID: EE-OP207

Visible-Light Driven Reaction of CO_2 with Alcohols Using Ag/CeO_2 Nanocomposite: First Photochemical Synthesis of Linear CarbonatesUnder Mild Conditions

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Abstract
In recent decades, capturing and converting CO_2 to chemicals has been considered apromising alternative for CO_2 mitigation. However, the high stability and chemically inert nature of CO_2 having a high C=O bond energy (750 kJ mol^{-1}) means that it requires harsh reaction conditions (higher temperatures and pressures) for thermos-catalytic conversion. Conversely, the photocatalytic conversion of CO_2 occurs at mild operating conditions, i.e., room temperature and atmospheric pressure, using solar energy that is abundant, renewable, and inexhaustible. Accordingly, we have reported the first photocatalytic synthesis of linearcarbonates from the reaction of CO_2 with alcohols, both alkyl and aryl, using silver-doped ceria (Ag/CeO_2) nanocomposites at room temperature under visible light irradiation. The doping of silver nanoparticles improved the photocatalytic properties of the material as theyact as an electron sink, which traps the photo-generated electrons to stabilize the charge separation and diminish the charge recombination. Among the various compositions, Ag/CeO_2 (AC-5, containing 5 wt % Ag NPs) gives a maximum conversion rate of 86%. Furthermore, the stability and heterogeneity of the photocatalyst through recycling experiments have been studied, confirming the absence of active metal leaching during photoreactions by ICP analysis. Moreover, after five cycles, the silver content in therecovered photocatalyst remained consistent with the fresh catalyst, highlighting its potentialas an eco-friendly and efficient means of converting CO_2 into valuable chemicals.

Keywords: CO2 utilization; Photocatalysis; Linear carbonates

Abstract ID: EE-OP211

Enhanced Biodiesel Production from *Catalpa speciosa* Oil: Harnessing the Synergy of Ultrasonic Reactors and CaO/Zeolite Catalysts

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Abstract
This study is driven by the need for efficient and sustainable methods of biodiesel production from different and novel lipid sources. For the current work underutilized *Catalpa speciosa* (Northern Catalpa) oil is chosen. The potential synergies between an ultrasonic reactor and a catalyst composed of calcium oxide (CaO) loaded onto zeolite derived from Bagasse Fly ash in the context of biodiesel production was investigated. The practical determination of the optimal precursor concentration used in the impregnation of zeolite was analyzed. The resulting CaO/zeolite catalyst was subjected to comprehensive characterization using classical techniques FT-IR, SEM-EDS and XRD. Subsequently, the characterized catalyst in synergy with the ultrasonic reactor to optimize and model the biodiesel production process was also harnessed. Through experimentation and the use of central composite design, the optimum conditions for biodiesel production, with independent variables including CaO/zeolite amount (8% wt./vol), methanol/oil ratio (15:1), and reaction time (90 mins) were obtained. Under these optimized conditions, a remarkable biodiesel yield of 97.56% was obtained, which had demonstrated the synergistic collaboration between the reactor and the synthesized catalyst yielding an exceptionally efficient biodiesel production method. Furthermore, the current research highlighted the ease of the catalyst separation from the reaction product and its potential for multiple reusage cycles when operated under the optimal conditions. This had paved way for an economically viable and sustainable route for the production of efficient biodiesel.

Keywords: Zeolite; Central composite design; Biodiesel; Ultrasonication

Abstract ID: EE-OP212

Optimization of Novel Symbiotic Bacteria in Algae Growth

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Abstract
In this study a novel symbiotic bacteria (*Stenotrophomonas maltophilia)* isolated from algae culture and it has been cocultured with *Chlorella pyrenoidosa* and *Scenedesmus abundans* in 3N BBM+V medium at aseptic condition. Further, the optimization study was carried out to maximize the growth of algae biomass. To identify the independent parameters such as bacterial inoculum concentration, pH of the medium, and aeration rate of culture system and other known parameters were temperature, light intensity, inoculum volume of algae and culture time were kept constant. Thus, the effect of bacterial inoculum concentration study was done by varying 0, 2, 4, 6, 8 and 10 %. Same as the initial pH of the medium has been done by the changing medium pH via buffer solutions. Aeration rate of the culture system was the foremost important stage to know the actual outcome of the product. Therefore, to determine the influence of aeration rate in the system, different ranges of volumetric oxygen rates were varied as 90, 80, 70, 60, 50, 40, and 30 %. The results shown the optimal value of 8 % bacterial inoculum concentration, 7 pH of the medium, and 90 % aeration rate for maximum lipid yield.

Keywords: *Stenotrophomonas maltophilia*; Algae; *Chlorella pyrenoidosa*; *Scenedesmus abundans*

Abstract ID: EE-OP213

Radiation Risk Mitigation for Pioneering Space Exploration

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Abstract
The growth of space operations, including satellites, space tourism, lunar and Martian missions demand an all-encompassing strategy for radiation risk mitigation. Galactic Cosmic Rays (GCRs) and Solar Energetic Particles (SEPs) pose unique threats. GCRs, chronic and fluctuating are High-Z High-Energy (HZE) particles. Solar activity affects GCR intensity due to Solar Wind (SW) variations on an 11-year cycle. Passive shielding is the prevailing and practical defence against GCRs and SEPs. However, it's not reliable; some materials, like metals, can increase radiation exposure. Shielding effectiveness is based on electron and nuclear interactions. Cosmic Shielding Corporation (CSC) leads the field in comprehensive space radiation risk mitigation.

Utilizing a customized NASA MAG4 program, CSC forecasts Solar Energetic Particles(SEPs), solar flares and CMEs providing a crucial 48-hour lead time. Precise radiation transport simulations within spacecraft components, crew quarters, and electronics enable damage assessment. Regarding CSC Solutions reference to reducing space radiation, we came up with the most efficient spacecraft materials are UHMW (Ultra High Molecular Weight) polyethylene composite, RFX-1. They excel in strength, thermal control, ballistic resistance, low flammability, and high melting point; withnearly triple the Ultimate Tensile Strength (UTS) of typical alloys. In essence, this abstract underscore the vital need for a comprehensive radiation risk mitigation strategy in space exploration in prediction, shielding and structural reinforcement.

Keywords: Galactic Cosmic Rays (GCRs); Solar Energetic Particles (SEPs);RFX-1; Space safety

Abstract ID: EE-OP214

Employing Cadmium Nitrate as a chemical catalyst to sequester carbon

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Abstract
This endeavor looked into the interactions between catalysts and the numerous chemical processes in which they could be used. The goal of this endeavor was to reduce CO_2 in the chemical environment. The specialized attention to various catalytic activities was given to study their various combinations for percentage reduction in the emitted CO_2. Cadmium Nitrate was treated by hydrothermal reaction based on the multiple acid ligands. Cadmium Nitrate as a single compound led to small amount of CO_2 absorption. It was further physically treated by photocatalyst Titanium dioxide (TiO_2) to increase the reaction rate and therefore leading to increased amount of CO_2 absorption, as Titanium dioxide is still the most efficient photocatalyst due to its high specific surface. Based on several parameters that were needed, catalyst was evaluated and lastly it was noted that carbon was sequestered in the desired sample.

Keywords: Carbon dioxide reduction; Catalysis; Cadmium nitrate; Photocatalyst titanium dioxide TiO_2

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Abstract ID: EE-OP216

$NiCo_2O_4/MnO_2$ Microsphere as Efficient Bi-functional Electrocatalyst for Zinc-air Battery

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Abstract
Microsphere-like $NiCo_2O_4/MnO_2$ composite was synthesized via hydrothermal route as an efficient bi-functional electrocatalyst for oxygen electrocatalysis reactions and as air cathode for zinc-air battery (ZAB) application. The as-synthesized $NiCo_2O_4/MnO_2$ revealed versatile oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) kinetics, showcasing a half-wave potential of 0.77 V for ORR and an overpotential of 341 mV for OER under a current density of 10 $mA.cm^{-2}$. The double layer capacitance for $NiCo_2O_4/MnO_2$ was experimentally calculated to be 31.67 $mF.cm^{-2}$, indicating high electrochemical activity of the synthesized composite. The as-assembled ZAB device using $NiCo_2O_4/MnO_2$ cathode in 6 M KOH electrolyte delivered an open circuit voltage of 1.48 V, maximum power density of 126.95 $mW.cm^{-2}$ at a current density of 191.8 $mA.cm^{-2}$, along with a high specific discharge capacity of 756.62 $mAh.g^{-1}$ at a current density of 5 $mA.cm^{-2}$. The ZAB demonstrated excellent stability during 200 hours (600 cycles) of charge-discharge cycling at 5 $mA.cm^{-2}$, experiencing an almost negligible loss in voltaic efficiency (~1.58%). Furthermore, the practical utility of our $Zn//NiCo_2O_4/MnO_2$ battery was also examined by lighting a 2 V light emitting diode for 20 hours using two ZAB device in series. The present work paves the way for practical implementation of ZABs using Ni-Co-Mn-based cathodes.

Keywords: $NiCo_2O_4/MnO_2$; Zinc-air battery; Oxygen electrocatalyst

Abstract ID: EE-OP220

Formulation, Physicochemical and Antimicrobial Evaluation of Herbal Soaps of *Solanum Lycopersicum* and *Tagetes Erecta*

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Abstract
Skin disorders are major public health issues as they significantly affect both individuals and communities. As more unsafe synthetic chemicals are being added to skin care products, these skin illnesses are occurring more frequently. Herbal medicines are now being used as cosmeceuticals for a various skin condition due to their antimicrobial, antioxidant, and anti-inflammatory characteristics. Market data indicates an increasing trend in the herbal cosmetic business. The present work involves the formulation of herbal soaps by *Solanum Lycopersicum fruit* and recycled *Tagetes Erecta flower* and evaluation of their pH, foaming ability, emulsification, and anti-microbial properties of formulated soaps. The cold saponification process, which involves reacting oils with sodium hydroxide solution (lye solution), was utilized to produce herbal soaps. The pH and form-forming abilities of the synthesized herbal soaps were compared to the commercial herbal soaps. It is confirmed by the findings that the above-mentioned plant species might be used to make herbal soap in an efficient manner. When used against E. Coli bacteria, the formulated herbal soap showed inhibitory activity. The activity of in house developed herbal soap and commercial herbal soap against E. coli was found to be almost equivalent.

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Keywords: Antimicrobial activity; Herbal soap; Cosmetic industry; Synthetic chemicals

Abstract ID: EE-OP222

Light Assisted Coupling of Phenols with CO_2 to 2-Hydroxy- benzaldehydes Catalyzed by g-C_3N_4 /NH_2-MIL-101(Fe) composite

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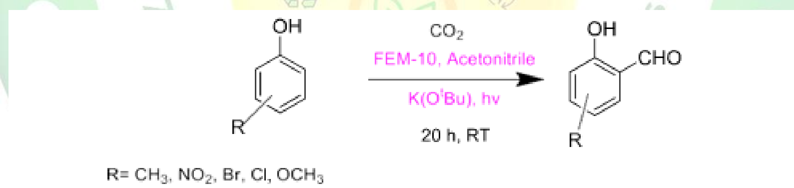
Abstract
Salicylaldehyde, a key precursor to a variety of medicinal compounds, is synthesized by heating phenol and chloroform in the presence of alkali using the Reimer-Tiemann reaction. Owing to the growing environmental concerns, the synthesis of chemicals from CO_2 is gaining considerable interest. In the present study, we have developed a graphitic carbon nitride/NH_2-MIL-101(Fe) composite for the light-assisted synthesis of 2-hydroxy benzaldehydes selectively from the reaction of phenols with CO_2 in acetonitrile solvent under visible light irradiation at atmospheric pressure (Scheme 1).[1] showed maximum efficiency prepared photocatalyst (FEM-10) was characterized by various characterization techniques such as XPS, HRTEM, FESEM, XRD, Raman and BET etc.[2] The synergistic combination of both components was found to be active for the efficient conversion. The reaction was found to be very slow using the individual components of the developed hybrid photocatalyst. The salient features of the developed methodology are mild operating conditions, highly stable and reusable photocatalysts, higher to excellent product yields, and broad substrate scope. Furthermore, the developed photocatalyst FEM-10 is easily recyclable and reused for the subsequent five runs without any loss in activity.



Scheme 1: Photocatalytic coupling of phenols with CO_2

Keywords: Photocatalysis; Fe-MOF; CO_2 reduction; g-C_3N_4

Abstract ID: EE-OP223

A review of various techniques for Carbondioxide capture – to reduce global warming

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Abstract
Accumulation of carbon dioxide (CO_2) in the troposphere is increasing speedily which has a greater impact on climate changes and causes global warming. CO_2 capture by post combustion techniques is gaining

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importance nowadays. CO_2 capture and storage (CCS) technologies for CO_2 capture, transfer and deposition, separation, seepage, investigation and life process analysis were reviewed. Post combustion techniques are discussed in this work. Adsorption by activated carbons derived from biomasses, fibers, cherry-based carbon, resins, amine functionalized, magnesium oxide loadings are discussed. Adsorption with zeolites, graphene, nanocomposites of graphene and various biomasses are discussed with their adsorption capacities. Various electrochemical CO_2 capture techniques are discussed relevant to their energy consumption, current efficiency and current densities, as these techniques find viable in electrified industries. CO_2 sequestration by biological means with corresponding algae are discussed. CO_2 capture by membrane techniques is studied with their CO_2 permeability values. This was tailed by an examination of diverse modules grounded on modelling and simulation. Finally future prospects in this area were discussed.

Keywords: CO_2; EOR; Adsorption; Electrochemical; Biological; Membrane and modelling

Abstract ID: EE-OP224

Experimental Investigation on Products Yield through Slow Pyrolysis of Biomass in a Fixed Bed Reactor

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Abstract
The economy and population are both rapidly expanding, which is leading to daily increases in energy use. In order to fulfil the demand brought on by the growth in global energy consumption, new energy sources must be sought for. The numerous biomass products, such as biomass created from local agricultural waste or biomass derived from tree leaves, may be reliable sources of energy. There is a lot of potential for converting biomass into energy using thermochemical conversion processes. Pyrolysis is a form of heat conversion that occurs without oxygen and has been regarded as a sustainable technology because of its cheap cost and ease of use. In this study, dried tree leaves were slowly pyrolyzed in a pilot scale fixed bed reactor. The primary goal of this work was to examine how changing the temperature and heating rate affected the output of gas yields, so that it may be used to upgrade to hydrogen later on. The temperature range for the operation was 400–600°C. The experiment's findings demonstrate that product yields are influenced by temperature and heating rate. For instance, the maximum char and gas yields under isothermal conditions were 43.66% at 400℃ and 39.38% at 600℃ respectively, while under non-isothermal conditions they were 53.62% at 400℃ and 35.60% at 600℃ respectively. According to the findings, slow pyrolysis under non-isothermal conditions works well for producing char, whereas slow pyrolysis under isothermal conditions is appropriate for producing gas yields.

Keywords: Biomass; Thermochemical conversion; Slow pyrolysis; Fixed bed reactor

Abstract ID: EE-OP225

Innovative Strategies for Sustainable Lignin Recovery from Black Liquorin Cellulose Manufacturing

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Abstract
Black liquor, a byproduct of the cellulose manufacturing process, contains lignin fragments in addition to various organic and inorganic compounds, including sulphur. Traditional methods for lignin recovery entail acidification to reduce pH, filtration, and drying. However,this procedure emits Total Reduced Sulphur, necessitates a significant amount of acid for filtrate washing, and slows down filtration rates.
To resolve these challenges, innovative approaches emerge. Total Reduced Sulphur can be effectively separated by fractional distillation, hydrogen sulphide can be converted to thiosulfide via enzymatic conversion, and mercaptans can be converted to hydrogen sulphide via hydrotreatment. In addition, separated hemicellulose can endure microbial degradation, resulting in the production of useful acids such as acetic, formic, lactic, and oxalic acid. These acids serve as pre-acidifying agents, enhancing lignin precipitation's purity and decreasing acid consumption. In addition, the exothermic reaction between base and acid generates heat, which acceleratesthe coagulation and filtration of lignin. However, a powerful acid is still required for the acidification process. The present work highlights the significance of developing sustainablelignin recovery methods, reducing environmental impact, and improving the efficacy of the pulp manufacturing industry.

Keywords: Black liquor; Lignin recovery; Sustainability; Environmental impact; Pulpindustry

Abstract ID: EE-OP226

Use of Heterogeneous Nanocatalyst for the Production of Biodiesel from Sewage Sludge

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Abstract
Municipal sewage sludge of particle size below 425 µm has been utilized as the feed stock for biodiesel production. Titanium di-oxide (TiO_2) was used as the heterogeneous nanocatalyst. Size of TiO_2 nanoparticles was found to be in the range of 80-150 nm and shape of the nanoparticles was spherical in nature. Different parametric studies of transesterification reaction such as catalyst dose, reaction time, temperature, and methanol to solid ratio (MS ratio) has been done. Transesterification of sewage sludge was conducted in the presence of different catalyst dose such as 0.5, 1, 3, 5, 7, and 10%. Reaction was continued for 10, 20, 30, 40, 50, 60, 70, and 90 min. Optimum value of catalyst dose was found to be 5% and reaction time was 20 min. Reaction was tested at different temperature such as 30, 40, 50, 60, 70, 90^{0} C and optimum value was found to be 40^{0} C. Different MS ratio was maintained 5:1, 10:1, 20:1, 30:1, 40:1, 50:1, 60:1 and the optimum value was identified as 50:1.

Keywords: Biodiesel; Sewage sludge; Titanium di-oxide; Nanomaterials; Heterogeneous Catalyst; Transesterification

Abstract ID: EE-OP227

Waste to Energy

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Abstract
The primary methods for disposing of solid waste are open dumping and landfills, which have adverse environmental impacts such as air pollution, water and soil contamination, and contributions to climate change. In recent years, solid waste management has become a critical issue for state and local authorities due to limited landfill space. Consequently, converting solid waste into energy is an effective approach to address space constraints while minimizing pollution and costs through energy recovery. Many countries have adopted waste-to-energy technologies, including incineration, gasification, pyrolysis, and anaerobic digestion, to reduce waste volume and generate renewable energy. These technologies play a vital role in the circular economy, helping meet future clean energy demands. The study's focus is on assessing the current state of solid waste management practices in India and delving into the country's solid waste-to-energy programs. By embracing eco-friendly waste-to-energy solutions, India and other nations can mitigate the environmental impacts of traditional disposal methods while advancing towards sustainable, energy-efficient practices.

Keywords: Waste-to-energy; Sustainability; Renewable energy; Waste management

Abstract ID: EE-OP228

Characterization of Biochar obtained from a Pilot Scale Biomass Gasifier

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Abstract
Biochar, a carbon-rich, highly porous substance derived from the pyrolysis of biomass under oxygen-deprived conditions, boasts a versatile range of applications. Today, its utility spans across agriculture, water purification, carbon storage, livestock nutrition, energy generation, and more. However, achieving a comprehensive understanding of biochar is paramount for optimizing its performance. Key aspects of biochar characterization include particle size and surface area analysis, chemical and elemental composition, spectroscopic examination, assessment of hydrophobicity, and determination of thermal stability.
The characterization of biochar plays a pivotal role in tailoring this material to meet specific requirements in various environmental and agricultural scenarios. This research endeavor sheds light on the characterization and morphological structure of dry leaf biochar produced from a pilot-scale biomass gasifier operating within a temperature range of 600-700ºC. The biochar samples were subjected to various analytical techniques, including bomb calorimetry to determine calorific value, precision density analysis to measure density, proximate analysis to evaluate composition, and scanning electron microscopy for a detailed exploration of microstructure and morphology.
A thorough understanding of these properties not only enhances our capacity to harness the potential of biochar but also ensures its efficacy in diverse applications. Properly characterized biochar has the potential to positively influence soil fertility, improve water quality, and contribute to carbon sequestration efforts. In essence, the comprehensive characterization of biochar is a fundamental step toward realizing its full potential as a multifaceted solution for addressing various environmental and agricultural challenges.

Keywords: Biochar; Proximate analysis; Bomb caloriemetry; SEM

Abstract ID: EE-OP230

Study on the Properties of Products Obtained from Direct Liquefaction of the North eastern Indian Coals

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Abstract
In the current study, alternating petroleum fuel production potential of three Northeastern Indian coals was investigated by direct liquefaction (DL) The freshly mined coal samples were procured from Margherita Coalfield, Assam (MG), Bakulia, Assam (AB) and Bapung of Jaintia Hills, Meghalaya (MB). Detailed physicochemical characteristics of all the collected samples were studied. The AB coal was found of lignite grade and the other two (MB and MG) were of bituminous grade. In a 200ml batch reactor tetralin (THN) was used as the solvent in a 1:3 coal to solvent ratio with 3MPa N_2 initial pressure to perform non-catalytic runs. The experiments were performed at 400°C and 450°C at 10°C/min heating rate with 1-hour residence time. The obtained products were characterized as water, oil, asphaltene, preasphaltene, gas and char (solid residue) based on their solubility in various solvents such as hexane for oil, toluene for asphaltene and tetrahydrofuran for preasphaltene along with gas, water, and char (solid residue). The gases were analyzed using GC–TCD (Thermal Conductivity Detector) and FID (Flame Ionization Detector) detectors. The liquid products were analyzed by using FTIR (Fourier Transform Infrared Spectroscopy), ^{1}H and ^{13}C NMR (Nuclear Magnetic Resonance Spectroscopy), and GC–MS (Gas Chromatography – Mass Spectroscopy). The porous structure and surface morphology of the char was studied using FESEM (Field Emission Scanning Electron Microscopy).

Keywords: Direct Coal Liquefaction; Product Characterization; Lignite; Bituminous; Tetralin

Abstract ID: EE-OP231

Advanced Energy Storage Solutions: Innovative Approaches to Microencapsulation of Phase Change Materials

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Abstract
Phase change materials (PCMs) represent a significant advancement in thermal energy storage systems, offering the capacity to absorb or release energy as needed by a system. Their applications span a wide range, from building and textile industries to electronic devices and heat management in batteries. PCMs are favored for their exceptional attributes, including high energy storage density, cost-effectiveness, reusability, minimal interference with the system, and suitability for various temperature ranges. However, the application of PCMs often encounters challenges related to leakage and interaction with the external environment. To address these issues while preserving the thermal energy storage capabilities of PCMs, microencapsulation has emerged as a promising containment technique. It ensures the safe encapsulation of PCMs, preventing leakage and maintaining their performance. Numerous physical and chemical methods have been developed for producing microcapsules with robust mechanical strength and stability. However, none of these methods can provide Microencapsulated Phase Change Materials (MEPCMs) with all the

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desired properties. There is a pressing need to innovate and design MEPCMs with enhanced structural stability and prolonged service life for more effective utilization. Furthermore, existing techniques can be improved through modifications such as the incorporation of nanoparticles and other binding materials, enhancing the overall properties of MEPCMs.

Keywords: Phase Change materials; Microencapsulation; Energy storage systems

Abstract ID: EE-OP236

Comparative Studies on Fuel Characteristics of Diesel with Pyrolysis Oil from Waste Tire, Pumpkin Seed Oil and Binary Blends

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Abstract
Alternate fuels are the emerging trends towards sustainable energy production and also to meet the ever-increasing energy demand in an environmentally friendly way. In this study, fuel properties of diesel, tire oil, pumpkin seed oil and binary blends (diesel-tire oil, tire oil-pumpkin seed oil and diesel-pumpkin seed oil) were studied. Tire oil was extracted through a pyrolysis process at a temperature of 450°C and was further purified with fractional distillation. Pumpkin seed oil is prepared using methoxide and sodium hydroxide (NaOH) as a catalyst. For binary blends, proportions of 10%, 20% and 30% (by volume) of tire oil and pumpkin seed oil were blended with diesel to study the parameters. The properties tested in this investigation were density, viscosity, API Gravity, higher and lower heating value, smoke limit, flash point, fire point, aniline point, pour point, cloud point, sulphur and carbon residue and characterization of the fuels by FTIR showed that the properties of oil blends found to have better quality than the pumpkin seed oil but inferior to the properties of diesel. Binary blends of oil showed similar properties compared to the individual properties of oil but not as vital as the former.

Keywords: Diesel; Tire oil; Binary blends; Pyrolysis; Fuel properties

Abstract ID: EE-OP237

Study in interfacial adhesion bonding between ethylene vinyl acetate and photovoltaic backsheet varying the structural composition

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Abstract
Solar photovoltaic (PV) module can be defined as a multi-layered structure, which possesses optimum interfacial bonding and adhesion at different layers for reliability and durability over 25 years in field. Ethylene vinyl acetate, copolymer of ethylene and vinyl acetate, performs interfacial adhesion at different interfaces of glass, silicon cell and back sheet in the PV module. However, decay in adhesion strength in EVA due to field aging has been studied well. In this investigation, different PV grade EVA films have

been fabricated containing vinyl acetate content (18%, 24%, 33%, and 40%) and laminatebetween two layers of backsheet. Backsheet/EVA/Backsheet laminates are subjected to the damp heat (85^{O}C, and 85% RH) aging for 1000 hours to examine the alternation in adhesion strength due to moisture. T-peel adhesion test, degree of crosslinking, Fourier transform infra-red spectroscopy (FTIR), and thermogravimetric analysis (TGA) are performed. The adhesion strength for EVA films containing 18% VA content has been improved while, it deteriorates for EVA with 40% VA content after 1000 hours of DH aging.

Keywords: EVA encapsulant; Damp heat aging; Interfacial adhesion strength

Abstract ID: EE-OP240

Studying the effect of different parameters on hydrogen yield and energy optimization by simulation using DWSIM

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Abstract
Hydrogen is considered to be one of the most demanding sources of energy. One of the most promising features of hydrogen gas is that it can go through combustion for the production of electricity. The methods for hydrogen production are electrolysis, gasification, steam methane reforming. These simulations allow engineers and researchers to analyze factors like reaction kinetics, temperature, pressure, and catalyst performance to improve process efficiency and reduce costs. By utilizing simulation tools, the hydrogen production industry can develop more sustainable and economically viable methods for producing this crucial clean energy carrier. In the present study, the hydrogen production process has been simulated using DWSIM and effect of feed temperature and outlet temperature on reactant conversion in a Gibbs reactor has been studied. Energy calculations have also been performed in the software.

Keywords: Hydrogen yield; Outlet temperature; EED energy; DWSIM

Abstract ID: EE-OP241

Abstract Harnessing the Potential of Gas Hydrate Technology to Address the Current Challenges of Clean Energy and Climate Change

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Abstract
There is the sudden surge towards the development of exotic materials to counter the adversities caused by the enhanced frequency and scales of climate activities across the globe. It is clear that the time window is narrowing down with every passing year and yet there is no real solution exists which can be replicated on mass level. On the top this crisis, there is ever growing consumer demand of products which are ultimately

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contributory factors towards the global warming. The difficult times are yet to be faced and may cause the irreparable losses to the Humankind and life on earth.
Under the mentioned serious threats, the potential of the Gas hydrates and their exploration to counter the challenges of Clean Energy and Climate Change will be addressed. The engineering solutions to the existing problems with the minimal carbon foot-print and effective, sustainable and replicable in the form of technology will be discussed in great detail and the economical perspectives will also be summarized. At present, there is not known technological venture correlating the Gas hydrate technology for the climate action and address the global challenges. Investigating the full potential of gas hydrates, in particular for the use of gas hydrate technology in India, with the goal of meeting the current issues of clean energy and climate change and imagining the future in which it could be implemented.

Keywords: Gas hydrate technology; Clean energy; Climate change; UNSDG; IPCC; Carbon and hydrogen economies

Abstract ID: EE-OP244

AI application to save energy in chemical industry

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Abstract
The application of Artificial Intelligence (AI) to conserve energy in the chemical industry emerges as a pivotal frontier, addressing sustainability challenges and optimizing operational efficiency. This talk encapsulates the profound impact of AI on energy management within chemical engineering, delineating key strategies and outcomes.
AI-driven systems leverage advanced analytics and machine learning algorithms to meticulously analyze and optimize energy-intensive processes. Real-time monitoring of equipment performance and energy consumption enables precise adjustments, minimizing inefficiencies and enhancing overall operational energy efficiency. Predictive maintenance models further contribute by identifying potential issues before they escalate, averting energy wastage due to equipment failures.
Furthermore, AI facilitates the development of intelligent control strategies that adapt to dynamic operating conditions, ensuring optimal energy utilization across diverse manufacturing processes. The integration of smart sensors and automation enables continuous data collection, empowering engineers to identify areas of improvement and implement targeted energy-saving measures.
As a seasoned chemical engineering professional in the industry, this talk underscores the transformative role of AI in reshaping energy management practices, fostering sustainability, and fortifying the chemical industry's commitment to resource-efficient operations.

Abstract ID: EE-OP245

Applications of Industrial Gases in the Refining, Chemical and Petrochemical Industries

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Abstract
Industrial Gases like Hydrogen, Syngas, Nitrogen, Oxygen, Argon and CO2 are widely used for various applications in the Chemical and Steel industry. Huge quantities of hydrogen gas are required in petroleum

refineries for hydrotreating of fuels for Sulphur reduction (e.g., less than 10 ppmv Sulphur in Diesel as per Euro-VI fuel standards). Syngas which is a mixture of Hydrogen and CO is widely used as a building block for various chemicals like Ammonia, Methanol, MTO, DME, Ammonium Nitrate, oxo-alcohols, SNG, etc. Syngas can be produced either by steam methane reforming or by partial oxidation of Natural Gas or by gasification of coal / petcoke. IGCC plants produce Syngas for power generation which is environmentally clean. Nitrogen is widely used as an inert gas for blanketing, purging, food preservation, as a transportation gas, for accelerated cooling, etc. Oxygen has wide applications in Petrochemicals like oxidation (e.g., EO/EG) and liquefaction processes, to produce syngas and in air enrichment in the combustion process in the refining industry. Also, for pH control in wastewater treatment. CO_2 has wide applications in production of beverages, food preservation, production of fertilizers like Urea, fire extinguishing chemicals, etc. Oxygen, Nitrogen and Argon are also widely used for Steel production. Argon is used as a shielding gas for welding purpose. Industrial gases touch our lives in every way for various applications as explained.

Abstract ID: EE-OP246

Biomass Conversion to Biochar and its Implications on Carbon Sequestration and Climate Change

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Abstract

Several agricultural residues and other carbonaceous wastes (food processing, railroad ties, biosolids, etc.) can be converted to stable biochar through pyrolysis. The biochar can be used as a soil amendment and in several other applications, thus facilitating carbon sequestration. Otherwise left alone to degrade, biomass will lead to biogenic methane, about 25 times more potent global warming gas than carbon dioxide. During the pyrolysis, bio-oils, syngas, and sensible heat can be recovered, making the process commercially viable. Biochar has excellent potential to achieve carbon dioxide removal and helps realize net-zero or net-negative greenhouse gas emissions reduction goals. The biochar approach is a viable climate change mitigation option. This presentation will be an overview of the conversion of several biomasses (agricultural and other hardwoods) into biochar, many applications of biochar, and its climate change mitigation potential.

Abstract ID: EE-OP247

Gasification of coal, and petcoke with the addition of biomass wastes like coconut and banana in a fluidized bed reactor

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Abstract

The current work conducted gasification experiments with coal, petcoke, and coconut and banana waste mixtures. Blends of biomass substances, namely coconut shell, coconut husk, and banana peduncles, were

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prepared with the mentioned carbon-based fuels, and the gasification performance was evaluated based on the product syngas quality. During the experiments, operating parameters, namely solid feed rate, steam/O2 ratio, feed particle size, and gasification reactor temperature, were kept constant in a bench-scale externally heated fluidized bed gasifier. A thermal conductivity detector (TCD) based gas chromatograph (GC) was applied to measure gas yield and distribution of composition profile. Biomass materials showed an enhancement in the syngas quality for both the coal and petcoke samples, especially in cold gas efficiency (CGE) and carbon conversion efficiency (CCE), with 80/20 blends compared to the coal and petcoke only. The product hydrogen yield and combustible gas concentrations were also increased. The solid residues of different gasification experiments were characterized and analyzed by scanning electron microscopy-energy dispersive X-ray analysis (SEM-EDX) and field emission-scanning electron microscopy (FE-SEM) analytical techniques. The presence of alkali and alkaline earth metals (AAEMs) highlighted the catalytic effect of these elements during the gasification experiments. The current research work aimed to demonstrate the utilization of biomass waste materials such as coconut and banana waste sustainably and synergistically with conventional fossil fuels, especially coal, and petcoke.

Keywords: Coal; Petcoke; Biomass; Fluidized Bed; Syn-gas

Abstract ID: EE-OP248

Petroleum Refining Challenges & Technological Solutions for achieving Net Zero Target

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Abstract
In the upcoming scenario of energy transition & to achieve Net Zero target, petroleum refineries are in need of technologies which can enable diversification of product portfolio, integration of alternative feedstock, reduce emissions, promote circularity etc. IndianOil in its endeavor to provide solution and show the path to global refiners, has developed several game changing products and processes which can aid in achieving Net-Zero targets. IndianOil's Eco-friendly Plastic to Fuel Technology - INDEcoP2F is one such enabler which aids conversion of solid waste plastic in a petroleum refinery. In addition to solid waste plastic processing, IOCL has also developed process for co-conversion of circular pyrolysis oils & Bio-oil in a petroleum refinery. Advanced Coker Technology Ind-Coker^{AT} has been developed to reduce the coke yield from a conventional Delayed Coker Unit to solve the Pet Coke disposal issue. Diversification of product portfolio by producing Needle coke, a niche carbon material having wide ranging applications in Steel industry and EV batteries is another crucial initiative which can help in ensuring readiness for the future. This talk shall cover various initiatives which can enable smooth achievement of sustainability goals & Net Zero target.

Keywords: Net Zero; Energy Transition; Sustainable Environment; Circularity; Technologies

Abstract ID: EE-PP4

Decoration of Spherical Sb_2S_3 Over CuO Nanoflakes for Efficient Photoelectrochemical Hydrogen Generation

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Abstract
Developing an efficient photocathode system from earth abundant materials is essential for effectual Photoelectrochemical (PEC) water splitting. Charge transfer between heterojunctions is important in fabricating a novel composite, keeping cost-effectiveness, abundance, and PEC performance in mind. The p-type narrow band gap CuO-based photocathode synthesized by hydrothermal method, was decorated with Sb_2S_3 by adopting a facile chemical bath deposition (CBD) to fabricate efficient CuO/Sb_2S_3 heterojunction. Fabricated heterojunction shows better PEC performance contrary to exposed CuO. Improved photocurrent density (J_{ph}) of CuO/Sb_2S_3 compared to CuO is attributed to enhanced charge carrier generation/separation. The CuO/Sb_2S_3 shows higher J_{ph} (-1 mA.cm^{-2}) than CuO (-0.3 mA.cm^{-2}) photoelectrode at 0 $V_{RHE\ in}$ 0.5M Na_2SO_4 (pH 6.85). Sb_2S_3 works as a sensitizer, diminishing the recombination rate of the e^-/h^+ in the CuO. UV-Visible and photoluminescence (PL) emission spectra results suggested CuO/Sb_2S_3 composite with enhanced absorption spectrum and reduced rate of recombination in CuO/Sb_2S_3 compared to pristine CuO. Electrochemical impedance spectroscopy studies show less charge transfer resistance for CuO/Sb_2S_3 than CuO. This finding will pave a new path in developing novel photocathodic material configurations and composites with Cu-based binary oxides/chalcogenides, which is challenging to synthesize due to inbuilt restrictions with materials and experimental constraints.

Keywords: PEC; Hydrogen generation; Photocathode; Solar harvesting; Photocathode

Abstract ID: EE-PP9

Preparation of Alumina Supported Nickel Catalyst via ESI Method and Hydrogenation of Benzene

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Abstract
The petrochemical industry has focused on developing new catalysts and the processes for the saturation of benzene. By saturating aromatics, the fuel ignition quality and cetane number improved, leading to better combustion of fuel. The present study focuses on Al_2O_3 supported Ni catalyst synthesized by Excess Solution Impregnation (ESI) technique and study the hydrogenation reaction employing the synthesized catalyst and varying the catalyst dosage (0.2 to 1.0wt %) Ni/Al_2O_3, temperature, pressure and weight hour space velocity (WHSV). The catalysts and supports were characterized by SEM, TEM, BET, EDX, H_2 -TPD, TPR, XRD and HRTEM techniques. The H_2 -TPD study expressed that the Ni/Al_2O_3catalyst stored hydrogen with an amount of expecting with the nickel particle size. It was noticed that the hydrogenation of benzene on supported nickel catalysts is a structure-unresponsive reaction. So, it is assumed that the utilization of the ESI method decision makes a sequence of nickel catalysts, as well as but not imperfect to spongy nickel, vital fixed bed catalysts for the petrochemical industry.

Keywords: Benzene Hydrogenation; Ni/Al_2O_3 catalysts; ESI method

Abstract ID: EE-PP10

Coal syngas to Methanol: CSIR-CIMFR initiatives

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Abstract
Methanol has received considerable attention as a possible future clean fuel, suitable energy storage material, and building block material for other chemicals and can be produced from a wide variety of feedstocks, e.g., coal, biomass, and natural gas. Alternatively, methanol can be easily converted to dimethyl ether (DME), which is considered a substitute for petrol and diesel. It can also produce olefins, a precursor product used to manufacture plastics. Similarly, the high demand for methanol fuel would push the overall demand for methanol several folds, much beyond the demand for methanol as an intermediate for chemicals. India is the second largest producer of coal in the world. The large reserve of coal and a limited reserve of natural gas /petroleum crude fostering towards coal as an attractive raw material for the production of methanol. This has a huge impact on India, potentially relieving the pressure on importing liquid fuel requirements, provided a suitable indigenous technology is developed based on high ash coal to methanol. NITI Aayog (GoI) initiated the "Methanol Economy" program, which aims at reducing oil import bills and minimizing greenhouse gas (GHG) emissions. In this connection, CSIR-CIMFR has already developed a 1.5 TPD oxy blown PFBG pilot plant, which is to be integrated with a syngas to methanol pilot plant with a capacity of 250 kg methanol/day. Several experiments (Temp. range: 200-240^{o}C, Pressure range: 40-60 bar) have been carried out in a 100 ml fixed bed tubular reactor using syngas having composition equivalent to syngas obtained from 1.5 TPD PFBG gasifier after cleaning and conditioning. The observed total carbon conversion towards methanol is 30-40 %, and methanol selectivity is > 98%.

Keywords: Methanol; Pressurized fluidized bed gasifier; Octane number; Syngas

Abstract ID: EE-PP11

Two Stage Thermal Catalytic Conversion of Polyethylene into Gas Fuel

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Abstract
Gas Fuel (hydrogen and light olefins) production from waste plastics is an important alternative for managing waste plastics. Hydrogen is an energy carrier that can be utilized in various applications and clean transportation fuels without emissions. In contrast, light olefins are a basic building block of chemical industries and are used in synthesizing high-value products. Low-density polyethylene (LDPE) waste has become the second-largest plastic waste in Municipal Solid Waste (MSW) after Polypropylene (PP). This work addresses a promising technology for co-producing light olefins in addition to the production of hydrogen from LDPE. Catalyst design is a critical factor to control the production of hydrogen and light olefins. 3d transition metals modified alumina catalysts were used for gas fuel production from Polyethylene (LDPE). It was found that the Mn-Al_2O_3 catalyst with the lower Mn content shows higher depolymerization and dehydrogenation rate of LDPE, resulting in a higher yield of hydrogen and olefins obtained. The reaction was conducted in a two-stage semi-batch reactor at atmospheric pressure, and influences on the yield of hydrogen and light olefins derived from LDPE are reviewed in relation to the different 3d metals and molar ratio, Carrier gas flow, Catalyst feed ratio used for gas fuel growth and the influence of operational parameters.

Abstract ID: EE-PP14

Numerical Investigation of Heat Transfer Enhancement in Heat Exchangers Using CFD

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Abstract
The growing demand for energy consumption in industrial sectors has made designers to build effective heat exchangers. This paper entails design as well as CFD analysis of heat exchangers by considering different flow arrangements namely counter current and co-current and by changing the geometry which includes multi-tube pass with baffles, fin tubes and U-tube with and without baffles heat exchangers. These exchangers are evaluated on the basis of pressure drop and thermal performance. Numerical simulations are carried out on ANSYS Fluent software. Multi-tube pass with baffles has shown 145% more heat transfer than the counter-current pathway of the 1-shell 1-pass heat exchanger considering same area and heat transfer coefficients. It has been analyzed that U-tube heat exchanger with two baffles is 4% more efficient than U-tube heat exchanger without baffles. Moreover, the flow patterns in laminar and turbulent flow regimes for plain and wavy fins has been studied for fin-tube heat exchanger, where the wavy fin staggered configuration is likely to provide better heat transfer compared to the wavy fin inline configuration. Additionally, it is found that, reduction in the mass flow rate decreases the convective heat transfer coefficient on the shell side which leads to a higher outlet temperature.

Keywords: Heat exchanger; multi-tube pass baffles; Fin-tubes; Vortex; LMTD

Abstract ID: EE-PP16

Mechanistic Investigation of Ultrasound-Assisted Saccharification of Lignocellulose Biomass: Using Molecular Docking and Molecular Dynamics Simulations

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Abstract
Enzymatic saccharification is the main step for bioethanol fuel production from lignocellulose. This study attempts to give mechanistic insight into ultrasound-assisted enzymatic hydrolysis of lignocellulosic biomass using molecular docking and molecular dynamics simulations. The physical effect of ultrasound-assisted treatment leads to depolymerization of the lignin matrix. The chemical pretreatment generated free radicals causes oxidation or hydroxylation of aromatic moieties and elimination of side chain and ultrasound also reduces the use of chemicals for pretreatment. Saccharification of lignocellulosic biomass using ultrasound-assisted therapy enhanced the production of sugar for the production of bioethanol fuel. Molecular docking results revealed the mechanism of protein-ligand complex interaction and its interacting amino acid residues surrounding the active site, and MD simulation analysis showed the RMSD, RMSF, and H bonds interaction. This study has provided a better understanding of the enzymatic hydrolysis of lignocellulosic biomass for bioethanol synthesis and its enzyme-substrate complex interactions during enzymatic hydrolysis.

Keywords: Enzymatic hydrolysis; Ultrasound-assisted; Molecular Docking; Molecular Dynamics and Simulation (MD Simulation)

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Abstract ID: EE-PP17

Ultimate Degradation of Plastic Waste

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Abstract
Plastic has played a significant role in our modern society and offers several important benefits. While it's important to acknowledge the hazards associated with plastic waste. Plastic waste and its accumulation pose significant hazards to the environment, human health, and wildlife. Therefore, there is a need to search for a potential solution that could help in the bio degradation of synthetic polymers. Certain microorganisms are capable of degrading plastic. This process of degradation of plastic can change the situation of the plastic problem in our environment with a high impact. In this the advancements in the degradation of plastic using microorganisms, metabolism that occurs inside microorganisms and various studies on bio degradation of plastic were discussed. According to previous research done scale up of the process to solve the problem of plastic in the environment, limitations and possibilities of overcoming those limitations was also discussed.

Keywords: Plastic waste; Bio degradation of synthetic polymers

Abstract ID: EE-PP18

Development of highly efficient electrocatalyst derived from ZIF-67 for the synthesis of green ammonia from Nitrate

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Abstract
Ammonia is not only a crucial component in nitrogen-based fertilizers to ensure food security but also serves as a versatile energy carrier with efficient storage and transportation capabilities. The traditional Haber-Bosch process dominates industrial ammonia production but requires harsh reaction conditions, and generates significant CO_2 emissions. Recently, the electrochemical synthesis of ammonia from nitrate is regarded as one of the green and promising alternatives to the traditional Haber-Bosch process. This is a "two birds with one stone" approach that facilitates wastewater treatment while generating ammonia. In this work, we developed a binder-free, self-supported, low-cost electrocatalyst with high surface area derived from the pyrolysis of Zeolitic imidazolate framework (ZIF-67) to a carbonized nanowall (CNW) structure which acts as a promising electrocatalyst for the reduction of NO_3^- to ammonia. This study also explores the profound impact of carbonization levels of CNW and highlights the crucial significance of in-situ nitrogen doping on carbon substrate for ammonia synthesis. The prepared catalyst shows a high yield rate of 5177.35 $\mu g\ h^{-1} cm^{-2}$ at -0.3 V Vs RHE and a faradaic efficiency of 96.2 % at -0.2 V Vs RHE. This work will provide new insights and open avenues for future electrocatalyst development.

Keywords: Electrocatalysis; ZIF-67; Haber-Bosch process; Green ammonia
Abstract ID:EE-PP19

Development of non-noble metal nitride for hydrogen evolution reaction

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Abstract
Enormous population growth and intense usage of natural energy resources like fossil fuels has led the world to global energy crisis and environment pollution, which demand our immediate attention. Hydrogen can be considered as the most promising clean energy resource with zero-carbon emission and highest gravimetric energy density (145 MJ/kg). Green Hydrogen can be produced by electrochemical water splitting with the help of an electrocatalyst. To date, noble-metal based catalysts are frequently used as electrocatalyst, but their high cost and low abundance limits their use in practical areas. So, developing efficient non-noble metal based electrocatalyst is of crucial importance. Recently, transition metal sulfides, nitrides, phosphides have emerged as the electrocatalyst with high performance. Herein, we have synthesized binary NiMo nitride (NiMoN) grown over carbon cloth (CC) via a facile hydrothermal method followed by nitridation. In this case not only the NiMo oxide phase is converted into the nitride phase but also multiple nitride phases (Ni_3N, Mo_2N, etc.) are created after dealloying the parent NiMo oxide. The as-developed heterophase NiMoN exhibits an excellent catalytic activity toward the hydrogen evolution reaction (HER) the cathodic part of water splitting with an overpotential of only 65 mV and Tafel slope of 81 mV dec^{-1} in alkaline condition.

Keywords: Green hydrogen; Electrochemical water splitting; Electrocatalyst; HER

Abstract ID: EE-PP20

Diligence of carbohydrates for sustainable industrial applications towards value added products generations in bioenergy and environmental sectors

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Abstract
Carbohydrates and its derivatives have been considered as very pivotal feedstocks towards value added products generations as industrially viable and sustainable way out. Nature provides immeasurable quantities of carbohydrate-based resources with unique bio-physico-chemical features. The massive usages of harmful and toxic raw feedstocks have been impacted on medical sciences, energy sectors and environmental arenas. Hence, this current scenario has initiated the necessity to attain an alternative approach for developing environmentally benign and cheaper raw feedstocks which are none other than carbohydrates and its associated derivatives. Moreover, carbohydrates and its associated derivatives are available plenty as a major outcome of plant metabolic biosynthetic pathways. Natural carbohydrates include cellulose, hemicellulose, starch, chitin, pectin, alginate, and chitosan etc. Carbohydrates and its associated derivatives do have multi facet perspectives and prospects in different research areas including bioleaching, bioremediation, nanobiotechnology, medical sciences, nutrient recycling, food technology, vaccine development, bioenergy generation and many more. Based on this scenario the current study deals with extensive summarization on different carbohydrates having its biosynthesis, functionalization, and application towards sustainable industrial applications for addressing issues in medical sciences, energy sectors, and environmental arenas including value added biomolecules generations with special emphasis on metabolic engineering and synthetic biology.

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Keywords: Carbohydrates; Industrial application; Sustainability; Value added product; Plant metabolism; Metabolic engineering; Synthetic biology

Abstract ID: EE-PP21

Thermodynamic and experimental study of selective oxidation of methane into methanol using Cu/CeO_2 catalyst

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Abstract
Methane is one of the most abundant resources of fuel on earth; however, due to difficulty in its transportation, efficient utilization of methane has become a challenging task. As methane is also a greenhouse, its leakage from pipeline networks makes methane utilization even more problematic. Conversion of methane into liquid fuel such as methanol can be an attractive solution for these problems.

Industrially, methane to methanol conversion is done by a two-step process. First, methane is converted into syngas and then syngas is converted into methanol. The first step of this process is very energy and capital-intensive. To make the conversion of methane into methanol more economical, a single step process is required. In this study, direct selective oxidation of methane to methanol under gaseous conditions on a non-noble based catalyst, Cu/CeO_2 catalyst, which was prepared using a sol-gel method, was investigated.

Along with experimental studies, a detailed thermodynamic equilibrium calculation was also performed using DWSIM software that solves the isothermal equilibrium state of the gas mixture based on Gibbs free energy ionization. The equilibrium conversion of CH_4 and product distribution was calculated at molar ratio (CH_4/O_2) of 2,5 and 10 while the pressure varied from 1 to 50 bar. Similar condition was adopted for experimental studies also.

Keywords: Methane; Methanol; Gas-to-Liquid, Catalyst; Gibbs reactor; Catalyst

Abstract ID: EE-PP22

Two-dimensional layered nanomaterial for electrocatalytic degradation ofemerging pharmaceutical pollutant

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Abstract
Emerging pharmaceutical pollutants in wastewater have become a significant environmental concern due to their potential adverse effects on ecosystems and human health. The present study employs a two-dimensional layered nanomaterial for the electrocatalytic oxidation of a specific pharmaceutical pollutant. The pharmaceutical pollutant for the study will be chosen based on its widespread occurrence in wastewater and potential persistence in conventional treatment processes. The desired properties of the layered nanomaterial, such as its large surface area and electron transfer capabilities, will enhance pollutant degradation efficiency. Overall, the study will highlight the potential of using electrocatalytic oxidation in the presence of two-dimensional layered nanomaterial to degrade emerging pharmaceutical pollutants in wastewater efficiently.

Keywords: Electrocatalytic oxidation; Wastewater treatment; Pharmaceutical pollutant

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Abstract ID: EE-PP28

Cadmium based Metal Organic Framework for the recovery of Palladium from Aqueous Medium

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Abstract
The safe management of radioactive nuclear waste and the rising demands of industry necessitate the recovery of palladium from high level liquid waste. The expanding field of metal organic frameworks with customizable functionality may offer a practical solution to the problem of extremely effective palladium extraction. In this present study, cadmium-based MOF using linker 2-amino benzene dicarboxylic acid was synthesized using solvo-thermal route for the efficient recovery of Pd(II) from the aqueous solution. The characterization of the synthesized MOFs was performed using FT-IR, powder-XRD and TGA. Sorption studies were performed at various pH conditions. The synthesized MOF exhibited maximum sorption of 57% at pH 3.

Keywords: Metal-organic-frameworks; Palladium extraction; DFT

Abstract ID: EE-PP29

Solvent extraction and complexation studies of *N, N, N', N'*-tetradodecyl diglycolamide with trivalent metal ions from nitric acid medium

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Abstract
N, N, N', N'-tetraoctyldiglcolamide (TODGA) in *n*-dodecane is one of the accepted solvents for the separation of trivalent metal ions from high level liquid waste. However; it is more prone to form third phase when contacted with high concentrations of nitric acid/trivalent metal ion. Several studies have been done to increase the third phase formation limit, among which structural modification like elongation of alkyl chain have been demonstrated to be successful. So, the present study explores the use of higher chain homologue of TODGA, namely the *N, N, N', N'*-tetradodecyldiglcolamide (TDdDGA) for the extraction of nitric acid and trivalent metal ion in TDdDGA/*n*-DD, along with the aggregation behavior of the extracted phase. The results revealed that, TDdDGA/*n*-DD is a promising extractant with higher phase formation limit, and with similar extraction ability towards trivalent metal ions like TODGA/*n*-DD. Further, the complexation behavior of Nd (III)-TDdDGA complex in the extracted organic phase was probed by ATR-FTIR spectroscopy. The detailed results shall be discussed in the presentation.

Keywords: Diglycolamides; Dynamic light scattering; FTIR spectroscopy; Nd (III) extraction; Aggregation

Abstract ID: EE-PP30

Recovery of metal ions from simulated high-level liquid waste by solvent extraction using *N, N*-didodecyl-*N', N'*-dihexyl diglycolamide/*n*-dodecane

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Abstract
A systematic investigation on the extraction of various metal ions present in the simulated high level-liquid waste (SHLLW) was carried out in *N, N*-didodecyl-*N', N'*-dihexyl diglycolamide (D^3DHDGA)/*n*-dodecane. It is important to determine the distribution ratio of all the metal ions present in SHLLW to understand the selectivity of the extractant towards the target metal ion in the presence of other metal ions. It was found that the distribution ratios of most of the metal ions were decreased during their extraction from SHLLW, compared to their extraction from 4 M nitric acid individually. This could be due to the co-extraction of other metal ions that are competing with the target metal ion for the extraction into organic phase. Other metal ions like Zr (IV) and Y(III) exhibited very high extraction tendencies even from SHLLW, and metal ions like Sr (II), Pd (II) were extracted to a significant extent. Hence, aqueous soluble complexing agent, CyDTA was added to reduce the co-extraction of unwanted metal ions. Our results on these extraction studies clearly indicated the higher affinity of the extractant, D^3DHDGA towards trivalent f-ions from SHLLW without leading to any third phase formation, which demonstrates the promising nature of the solvent for the partitioning of minor actinides from HLLW.

Keywords: Distribution ratio; High level-liquid waste; Extraction, Actinide; Third phase

Abstract ID: EE-PP32

Extraction and stripping behavior of lower concentration of U(VI) with 1.1 M TBP/n-DD with annular centrifugal extractor

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Abstract
PUREX process is the widely employed solvent extraction technique for the recovery of uranium and plutonium from spent nuclear fuel. In this process a 1.1 M solution of Tri-n-butyl phosphate (TBP) in n-dodecane (n-DD) is used as a solvent phase for the extraction of U(VI) and Pu (IV) in a 16-stage annular centrifugal extractor in counter-current mode. In the present study, the extraction behavior of U(VI) (1 g/L) in 1.1 M TBP/n-DD was studied followed by a stripping or recovery run as per plant flow-sheet conditions. The extraction and striping experiments were carried out for 102 and 97 minutes respectively. The concentration of U(VI) and nitric acid in both organic and aqueous phases was estimated in all stages. From nitric acid concentration profile, it is noted that the steady state was attained in both extraction and stripping experiments. From the U(VI) concentration stage profile quantitative extraction of U(VI) is observed in three stages, during striping the recovery of U(VI) was not completed even in eight stages. The observed experimental results were further supported by the SEESPEC solvent extraction code developed for reprocessing of spent nuclear fuel by PUREX process.

Keywords: Solvent extraction; Uranium; Centrifugal extractor; Tri-n-butyl phosphate

Abstract ID: EE-PP34

Risk Assessment of Chemical Plant Containing H2S Chlorine and Ammonia

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Abstract
Chemical process industries normally handle bulk amount of chemicals in storage, process,transport etc. These chemicals are normally found toxic, flammable and corrosive. If propersafety precautions are not taken these chemicals may lead to fire, toxic dispersion or loss of integrity of the vessels. Sometimes after leakage of these flammable chemicals may disperseand form airborne this air borne gases due to confinement gets detonated and cause chemicaldisaster. Hence consequence analysis of the toxic and flammable chemicals is necessary to establish the mitigating measures and adhere safety regulations. After release of chemicals, it not only affects the human being, it also affects the environment.
The study has been carried out on release of H2S from chemical plant where H2S is used in the isotopic exchange process. The consequence analysis of 2" outlet pipeline postulated release studied at different process conditions and weather condition were studied to understand the effect of each parameter. The study helps to find out emergency preparednessand the safety system required for mitigation due to accidental release.

Keywords: Consequence analysis; H_2S release; Emergency preparedness; Mitigation,ALOHA, Toxic chemical dispersion

Abstract ID: EE-PP35

MICROPLASTICS: An emerging contaminant in air pollution study

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Abstract
Plastic is the most widely used product in our daily life because of its durability, malleability,lightweight, and economical nature. Initially, it was the better option for reducing greenhousegas emissions indirectly by preventing trees and other energy requirements. But now, it has been found that in the process of abrasion/breakdown, plastics fragments in the form of microfibers, microbeads, fragments, or foams, which are called microplastics (MPs) and reach different environments, including air, water, and soil. The size of the MPs is less than5 μm; this small size can easily uplift from the wind action and reach into the air. In the present study, we investigated the presence of MPs in the air at various selected sites in Varanasi. The high-volume samplers were used for the collection of the air samples. The samples were digested in 30% H_2O_2 at 70 for 1 hour. The visual and morphological identification were done using binocular microscopy and SEM analysis. For further identification, FTIR and Raman spectroscopy were done. A significant concentration of MPswas detected in the samples, which is a concern for human and animal health, and also a greatchallenge to emerging air pollution contaminants in the form of MPs.

Keywords: Microplastics; Emerging contaminants; Greenhouse gas emissions; FTIR; SEM; Raman microscopy

Abstract ID: EE-PP36

Thermo-Catalytic Direct Oxidation of Methane into Methanol using Fe/ZSM5 Catalyst

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Abstract
Methane, a primary component of natural gas, is an abundant and under-utilized energy resource. Apart from being an energy source, it is also a harmful greenhouse gas. It has 30 times the global potential to that of CO_2. One of the major problems associated with methane use is that it requires a large pipeline infrastructure. Industrially, methanol is produced by an indirect method in which methane is first converted into syngas and then syngas is converted into methanol. The first step of this indirect method is highly endothermic, making this process uneconomical. However, direct or single-step methane-to-methanol conversion can address this challenge. In this work, a single-step direct oxidation of methane into methanol is studied using a 2wt.%Fe/ZSM5 catalyst. Initially in the reaction, there is very low conversion of 0-1% is observed with a very low production of methanol. For this purpose, catalyst is prepared using the dry impregnation method. The activity test for this reaction was done at a temperature of 500℃ and a pressure of 5 bar. To further study this reaction, a thermodynamic equilibrium study was also performed at different operating conditions using DWSIM software. The equilibrium product composition was calculated at different CH_4/O_2 =2, 5 and 10; Pressure =2, 30 and 50 bar.

Keywords: Thermo-catalyst; DWSIM; Methanol; Energy resource

Abstract ID: EE-PP38

Advances in 3D-Printed Electrodes for Electrochemistry

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Abstract
Recently, 3D printed electrodes have gained significant attention in the field of electrochemistry due to their versatility, customization capabilities, and potential for innovative designs. Traditional electrode fabrication methods can be limited in terms of shapes, sizes, and materials. 3D printing, on the other hand, offers the ability to create complex and precise electrode structures, opening up new possibilities for various electrochemical applications. The ability to create tailored structures with enhanced properties has opened doors to novel applications in sensors, energy devices, and catalytic systems. This review paper highlights the recent advancements and prospects of 3D printed electrodes for various electrochemical applications.

Keywords: 3d Printing; Electrodes; Electrochemistry; Sensors; Energy storage; Electrocatalysis

Abstract ID: EE-PP39

Integrated design of methane steam reformer and methanol synthesizer: Perspective on hydrogen and methanol production

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 ISBN: 9789310 000719

Abstract
This paper proposes an integrated approach for the simultaneous production of hydrogen and methanol from natural gas (methane). Hydrogen is generated from methane via steam reforming employing a Palladium (Pd) membrane reactor, enhancing the reaction equilibrium while selectively permeating hydrogen. A portion of the produced hydrogen is then utilized for methanol synthesis by reacting it with CO_2, resulting in a value-added product i.e., methanol. Moreover, the water byproduct from methanol synthesis is efficiently recycled to fulfill the steam requirements in the methane steam reforming process. This integrated scheme demonstrates a promising pathway for efficient and controlled production of hydrogen and methanol with effective utilization of CO_2. In this study, a framework for simulation and economic optimization of the proposed integrated process is presented.

Keywords: Hydrogen; Methanol; Methane steam reforming; Palladium membrane reactor; Methanol synthesis; Economic optimization

Abstract ID: EE-PP43

Study on the Storage and Recovery of Hydrogen from Carbonate Reservoirs and the Effect of Residual Oil Saturation

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Abstract
Hydrogen has emerged as a promising renewable alternative for addressing our energy needs and advancing towards the goal of achieving net-zero carbon emissions. Large scale generation of hydrogen is a way forward to the storage of renewable energy and securing the energy economy for a future perspective. Within this context, underground hydrogen storage in depleted reservoirs, saline aquifers and salt caverns have garnered increasing attention due to its potential to securely and cost-effectively store hydrogen on a large scale. However, a primary challenge in the domain of hydrogen geo-storage lies in achieving efficient hydrogen extraction from porous media after extended storage periods. In an ideal scenario, the volume of hydrogen recovered should equal the volume initially injected. Due to their abundance and suitability of geological features for storage, carbonate formations, once served as a source of fossil fuels are being explored as potential sites for the geo-storage of hydrogen. Although there are many wettability studies on carbonate rock to find out interactions of rock-brine-hydrogen, there are limited studies on the interactions of stored hydrogen with the residual oil saturations. The presence of residual oil saturations in depleted reservoirs can lead to the unintentional recovery of undesirable quantities of oil alongside the hydrogen. Therefore, comprehending how the remaining oil in these reservoirs interacts with stored hydrogen, and how this interaction impacts storage efficiency and subsequent hydrogen recovery, is of paramount importance. Hence, this study concentrates on the effect of residual oil saturations in depleted carbonate reservoirs on the storage efficiency and recovery of hydrogen. The experiments include wettability studies, recovery studies and saturation studies under in-situ conditions. The influence of varying residual oil saturations, soaking periods, and injection pressures are also examined. This study provides both qualitative and quantitative insights into the hydrogen trapping efficiency as well as effective recovery from depleted carbonate reservoirs.

Keywords: Hydrogen geo-storage; Carbonate reservoir; Residual oil saturation

Abstract ID: EE-PP45

Machine Learning-Guided Optimization of Biofuel Blends for Enhanced Engine Efficiency and Emission Reduction

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Abstract
India heavily relies on imported foreign crude oil, prompting the need for effective solutions to reduce this dependency. One such solution is the blending of Bio Diesel, Palm oil, and Ethanol with original diesel. The crucial concern lies in determining the optimal blending ratio that maximizes Engine Efficiency while maintaining reasonable levels of Oil Consumption and NOx emission. To address this, experimental data are collected from the paper [1] which systematically blend biodiesel. Experimental data involved three input parameters [Load, Palm Biodiesel, Ethanol] and three output parameters [Motor Brake Thermal Efficiency (BTE), Brake Specific Fuel Consumption (BSEC), and Nitrogen Oxides (NOx)], with 40 different runs. The prediction was accomplished using 26 Machine Learning Models, including Gaussian Process Regression, Support Vector regression, ANN, Tree and Linear Regression and others. Among the 26 models considered in the analysis, three models emerged as the top performers. The Stepwise Linear Regression Model [SLRM] yielded the highest Brake Thermal Efficiency (BTE), the Fine Tree Regression Model [FTRM] achieved the lowest Brake Specific Energy Consumption [BSEC], and the Matern 5/2 Gaussian Process Regression Model [MGPRM] demonstrated the lowest Nitrogen Oxide (NOx) emission. These models displayed a range of Root Mean Square Error (RMSE) and Rsquared(validation) values: 0.02077–0.02333 and 0.99 for SLRM, 0.03789–0.03907 and 0.98 for FTRM & 0.02184–0.02296 and 0.99 for MGPRM. Moving forward, a multi-objective optimization approach has been undertaken to simultaneously maximize BTE while minimizing both BSEC and NOx emissions. To accomplish this, a Multi Objective Genetic Algorithm [MOGA] is employed to identify the Pareto Optimal Solution. The optimization process [MOGA] resulted in a series of 18 Pareto Optimal Solutions. These solutions provide insights on the appropriate blend ratios of Load, Palm Biodiesel and Ethanol in order to maximize Engine Thermal Efficiency while minimizing Fuel Consumption and NOx emissions.

Keywords: Palm biodiesel; Engine thermal efficiency; Machine learning model; Multi Objective Genetic Algorithm [MOGA]; Pareto optimal solutions; Efficient optimization

Abstract ID: EE-PP49

Analysis of Natural Radioactivity and Radon concentration level in Building material

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Abstract
This abstract summarizes a study on the analysis of natural radioactivity and radon concentration levels in building materials collected from the Pune region. The research investigates the presence of radioactive elements within these materials and assesses the associated radon gas emissions. By employing advanced analytical techniques like gamma ray spectrometer and Smart RnDuo radon detector, the study provides insights into potential health hazards and radiation exposure risks posed by building materials commonly used in construction. The findings contribute to a better understanding of indoor air quality and safety in residential and occupational environments.

Keywords: Radon concentration; Gamma-ray spectrometer; Smart RnDuo radon detector; building materials

Abstract ID: EE-PP51

Harvesting of energy from real wastewater using micron-scale Microbialfuel Cell.

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Abstract
The development of an effective small-scale MFC for energy generation from different types of real wastewater for energy generation is necessary. An innovative miniature MFC with a crosslinked membrane was developed, using a microfabrication technique unique with structural features like a heart-shaped flow channel which has increased its power density and biofilm growth along with COD removal efficiency. The advantage of developing Micron scale MFC devices for energy harvesting is portable power supplies especially when connected in series to achieve increased voltage and power. It can act as a small robot where the tummy of the robot will be filled with wastewater and also for power devices like mobile phones. Miniatured MFC has got its applicationsin heavy metal detection in wastewater.

Keywords: Miniature microbial fuel cell; Real wastewater; Poly (vinyl alcohol); Chargeseparator

Abstract ID: EE-PP52

Production of benzoic acid reference material for calorimetry analysis

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Abstract
Reference materials are of critical importance and indispensable for calibration of instrument, method validation, accuracy of analytical results, quality control and quality assurance of products and processes. Academic institutes, industries, R&D organizations and science & technology sectors of India are extensively utilizing reference material for their day-to-day work. Mostly they are procuring the SI traceable Certified Reference Materials (CRMs) from international CRM producers. Benzoic acid is used as a reference material (RM) for calorimetry analysis such as in bomb calorimeter instrument for calibration. This reference material is hugely used in our country for gross calorific value (GCV) analysis. In this work we have developed Benzoic acid reference material (RM) for calorimetry analysis and studied the homogeneity and stability test. The indigenous benzoic acid RM development would contribute up to certain extent in "*Aatmanirbhar Bharat*" mission and "*Make in India*" initiative.

Keywords: Reference material; Benzoic acid; Gross Calorific Value; Bomb calorimeter; Calibration; Analytical testing

Abstract ID: EE-PP53

Doping of Group V Elements in CdSeTe Solar Cells: A DFT Approach

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Abstract
The CdTe solar cell is recognized as the most effective and economical thin-film solar cell technology in recent decades with an unprecedented energy conversion rate of more than 22%. It is economically viable against silicon modules and over 25 GW of solar energy systems implanted throughout. A significant effort has been done by the researchers to replace copper doping in CdTe with group V compounds like phosphorus, arsenic, antimony and bismuth. According to the study, incorporation of group V elements in CdSeTe can compensate for Cu doping shortcomings. In this report, we have examined the incorporation of group V elements in CdSeTe solar cells by using Density Functional Theory approach. Geometry optimization of CdSeTe as well as CdSeTe doped with group V elements are performed with Gaussian 16. Optimization of these systems are performed by using functional Local Spin Density Approximation (LSDA) with basis set LANL2DZ. Highest Occupied Molecular Orbital (HOMO) – Lowest Unoccupied Molecular Orbital (LUMO) energy gap of CdSeTe and doped-CdSeTe are calculated. The result shows that incorporation of group V elements enhances the physico-chemical properties as well as stability of the host system.

Keywords: CdSeTe; Density functional theory; HOMO-LUMO energy gap

Abstract ID: EE-PP54

Production of energy from infrared rays

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Abstract
The following study describes about the benefits of extraction of infrared rays using infrared house which consists of a proper arrangement of quartz panels as quartz is a very efficient absorber of infrared rays. Secondly, it is a very highly affordable material. Since,we know that due to our present lifestyle,the ozone layer that surrounds the atmosphere of our planet, Earth jis getting depleted day by day due to continuous emissions of chloroflurocarbons(CFCs) causing the infrared rays to enter into the Earth's surface. The production of energy from infrared rays typically involves using materials or devices that can convert infrared radiation into usable energy, such as electricity. This process is often achieved through technologies like thermophotovoltaics, where infrared radiation heats up a material, generating electron-hole pairs to produce electricity. Additionally, some solar panels can capture a portion of infrared radiation along with visible light to generate electricity. However, the efficiency of these methods can vary, and research in this field continues to develop more efficient and practical solutions for harnessing energy from infrared rays.Thus, all the above things mentioned above can help in the production of energy from the infrared rays coming from the Sun.

Keywords: Quartz; Efficient; Absorber; Affordable; Ozone; Emissions; Chloroflurocarbons; Thermophotovoltaics; Electricity; Efficient

Abstract ID: EE-PP55

Unleashing the potential of plastic waste for hydrogen and value-added carbon production via thermocatalytic route

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Abstract
Producing hydrogen from waste plastics represents a valuable alternative for waste management. This study explores a promising approach that not only generates hydrogen but also yields value-added carbon, thereby substantially enhancing the economic viability of the process. The key determinant for controlling hydrogen and carbon production is the design of the catalyst. Fe-Al_2O_3 and Ni-Al_2O_3 catalysts, synthesized via wet impregnation method, with varying metal molar ratios, were used with different plastic types in a fixed-bed reactor. The results revealed that Ni-Al_2O_3 catalysts produced a greater carbon yield (approx. 40-50 wt.%) compared to Fe-Al_2O_3 catalyst. Further, both the catalysts promoted hydrogen formation ranging between 50-60 wt%. Gas chromatography was performed to analyze the gaseous components, particularly hydrogen. XRD and Raman spectra confirmed the deposition of carbon on the catalyst surface which can be recovered and utilized in other applications. The conversion of plastic waste through thermocatalytic route offers a potential solution to both plastic pollution and the need for clean energy sources.

Keywords: Carbon; hydrogen; plastic waste; pyrolysis, waste management

Abstract ID: EE-PP56

A Hybrid Hydrogel Approach for the Design of N, S-Dual Doped Porous Carbon Catalyst for Electrochemical Oxygen Reduction Reaction

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Abstract
Design of Platinum group metal (PGM) free catalysts is highly essential for large scale commercialization of fuel cell technology. Among the various PGM-free approaches, heteroatom (B, N, S, P etc.) doped porous carbon catalysts also called metal free catalysts are unique and easy to synthesize. These metal free catalysts are customarily synthesized using exfoliated graphene. In this work, we have developed a hybrid hydrogel composed of poly-pyrrole and thiophene as the precursors to design a N, S-dual doped porous carbon catalyst. The hybrid hydrogel was pyrolized at 800 / 900 / 1000℃ in nitrogen flowing atmosphere followed by acid wash to remove residual chemicals and then dried under vacuum to obtain the final catalysts. The catalysts were characterized by XRD, SEM, TEM, XPS, BET, Raman followed by evaluation of their electrocatalytic activity for oxygen reduction reaction (ORR) in 0.1M KOH. The porous carbon nature was confirmed from XRD and SEM with uniform elemental distribution. The chemical state of the elements was confirmed from XPS. The defect rich structure was evident from the Raman spectroscopy. The electrochemical performance of the catalysts as evident from the CV and LSV curves indicates characteristic ORR peak at 0.75V with an $E_{1/2}$ of 0.70V vs RHE respectively.

 ISBN: 9789310 000719

Keywords: Electrocatalyst; PGM; ORR; Metal free catalyst

Abstract ID: EE-PP57

Surface Modification of Fe-K/CNT Catalysts for the Production of Light Olefins via CO2 Hydrogenation

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Abstract
The development of effective carbon dioxide (CO2) hydrogenation catalysts is essential towards the quest for mitigation of greenhouse gas emissions via CO2 utilization through sustainable decarbonization pathways for platform chemicals production. This study focuses on the surface modification of carbon nanotubes (CNTs)-supported-iron (Fe) nanoparticles for increased CO2 hydrogenation via Fischer-Tropsch synthesis. To maximize the catalytic performance of CNTs, the surface chemistry of these materials was modified through functionalization. The influence of KOH activation on the textural properties (pore size and surface area) and olefins selectivity were studied by varying the KOH concentration, stabilization temperature, and Fe loading in the range of 0.8-1.2 M, 600-800°C and 10-20 wt.%, respectively, using the Central Composite Design method in Design Expert ®. Upon KOH activation, the micro-porosity of CNT was enriched which improved the Fe dispersion. The physico-chemical properties were extensively characterized by N2-physisorption, XRD, Raman, TEM, XPS and Mossbauer spectroscopy. Preliminary catalytic performance evidenced the potential of these catalysts in the enhancement of the FTS process, resulting in improved C2–C4 = productivity. This study emphasizes the value of specifically designed surface chemistry in CNT-based catalysts and their ability to power sustainable CO2 conversion pathways, providing encouraging possibilities for a greener future.

Key words: Olefins; CNT; Fischer-Tropsch; CO2 utilization; Hydrogenation; Catalysts

Abstract ID: EE-PP59

Influence of Riboflavin on Microbial Desalination Cell Performance

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Abstract
Accumulation of brine and high energy consumption are major challenges of desalination. Microbial desalination technology utilizes energy provided by the metabolism of electroactive bacteria to degrade organic matter. The aim of the present study was to investigate the influence of riboflavin on microbial desalination cell (MDC) performance on power generation, desalination efficiency and COD removal. The results revealed that riboflavin supplementation significantly enhanced MDC performance across multiple parameters. The addition of riboflavin in the anodic chamber led to improved power generation, with the highest efficiency observed at a concentration of 20μM RF, and has times increased current generation efficiency. The highest COD removal was noted in MDC with 30 μM RF, 4.4 times the highest COD value than the MDC without riboflavin, due to the increased microbial activity. This suggests that riboflavin plays a crucial role in promoting organic matter degradation and microbial activity, resulting in efficient organic

compound breakdown and reduction in COD. The findings clearly demonstrated the positive impact of riboflavin supplementation on MDC performance, offering valuable insights for the development of sustainable and efficient desalination systems.

Keywords: Microbial desalination; Riboflavin; Fuel cell; Water treatment

Abstract ID: EE-PP62

Recent Advancements in Polymer Recycling Technologies

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Abstract
The persistent global challenges related to polymer waste have driven substantial innovations in polymer recycling technologies. This paper presents a comprehensive overview of cutting-edge advancements in both mechanical and chemical recycling methodologies. While mechanical recycling has been revitalized through enhanced sorting and purification techniques, ensuring improved quality of recycled materials, chemical recycling offers transformative solutions by breaking polymers into their foundational monomers, enabling high-grade reuse and potential upcycling. A key highlight includes the emergence of innovative catalysts facilitating efficient depolymerization processes, paving the way for a broader spectrum of recycled polymer applications. Furthermore, the application of artificial intelligence in streamlining and optimizing recycling processes is discussed, showcasing its potential in revolutionizing polymer waste management. The paper also addresses the integration of design principles focused on recyclability, ensuring a lifecycle approach to polymer usage. By mapping the current trajectory of advancements in the field, this paper offers attendees a holistic understanding of the future landscape of polymer recycling, emphasizing the importance of transitioning towards a sustainable, circular polymer economy.

Keywords: Polymer waste; Mechanical recycling; Chemical recycling; Depolymerization; Circular economy

Abstract ID: EE-PP63

Influence of Evolving Consumer Behavior on Industry: A Deep Dive into Sustainable Packaging

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Abstract
In today's rapidly transforming market landscape, understanding consumer behavior is paramount for businesses to remain competitive. One prominent shift observed in recent years is the growing inclination towards sustainable packaging, reflecting the wider societal emphasis on environmental consciousness. This study aims to elucidate how such behavioral modifications are molding industry trends. Preliminary research indicates that an increasing number of consumers are prioritizing eco-friendly packaging solutions, compelling businesses to innovate and adapt. Consequently, industries are witnessing a surge in investments in research and development to find sustainable alternatives to traditional packaging materials. Beyond mere materials, the value chain, from design to disposal, is undergoing scrutiny and transformation to reduce the environmental footprint. The ripple effects of this shift are far-reaching,

impacting raw material suppliers, manufacturers, and waste management sectors. In conclusion, as consumers become more environmentally conscious, industries are forced to evolve in tandem, thereby redefining market dynamics. This presentation will provide a comprehensive analysis of the current market trends, challenges faced by industries, and potential avenues for innovation in the realm of sustainable packaging.

Keywords: Sustainable packaging; Consumer behavior environmental consciousness; Market trends; Value chain

Abstract ID: EE-PP64

Studies on the removal of dopamine from wastewater using a metal-organic framework

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Abstract
Dopamine is a neurotransmitter released by the brain that acts as a chemical messenger in humans and animals. DOPHCL, a hydrochloride salt of dopamine is used in clinical therapies. In this study, we investigate the efficiency of Basolite (metal-organic framework) for the degradation and removal of DOPHCL from pharmaceutical wastewater using adsorption experiments. HPLC with mobile phase potassium dihydrogen phosphate (pH 2.3) and C18 column (250 x 4.6 mm, 5 µm) is employed as the analytical method for the quantitative analysis of DOPHCL in the wastewater samples before and after treatment. The research encompasses several key aspects: Firstly, different concentrations of DOPHCL are taken, and a standard amount of catalyst is added. By varying the initial DOPHCL concentrations, the influence of the catalyst on the degradation process can be elucidated. Secondly, based on the initial concentration study results, a specific DOPHCL concentration is selected as the standard concentration wherein the various pH values are examined. The optimum pH for enhanced degradation of DOPHCL is chosen. Lastly, keeping the optimum pH and concentration constant, the catalyst dosage will be varied to explore the influence of catalyst concentration on the treatment efficiency. Finally, the optimal dosage for maximum DOPHCL removal is identified.

Keywords: Basolite; concentration; pH; catalyst dosage; DOP-HCL; HPLC

Abstract ID: EE-PP67

Organic fraction of municipal solid waste as a renewable feedstock for biofuel and biobased materials: A circular economy approach

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Abstract

India's growing population and rapid urbanization have led to generation of enormous quantities of municipal solid waste (MSW) on a daily basis. Improper disposal of solid waste leads to significant loss of the organic fraction of MSW (OF-MSW). Although WtE conversion pathways have extensively been studied, there exists a limited understanding of the pyrolysis behavior of OF-MSW. In the present study, OF-MSW was pyrolyzed to study the effect of different operating parameters along with detailed structural, morphological, chromatographic and spectroscopic characterization of feedstock and obtained by-products. Thermo-kinetic parameters were investigated using isoconversional methods to elucidate the kinetics of the active pyrolysis zone. The reaction mechanisms were determined using the Criado master plot. Highest bio-oil yield of 29.8% was obtained at 550℃ with a heating rate of 20℃ min^{-1}. Calorific value of the bio-oil and biochar were 19.58 and 23.19 MJ/kg respectively. Bio-oil was found to contain higher amount of aliphatic and aromatic compounds. The study suggests that OF-MSW can serve as a potential feedstock for biofuels through thermochemical routes, thereby addressing the needs for second generation biofuels.

Keywords: Organic fraction of municipal solid waste; Pyrolysis; Circular economy

Abstract ID: EE-PP68

Innovative Strategies for Greenhouse Gas Mitigation and Carbon Resource Optimization: A Comprehensive Review

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Abstract
This paper presents a comprehensive review of innovative strategies and technologies to combat greenhouse gas emissions and optimize carbon resource utilization. Notably, Gas Switching Dry Reforming is highlighted as an efficient method for converting CO_2 and CH_4 into syngas, essential for gas-to-liquid synthesis. Carbon Capture and Utilization is explored as a promising approach capable of mitigating up to 3.5 billion tons of CO_2 equivalent emissions, contingent on substantial low-carbon electricity availability, projected to reach 55% of global electricity production. Furthermore, the integration of ethane dehydrogenation with CO_2 adsorption and utilization offers a promising pathway for emissions reduction. In the realm of biotechnology, microalgae's dual capabilities in CO_2 capture and high biomass productivity are examined, emphasizing the roles of biocatalysts like carbonic anhydrase and formate dehydrogenase in enhancing CO_2 solubility and facilitating Carbon Capture and Utilization. The utilization of waste compost in agriculture is also discussed, showcasing its potential to enhance grain yield, sequester CO_2, improve energy efficiency, increase economic viability, and reduce environmental impacts. In conclusion, this review provides a comprehensive overview of diverse technological advancements and research developments, offering multifaceted solutions to address global greenhouse gas emissions, promote sustainable resource utilization, and tackle critical environmental challenges. It is a valuable resource for researchers, policymakers, and industries dedicated to addressing these pressing issues.

Keywords: Greenhouse gas mitigation; Carbon resource optimization; Environmental sustainability

Abstract ID: EE-PP69

Minimizing Friction Drag for Increased Fuel Efficiency in Aircraft

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Abstract
Fuel efficiency is significant in aircraft design and operation. Among various factors while designing aircraft, aerodynamic drag greatly affects fuel consumption. Some ways of doing this involve minimising the drag profile by improving wingspan design, incorporating aerodynamic shapes, using lighter material, increasing engine efficiency, and many other factors like minimising size and number of exposed components. Drag is also caused by skin friction. This is created when airflow across surfaces is disrupted. Skin friction will then increase because of surface roughness due to surface or paint imperfections, the adhesion of dirt or dead insects to aircraft surfaces or the presence of contaminating fluids caused by leaks, spillage, or de-icing. Aerodynamic drag is overcome by thrust provided by aircraft engine by burning the fuel. Hence, reducing the drag will proportionally reduce the thrust and required fuel will be less. Among various ways to reduce aerodynamic drag, coating, or smoothing surface increase fuel efficiency. This paper throws light on cutting potential drag and raising fuel efficiency using specialized coatings for the aircraft exterior.

Keywords: Aerodynamic drag; Fuel efficiency; Smoothening surface

Abstract ID: EE-PP70

Optimization of Biogenic Supplementary Cementitious Materials in Concrete prepared from East-Indian Lemon Grass (*Cymbopogon flexuosus*) and Poultry Litter using Response Surface Methodology

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Abstract
Developing construction materials from agricultural waste as a substitute of conventional cement is receiving immense global interest in recent times, due to issues like greenhouse gas emissions and extensive energy consumption during cement production. This study aims to investigate the mechanical properties of concrete through the utilization of bio-based products prepared from East-Indian lemon grass (*Cymbopogon flexuosus*) and poultry litter as supplementary cementitious materials (SCMs). The optimization process involves Central Composite Design (CCD) based Response Surface Methodology (RSM) for modelling and statistical analyses using experimental data from the study. Analysis of variance (ANOVA) revealed the model's significance, with coefficient of determination (R^2) of 0.9956. Based on RSM analysis, concrete prepared by substituting 17.57 % of Ordinary Portland cement with SCM (which was cured for 25.82 days with a water-cement ratio of 0.54), yielded the optimum compressive, flexural and split tensile strengths of 33.94 ± 0.12, 8.78 ± 0.02 and 3.06 ± 0.02 N/mm² respectively. Furthermore, the SCM-mixed concrete exhibited enhanced durability properties. The findings also demonstrate the robustness of RSM as a significant tool for optimization of concrete performance. Characterization results of pyrolytic lemon grass bio-oil (LG-BO) confirms its bioenergy potential thereby suggesting its diverse utilization in various applications.

Keywords: Calcined lemon grass biochar; Poultry litter ash; Supplementary cementitious material

Abstract ID: EE-PP71

Life cycle assessment of Mobil composite matter (MCM) for CO_2 mitigation

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Abstract
Fossil fuel burning is the primary source of energy produced worldwide to support industrial expansion. This process continuously raises the ambient CO_2 concentration, which seriously degrades the environment's global ecosystem. The use of solid adsorbents in carbon capture technology has gained traction recently and Mobil composite matter (MCM) is seen to be one of the most suitable substitutes for the industry's current amine absorption method. In the present study the environmental effects of MCM production process is analysed using GaBi software. The primary data was collected from published literature of lab experiments. The GaBi Indian extension database is used for the secondary data source. The results are reported using CML 2001 midpoint impact assessment methods. The impact potentials such as the global warming potential, abiotic depletion potential (elements + fossil), acidification potential, eutrophication potential, human toxicity potential and ozone depletion potentials are analysed.

Keywords: CO_2; MCM; life cycle assessment (LCA); GaBi

Abstract ID: EE-PP72

Convective Heat Transfer Performance on Microporous Biphilic Surface

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Abstract
Biphilic surfaces, possessing both hydrophobic and hydrophilic properties, have gained significant attention due to their unique surface interactions and potential applications. These surfaces exhibit a combination of water-repellent and water-attracting properties, enabling control over wetting behavior and opening up new possibilities for surface engineering. This paper investigates the impact of microporous biphilic surfaces with different combinations of material on pool heat transfer. The surfaces are prepared by electrochemical deposition along with the galvanic displacement method on a copper surface. The microporous surfaces are characterized using a scanning electron microscope and contact angle is used for surface characterization. The findings reveal that the developed biphilic surfaces have significantly higher heat transfer coefficients compared to the unmodified surface, demonstrating their importance in convective heat transfer performance.

Keywords: Biphilic surface; Electrodeposition; Microporous copper structure; Graphene-oxide nanoparticles; Heat transfer coefficient

Transformation for Energy Transfer (TET)

Hydrogen Production from various routes, Storage, Transportation and its Application; Catalysts for energy conversion; Li-ion Battery; Redox Flow Battery; Electric Vehicle and its advancement; Grid Scale Energy Storage; Solar PV and Solar Thermal Energy; Wind Energy; Tidal energy; Geo-Thermal Energy; Battery Management System; Bio fuels

Abstract ID: TET-OP2

Al-doped ammonium vanadium oxide: a potential cathode material for sodium-ion batteries

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Abstract
Sodium-ion batteries (NIBs) are the other most popular electrochemical storage technology after lithium-ion systems because of their low price and abundant availability across the globe. Vanadium oxide is widely utilized as a cathode due to its distinctive layered structure and the ease with which cations may be inserted into and extracted from its framework. $NH_4V_4O_{10}$ (NVO) has a sizeable inter-planar gap and a high diffusion rate for sodium ions. We investigated this electrode as a suitable NIB cathode due to its easy fabrication and morphological investigation. A direct hydrothermal technique was used to make layered structured ammonium vanadium oxide (NVO). Here, we improved the efficiency of NVO by doping aluminium hydroxide at different mole ratios of V:Al = 10:1, 20:1, 30:1, 40:1, and 50:1 by a simple hydrothermal technique. The characterization of the prepared NVO materials was performed using X-ray diffraction (XRD), Scanning electron microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDS), and Fourier transform infrared spectroscopy (FTIR). Based on morphological tests, elemental analysis, and spectrum comparisons of samples made at varying molar concentrations, the as-prepared Al-NVO samples appeared promising as a possible high-performance cathode for SIB systems.

Keywords: Ammonium vanadium oxide; Aluminium doping; Cathode; Sodium-ion battery

Abstract ID: TET-OP3

2D Oxide Nanomaterials: Versatile Uses in Energy Transition and Storage

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Abstract
2D oxide nanomaterials are thin oxide sheets or films with thicknesses ranging from a few nanometers to a few micrometers. When two or more additional elements, such as metals or non-metals, are combined with one or more oxygen atoms, the result is an oxide. Due to their distinctive electrical, optical, mechanical, and catalytic capabilities, 2D oxide nanomaterials have received a lot of attention lately. Graphene oxide, titanium oxide, zinc oxide, and tungsten oxide are a few examples of 2D oxide nanomaterials. 2D oxide nanomaterials have found their uses in energy conversion and storage devices which include lithium-ion batteries (LIBs), sodium-ion batteries (NIBs), as well as post-lithium batteries, etc. 2D oxide nanomaterials also find their use in the fields of photocatalysis and electrocatalysis, biomass conversion, and fine chemical synthesis. Self-assembled 2D networks of metal oxide nanomaterials are also widely in use to manufacture sub-ppm level breathalyzers. The utilization of 2D oxide nanomaterials has increased significantly in the past and finds its application in various fields. This review attempts to bridge the knowledge gap by summarizing how these nanomaterials find their usage in the above-mentioned areas of study. A significant attention is paid to corresponding 3D materials which can be obtained by engineering of these 2D oxides.

Keywords: Nanomaterials; Metal oxides; Energy transition; Catalysis

Abstract ID: TET-OP4

Plasmon-enhanced photocatalytic reforming of methanol for on-board applications

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Abstract

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Green hydrogen as a fuel, produced and transported using renewable energy sources is the best option available today to mitigate GHG emissions. But the infrastructure challenge with hydrogen is monumental and raises an important question on how to carry the fuel of the future i.e., hydrogen. Liquid hydrogen carriers prove to be more economical than other material-based methods and a liquid hydrogen carrier can address the challenges associated with transporting and storing gaseous hydrogen[1,2]. Methanol is a good candidate to be used as a hydrogen carrier as it can be stored in liquid form under ambient conditions at high density (pure methanol has 99 kg of H_2 per m^3 and stoichiometric mixture of methanol/water has 107 kg of H_2 per unit volume)[3].
For FCEVs applications methanol must be reformed to hydrogen using steam which is a well-known reaction termed as steam methanol reforming (MSR). Various thermocatalytic processes for H_2 production were demonstrated. Use of these catalysts for on board application is not feasible. Researchers have tried various alternatives to carry out methanol reforming at lower temperatures and one such approach is photocatalytic methanol reforming. The current work aims on development of a system where hydrogen is chemically stored and photocatalytically reformed to hydrogen to supply to the drivetrain of a passenger fuel cell vehicle.
As a first step, three commercially available photocatalysts i.e., TiO_2, ZnO and CeO_2 will be tested for methanol reforming. And these results will be compared with plasmonic-enhanced photocatalyst (Ag/Au-TiO_2/ZnO/CeO_2). Plasmonic photocatalysts have shown promising results for multiple applications and hence seems to be a good potential for methanol reforming reaction[4]. A comprehensive comparison with commercial on-board reformers will be done to check the viability of photocatalytic on-board reforming.

Keywords: Hydrogen; Photochemical reforming; Onboard FCEVs

Abstract ID: TET-OP7

A “double” circular economy perspective towards biohydrogen postproduction treatment challenges and economics from biowaste

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Abstract
In the modern era, more than 4/5th of the hydrogen (grey hydrogen) is still produced from the conventional energy source which is natural gas by the mixing of methane with high temperature steam to give hydrogen and carbon monoxide. As the world is shifting towards sustainability and net zero emissions, biohydrogen production has been a major alternative for grey hydrogen, to make green hydrogen which also requires a lot of different types of feedstocks. The post production biohydrogen treatment methods mainly involve microbial fermentation, microbial electrolysis and photocatalytic reforming. In this study, cassava residues and rice straw are examined for fermentation of the lignocellulosic feedstock, while xylose, glucose, mannose, and galactose are examined for microbial electrolysis, and sawdust, wooden branches, rice husks, and fescue grass are thoroughly examined for photocatalytic reforming. In addition, a thorough investigation of the treatment options is conducted for wastewater (urine and faeces) as well as animal waste such as faeces and fodder waste. The paper also discusses about municipal waste for fermentative hydrogen production and industrial waste scale up strategies for continuous hydrogen generation. Theissues associated with post-treatment and the financial factors solely based on circular economy are strongly considered in this study while analysing the biomass feedstocks.

Keywords: Post production treatment methods; Biohydrogen; Lignocellulosic feedstock;Municipal waste; Industrial waste; Biowaste

Abstract ID: TET-OP8

A Review of Recent Innovations in Battery, Super Capacitors, and Battery-Super capacitor Hybrid Energy Storage Device Technologies

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Abstract

Batteries can store excess energy; however, their lower power density and low-temperature range restrict their use in some instances. Supercapacitors can be the alternative solution, lasting millions of cycles. In addition, it provides access to a broader temperature range, but its energy density is marginal compared to that of batteries. Thus, it is imperative to significantly increase the energy and power density capacities of energy storage devices. Consequently, it is possible to create a Battery-Super capacitor Hybrid device with a higher cell voltage from 3 to 4.5 V and more capacity by substituting one of a symmetric Super capacitor's capacitive electrodes for a battery electrode. The hybrid device's specific energy density will increase to 20 Wh kg^{-1}, which could match typical Super Capacitors with a power density above 10 kW kg^{-1}. This review discusses the fundamental scientific principle, structure, and classification of battery-operated semiconductors (BSHs). It reviews recent advances in various existing and emerging BSHs, such as Li-/Na-ion BSHs, acidic/alkaline BSHs, redox electrolytes, and pseudo-capacitive electrodes. It also looks at recent progress in hybrid devices with specific functionalities of flexibility and transparency and aqueous high voltage window with integrated 3D electrode/electrolyte framework.

Keywords: Electrodes; Battery; Super capacitors; Renewable energy

Abstract ID: TET-OP11

Simulation and Optimization of Sun Tracking of Floating PV System

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Abstract
Solar panels attached on a structure that floats on a body of water, often a reservoir or a lake, are known as floating solar or floating photovoltaic (FPV). Since 2016, the floating photovoltaic (FPV) market has seen substantial expansion. The rate of expansion of this industry is expected to be boosted by technological advancements and government initiatives. In 2024, technology will account for more than 31% of total employment. The floating PV system is thoroughly examined in this study. Rapid technological developments of FPV technology giving competiveness to FPV with ground-mounted photovoltaic (PV) systems. The challenges and issues regarding economic factors, environmental aspects and feasibility of FPV plants have been discussed along with key opportunities. These plants can be developed on abundant water bodies or in artificial reservoirs with single or multipleusage facility. In multiple usage facility both food and electricity can be harvested simultaneously. FPV modules reduce evaporation level from the water body but less penetration of solar radiation is a problem. Other key challenge is negative effect on the aquatic ecology which results in salt deposition on plants and reduction of growth rate of flora and fauna. These problems can be overcome by using proper tracking system on FPV modules. Suitable tacking of FPV modules help in increasing system efficiency with capturing solar radiation properly as well as movement of modules during sun tracking increase penetration of solar radiation into the water body. In this study, a simulation study has been carried out with different types of tracking in floating PV system and it has been observed that Duel-Axis tracking is giving best result out of four tested tracking methods with 16.2% higher annual electricity generation compared with no tracking.

Keywords: Floating PV system; FPV; Tracking system; Efficiency; Electricity generation

Abstract ID: TET-OP12

Recent advances in high temperature solid oxide electrolysis cell for hydrogen production

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Abstract
The continuing depletion of fossil fuels and the escalating greenhouse effect have generated significant concern. Future alternative fuel source is hydrogen. Hydrogen and electricity are complementary and interchangeable energy carriers that can be utilized with electrolysis and fuel cell technologies to produce renewable energy. High-temperature solid oxide cells (SOCs) can be operated reversibly as fuel cells (SOFCs) and electrolyser cells (SOECs) for dividing water into hydrogen (H_2) and oxygen (O_2). Thus, electrical energy is converted to chemically bound energy in hydrogen molecules. However, the applied potential gradients differ between the two operating modes, which impacts performance and durability. The processes of gas diffusion and electrode polarization differ from those of SOFCs. If the same electrodes used in SOFCs were applied to SOECs, cell performance would be poor because the electrodes are exposed to various environments as a

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result of increased conversion resistance and a local temperature decrease in electrolysis mode. The principal challenge in the field of SOEC is the design of the electrode(s)/electrolyte(s) to be used for water electrolysis. In this review article, perovskite oxide-based materials (electrodes/electrolytes) for SOEC that offer stable long-term operation at high current density for efficient hydrogen production from water.

Keywords: Hydrogen production; Hydrogen; Solid oxide cell

Abstract ID: TET-OP13

Recycling of Cobalt based Lithium-ion Batteries

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Abstract
A large number of Li-ion batteries will be retiring soon due to the end of their lives in energy storage applications like laptops, power tools, portable electronic devices, and majorly from electric vehicles. Rechargeable Li-ion batteries are generally used in a wide range of application across the world because of their superior electrochemical performance, high energy density, and safety compared to other types of energy storage systems. But, due to the end of their cycle life, they should be recycled to avoid environmental pollution as well as to save valuable materials like Lithium, Cobalt, Nickel, and graphite and thereby minimize the impact on the environment. From the future perspective, growing electric vehicle market, recycling of Li-ion batteries will become mandatory globally. Here, we will present different types of Li-ion battery recycling technologies based on Hydrometallurgy and Pyrometallurgy approaches, and their impact on the environment, along with their pros and cons and future prospects.

Keywords: Li-ion batteries (LIBs); Energy Storage; Recycling of batteries; Hydrometallurgy methods; Pyrometallurgy methods

Abstract ID: TET-OP14

Recent advances in ZnO based photocatalysts for sustainable hydrogen evolution via photocatalytic water splitting

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Abstract
Because of the conscious use of coal and other fossil fuels, there is an increasing demand for renewable, low-cost, long-term green energy sources. The optimum energy source has been identified as clean hydrogen production by photocatalytic water splitting using less expensive and simply produced photocatalysts. Because of its intriguing qualities such as structural flexibility, large surface area, and visible light absorption ability, zinc oxide (ZnO)-based photocatalysts are the growing class of materials for photocatalytic hydrogen generation. The disadvantage of most ZnO is its low charge transfer and separation capacity during the photocatalytic activity. To address this issue, we offered a critical review of the development of ZnO-based photocatalysts for photocatalytic hydrogen generation via metal/non-metal doping, heterojunction nanocomposites, and carbon insertion. Such innovative materials minimise charge recombination, improve stability, and increase hydrogen generation yield via photocatalytic water splitting. The primary goal of this review article is to investigate and compare the hydrogen evolution rates of several ZnO-based photocatalysts in order to determine the optimum option for hydrogen fuel production. The advantages, disadvantages, and current applications of hydrogen energy have also been briefly examined.

Keywords: Photocatalytic water splitting; ZnO-based photocatalysts; Hydrogen; Yield

Abstract ID: TET-OP15

Dry Reforming of Ethanol Production of Hydrogen Rich Syngas

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Abstract
There is increased interest in exploring an eco-friendly alternative energy to replace petroleum-based energy due to concerns about global warming, rising greenhouse gas emissions, and the depletion of fossil fuel supplies. Hydrogen having remarkable energy density of 120.7 kJ. g^{-1} and zero emission during combustion, has been considered as a green energy carrier of future. Currently, commercial hydrogen production involves use of unsustainable fossil fuels like natural gas and naphtha made from oil, which results in significant emissions of unfavourable greenhouse gas CO_2. Therefore, to utilize CO_2 efficiently, dry reforming of ethanol appears to be a potential sustainable approach for producing hydrogen rich syngas. Syngas is used as a feedstock for Fischer-Tropsch synthesis and downstream methanol production. In this study, dry reforming of ethanol was carried out over alumina supported nano-NiO catalyst in silica synthesized using sol-gel method. It was found that Ni loading in catalyst and reaction conditions affected the catalytic activity as well as products composition. Catalyst with 10% Ni loading appeared to be the best in terms of ethanol conversion, CO_2 conversion, carbon monoxide yield and hydrogen yield in ethanol dry reforming. For find out optimum process parameters, detailed experimental investigations were carried out over a wide range of operating parameters such as reforming temperature, CO_2: C_2H_5OH (molar ratio) and space-time. The most favorable reaction conditions were established at 750 ^oC with CO_2: C_2H_5OH molar ratio of 1.4 and space-time of 24.90 kg cat h/kmol of ethanol fed. Almost complete conversion of ethanol, CO_2 conversion of 76.0% and yield of hydrogen of 100% were achieved under this optimum condition. The time-on-stream study revealed that the catalyst was found to be active within the range of parameters examined at atmospheric pressure.

Keywords: Sol-gel; Syngas; Space-time; Yield

Abstract ID: TET-OP17

Fabrication of Nanoplate Shaped WO_3 Photoanode on FTO Substrate With and Without Seed Layer for Photoelectrochemical Water Splitting

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Abstract
Photoelectrochemical (PEC) water splitting utilizing solar energy for hydrogen and oxygen evolution is being considered the most plausible solution for clean and green source of energy. Nanostructured WO_3 as a photoanode has attracted a lot of research interest due to its favorable band gap (2.5-2.8 eV) to utilize solar spectrum and suitable hole diffusion length (150 nm). Growth of nanostructured WO_3 on fluorine doped tin oxide (FTO) substrates using facile hydrothermal or solvothermal route is very less reported. In this work, we synthesized and compared the growth of nanoplate shaped WO_3 on FTO substrate with and without seed layer and their role as a photoanode for PEC water splitting. The WO_3 nanoplate without seed layer was found to have better light absorbance, light harving efficiency and photocurrent density than WO_3 grown with seed layer on FTO substrate. The photocurrent density for WO_3 nanoplate without seed layer on FTO obtained under illumination of 50 $mWcm^{-2}$ and using 0.5 M Na_2SO_4 as electrolyte was 0.77 $mAcm^{-2}$ which is appreciable based on previous reported literatures.

Keywords: PEC water splitting; Photoanode; Hydrothermal; Nanoplates

Abstract ID: TET-OP21

Design and Development of kW-Scale Vanadium Redox Flow Batteries for Renewable Energy Storage

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Abstract
Energy storage is one of the prevailing factors of future energy mix in which batteries are considered to be one of the key solutions to effectively integrate high shares of solar and wind renewables in power systems. I will be presenting the design and development of redox flow battery (especially vanadium based) energy storage systems. These systems have distinct features such as independent scaling of power and energy ratings, long cycling life and low levelized cost of energy and therefore show great scope in applications like renewable microgrids and large-scale stationary energy storage. The system development includes a few key steps like material fabrication, designing tailored flow field for electrolyte distribution, scale-up, stack design, layout of tubing manifolds for desired feeding of electrolyte from a reservoir to individual cells, optimizing

the operating parameters, electrolyte management, development of balance of plant and integrating the system to renewable sources. The presentation gives you the summary on electrolyte distribution through various flow fields, interpretation of the findings of electrolyte distribution on the life cycle studies of the battery, engineering of flow fields and demonstration of the system integrated to inhouse solar PV and residential load.

Keywords: Electrolyte distribution; Redox flow batteries; Scale-up; Power density

Abstract ID: TET-OP23

Performance Study and Scalability of Multi-pass Membrane Separator for Improved Hydrogen Recovery Using Palladium-based Membrane

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Abstract
H_2 separation using a Pd-alloy-based membrane is a preferred choice due to its high hydrogen flux and selectivity over a wide range of temperatures and pressure. However, efficient hydrogen recovery from mixture gas remains a critical challenge due to the formation of a mass transfer barrier formed near the membrane surface called concentration polarization. To address this issue, we have developed a vertical baffle-integrated multi-pass membrane separator (MPMS) to enhance the H_2 recovery. The performance of MPMS is optimized to improve H_2 recovery at different temperatures, pressure, membrane-to-feed load, and membrane-to-pass ratio. H_2 recovery of more than 95% is achieved at 300 kPaG and 673 K in MPMS. Enhancement in H_2 recovery and effective membrane utilization is more significant (15-23%) at a lower feed flow rate. MPMS is more effective for multiple membranes in the same pass compared to the same number of membranes in different passes. Concentration polarization is more severe for the downstream membrane in another pass. Longer residence time in MPMS provides more opportunity for hydrogen molecules to diffuse across the membrane. Multi-pass effectively reduced the mass-transfer limitation along the membrane surface by disrupting the flow field which pushed more hydrogen toward the membrane. This study demonstrated that increasing the number of membranes at a higher feed flow rate in MPMS is more feasible economically for enhanced H_2 recovery.

Keywords**:** Hydrogen recovery; Membrane separator; Concentration polarization

Abstract ID: TET-OP24

Model-based Investigation of the Combined Effects of Fast Charging and Temperature on Li-ion Battery Aging

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Abstract
This abstract presents a model-based investigation into the combined effects of fast charging and temperature on the aging of lithium-ion (Li-ion) batteries. With the growing demand for fast-charging capabilities in various applications, understanding the impact of fast charging on battery aging becomes crucial for optimizing battery performance and lifespan. The study begins by developing a physics-based mathematical model by considering the governing equations, including charge, species, and energy conservation phenomenon on the electrochemical cell. Further, aging effects, including loss of lithium inventory (LLI) and loss of active materials (LAM) is incorporated into the P2D model. Utilizing the developed model, the study conducted an exploration of the influence of fast charging and temperature on critical aging parameters, including capacity fade, temperature rise, and degradation of active materials. The obtained results unveiled intricate relationships between charging rate, temperature profile, and the progression of aging mechanisms. The findings from this model-based investigation provide valuable insights into the complex interactions between fast charging, temperature, and Li-ion battery aging. The results can guide the development of optimized charging protocols, improved thermal management strategies, and advanced battery designs to enhance the overall performance and durability of Li-ion batteries under fast charging conditions.

Keywords: Lithium-ion batteries; Fast charging; Battery aging; Thermal Management; Mathematical modeling

Abstract ID: TET-OP25

Silver-doped CdS /Bi_2MoO_6 nanocomposite as a highly efficient visible-light photocatalyst for water splitting

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Abstract
The search for sustainable and eco-friendly methods of hydrogen generation has gained significant attention due to the growing demand for clean energy sources. Photocatalytic water splitting using semiconductor-based materials appeared to be a promising approach for sustainable hydrogen production. Herein, we have synthesized Ag-doped CdS/Bi_2MoO_6 composite photocatalyst since doping with Ag has enhanced photocatalytic activity as well as better visible light absorption properties compared with pure CdS. Bi_2MoO_6 also attracted much attention due to its narrow band gap (2.7 eV) and favorable CB/VB edge positions. The characterization techniques employed to evaluate the structural, optical, and photocatalytic properties of Ag-CdS/Bi_2MoO_6 nanocomposites emphasize the importance of understanding the material's fundamental properties for efficient hydrogen generation. Moreover, the influence of different parameters such as catalyst loading, light source, and pH on photocatalytic performance has been explored to provide insights into optimizing hydrogen generation efficiency.

Keywords: Photocatalyst; Hydrogen; Sustainable; Water splitting; Eco-friendly; CdS; Bi_2MoO_6; Visible light

Abstract ID: TET-OP26

Futuristic Green Hydrogen from Biomass: Review of Advanced Bio-fuel Technology and Catalysis

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Abstract
Diversification of global energy basket, strategizing carbon neutral technologies and Ratification of International-Climate-Change Paris Agreement are critical drivers to promulgate futuristic clean advanced bio-fuels like Renewable Green Hydrogen. Hydrogen contributes considerably to refining industry and is utmost costly molecule requiring costly naphtha to produce via steam reforming (SR). Ligno-cellulosic-biomass (like Rice husk, Wheat straw, Sugarcane bagasse, Corn cob, Empty Fruit bunches, Tea and Coffee Husk, Coconut waste etc.) derived Pyrolysis bio-oil as second-generation bio-fuel offers advantages over first generation bio-fuels due to sustainability without invoking food vs. fuel debate. Owing to challenges in Direct Hydrolysis of cellulose and hemi-cellulosic components of Ligno-cellulosic biomass, Biomass gasification and direct use of bio-oil due to high oxygen content & viscosity, prudent area of focus globally is alternate bio-oil utilization route by development of robust Catalyst & Process for steam reforming of bio-oil to Green Hydrogen.
For enhanced insight of this reforming technology, challenges in bio-oil reforming due to high temperature catalyst coking are elaborated with coking minimisation analysis by coke precursor gasification & steam activation by catalyst. Noble & non-noble catalysts as studied by researchers are discussed in paper. Support modifiers that enhance steam adsorption to facilitate partial oxidation/gasification of coke precursors and enhancers that slows coking surface reactions due to cracking and de-oxygenation are elaborated. Accelerated Water Gas Shift (WGS) reaction and depressed Methanation, Boudouard & Reverse Water-Gas Shift (RWGS) as a function of catalyst is analyzed. This paper critically reviews Novel bio-oil reforming techniques including catalytic electrochemical, spouted bed, auto thermal etc. and Innovative modifications in conventional fixed and fluidized catalytic reforming reactors for overcoming challenges like bio-oil polymerization, high viscosity, poor fluidity are argued.
Study of this technology aims to establish that bio-oil reforming can be promising pathway for producing Green Hydrogen using renewable ligno-cellulosic biomass. This is futuristic solution to mitigate challenges of grey hydrogen requirement in global refining industry with in-situ integration of this carbon neutral perspective of Biomass based Green Hydrogen.

Keywords: Green H_2; Bio-mass; Catalysis

Abstract ID: TET-OP29

Studies on the Effectiveness of Ethanol - Gasoline Blend as Fuel

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Abstract
The blending of ethanol with gasoline has become a popular alternative to traditional gasoline due to its potential to reduce dependence on fossil fuels and improve the environmental impact of transportation. However, ethanol has a lower energy content than gasoline, resulting in reduced fuel efficiency and increased fuel consumption, which can be compensated by adding very small amount of heavy organic compound like biodiesel. In this work, small amount of easily available diesel is used for that purpose.
In the present work, the experiments were conducted to study different common fuel properties like kinematic viscosity, boiling point etc, by preparing different ethanol – gasoline blend samples with ethanol variation from 0 to 35% with an increment of 5% and, also, by adding very small amount of diesel (1 to 5%) in the ethanol-gasoline mixture. The properties variation of samples due to the addition of ethanol and small diesel are very small if compared with normal gasoline. The addition of diesel compensates the loss of heating value. The Engine performance were studied in existing IC engine using blend upto 10% ethanol which shows suitability of it as fuel with almost no loss efficiency.

Keywords: Ethanol – gasoline blend; Engine performance; Heating value

Abstract ID: TET-OP30

Synthesis and Characterization of Graphene supported electro-catalysts for PEM Fuel Cells

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Abstract
Proton exchange membrane fuel cells (PEMFC) is one of the promising energy conversion devices for clean and mobile power generation systems due to its attractive features such as high-power density, minimal emissions, low operating temperature, negligible noise, and high efficiency. Catalysts have important role for on it. Different catalysts (Pt, alloys, and transition metal) are established and studied their performance with Graphene supported base. Catalysts are dispersed on supporting material to increase the active electrochemical surface area (ESA) of Pt electro catalyst to improve the dispersion of the metal electrocatalyst, high electrical conductivity, long term electrochemical stability under fuel cell operating conditions and good interaction between support material and metal catalyst. In the present studies of varieties of composition including graphene supported Pt, NiO, Al_2O_3, CuO, TiO_2 in different proportions were investigated. Membrane electrode assembly (MEA) synthesizes suitable for conducting fuel cell tests. Successful outcome will help towards the developments related to Synthesis and Characterization of Graphene Synthesis and evaluation of Graphene Supported Electrocatalysts.

Keywords: PEMFC; Electrocatalyst; Graphene

Abstract ID: TET-OP31

Solid Polymer Electrolyte Membranes for Fuel Cell Applications: Synthesis & Characterization

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Abstract

Increasing global energy demand, growing carbon emissions and the depletion of fossil fuel sources are some of the most driving forces for the development of sustainable energy solutions. Proton exchange membrane fuel cells (PEMFCs) are considered to be a promising technology for clean and efficient power generation in the twenty-first century. The devices require solid polymer electrolyte membrane having negatively charged functional group in the membrane forming polymeric material. The cost of polymeric membrane is considered as one of the major factors for its utilization. In the present work different composition of membranes having variable ionic functionalize groups were synthesized (e.g., sodium alginate, polyethylene glycol etc.). Lab made proton exchange membranes were used to prepare MEAs (Membrane Electrode Assembly) with varieties of catalyst composition to test in fuel cell. Few membranes appeared as promising alternative to the conventional Nafion membrane. The membranes and MEAs have been characterized to explore their application.

Keywords: PEMFC; Electrolyte; Proton exchange membrane

Abstract ID: TET-OP33

Synthesis of platinum group metal free electrocatalyst for polymer electrolyte membrane water electrolyser (PEMWE)

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Abstract

Polymer Electrolyte Membrane Water Electrolyser (PEMWE) produces green hydrogen and has advantages in terms of high charge density, compact structure and low temperature range. The major challenge in PEMWE is the sluggish kinetics of Oxygen Evolution Reaction (OER) at the anode compared to Hydrogen Evolution Reaction (HER) at the cathode. Currently, PEMWE uses carbon-supported platinum as HER catalyst and ruthenium and iridium-based oxides as OER catalyst. However, they suffer from high cost and scarcity in nature which make them unpractical for large scale hydrogen production by water electrolysis. This necessitates the development of platinum group metal-free (PGM-free) earth-abundant catalyst that have high efficiency for both OER and HER. Cobalt-oxide based materials are identified as a potential electrocatalysts for PEMWE. The present work involves the synthesis of Co_2MnO_4 powder and on the Fluorine Doped Tin Oxide (FTO) coated conductive glass substrate by thermal decomposition method. The synthesized catalysts were characterized by X-ray diffraction (XRD) pattern and Energy-dispersive X-ray (EDX). XRD diffraction pattern shows only the presence of Co, Mn and O_2 and no impurities. EDX analysis indicate that the sample formed is Co_2MnO_4. The OER performance is analyzed by Linear Sweep Voltammetry (LSV) and is compared with reported IrO_2 based catalysts.

Keywords: PEM Electrolyser; Oxygen evolution reaction; Hydrogen evolution reaction

Abstract ID: TET-OP34

Alumina-based Multi-metal Catalyst for E-waste management for reclamation of valuable products

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Abstract

Electronic and electrical waste (E-waste) has increased exponentially due to the humungous growth in Information Technology and Communication sector. Many multi-metal catalysts are developed by researchers for electronic waste plastic conversion into fuel products and recovery of valuable metals. In the present study an Alumina-based catalyst powder with Tungsten, Vanadium and Niobium metal oxides were prepared for better recovery of hydrocarbon liquids. FESEM with Energy dispersive spectroscopy, XRD and Laser diffraction Particle size analysis were used to characterise catalyst. The shredded E-waste chips to catalyst weight ratio was maintained from 2:1 to 10:1 and studied. The experiments were conducted with reaction temperature range from 300°C to 500°C. Produced fuel density measured was 0.88 kg/L, with 0.75 liquid fuel conversion and 71.7% overall liquid fuel yield. The light gas percentage were found to be 4-6 %. NMR analysis, Bomb Calorimetric study and Gas Chromatography of liquid fuel analysis suggest carbon chain compounds of C3-C20 hydrocarbon, indicating mixture of petrol and diesel like liquid product. The catalyst can be tuned to improve liquid fuel conversion. The liquid fuel product is promising for fuel use, however, upgrading treatments are needed to meet standard product specification.

Keywords: Alumina-based catalyst; E-waste management; Catalytic reactor

Abstract ID: TET-OP36

Modified metal Hydride and organometallic composites as a hydrogen storage material for portable storage system: A comprehensive review

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Abstract
Hydrogen is widely accepted by the scientific community scientist and researchers around the world. Successful implementation of hydrogen energy road map is limited due to some technical barriers in different stages such as portable hydrogen storage, refilling stations, operation, development of reliable appliances and user friendly engine etc. In this review paper progress of hydrogen storage technologies are briefly studied and reviewed to find out the key parameters that need further development and experimentation. Smaller size and lowest density makes it difficult to design user friendly storage. Many literatures reveal reports on high pressure storage (350 to 700 bar), cryogenic storage and different organometallic composites were studied widely and few prototypes already developed with specific limitations. Few literatures also reported high density hydrogen storage system with gravimetric capacity 6.5wt% with a working temperature from - 40 to 60^{O}C become the affordable solution. Few researches are also in progress related to metal hydrides and organometallic composites. Storage of hydrogen at atmospheric temperature in the form of modified metal hydride or organometallic composite with sufficient desorption have the possibilities to reach the goal.

Keywords: Hydrogen storage; Organometallic composites; Metal hydrides

Abstract ID: TET-OP37

Effect of temperature and pressure on hydrogen generation from sodium borohydride by thermolysis using catalyst

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Abstract

The composite materials (catalyst/$NaBH_4$) were prepared by facile solution method. The synthesized materials were studied for hydrogen generation via thermolysis in an autoclave reactor at various pressures (1, 5, 10, and 20 bar). The properties of the synthesized materials were characterized using X-ray diffraction, TG-DTA, Raman spectroscopy, Field Emission Scanning Electron Microscopy (FE-SEM), and Fourier Transform Infrared spectroscopy. The pressure effect plays a vital role in hydrogen generation from the storage device, followed by 1 bar > 5 bar > 10 bar > 20 bar. The optimum condition was found to be 1 bar pressure and 100 ^{o}C for the thermolysis and hydrogen generation. The composite material decomposition was incomplete after 1 h at 100 ^{o}C and 1 bar pressure. The generation of hydrogen using the composite material followed $30CaCl_2/NaBH_4$ (1.41% wt.%) > Pure $NaBH_4$ (0.11% wt.%) at 1 bar pressure. The study also indicated that the reaction or thermolysis pressure was a curial factor for hydrogen generation from the metal hydride (H_2) storage device.

Keywords: Pressure effect, $NaBH_4$, $CaCl_2$, Thermolysis, XRD, Raman spectroscopy, FT-IR

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"Tidal power generation"-prospects in India

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Abstract
The rapid growth in the entire field of lives of human being is electricity, which is primarily obtained using the once abundant & affordable fossil fuels like coal, oil and gas. The alarming situation is that the once abundant and affordable fuels were depleting rapidly and would soon become expensive to use. All this demanded for another source of power generation, and it is known as renewable energy sources-solar, wind, hydrogen, geo-thermal etc. One most important renewable energy source is yet untouched by the world-the tidal power. Tidal Power makes use of 50+ years of technology development pioneered by the sub-sea oil & gas industry and most recently the amazing development made by the offshore industries in efficient power transmission back to the shore. Tidal power have lots of advantages like-Zero Greenhouse Gas Emission, usefulness for long duration about two billion years, predictable and constant, ensure a relatively steady power supply. Though the initial costs are extremely high it has a big advantage of "mostly maintenance free over a life span of about 30-40 years." At present about nine to ten Tidal power generation projects are there which generates about 900 MW using any one technique (1) Tidal Barrage, (2) Tidal Stream Generator (3) Dynamic Tidal Power & (4) Tidal Lagoon. Some projects are under planning stage right now having huge potential of tidal power generation.
Looking at India's potential for tidal power generation, we can say that it has a tremendous scope to capture the Tidal Power Potential about 8000 MW of tidal energy including 8,200 MW in the Gulf of Kambhat & Gulf of Kutch in Gujarat &100 MW in Sunder bans in West Bengal. Testing prototype of 1-MW was made at Gulf of Kutch also & looking good opportunities, yet India is not moving forward for this Tidal power due to various financial challenges & high capital cost of Rs 30 to 60 crores per MW power generation. Here the challenge comes for engineers of India to show their talent to become a path giver for other countries in this field of Tidal Power Generation. Though India is generating power through Solar, Wind and bio-gas but the Tidal Power is challenging all of us. Why we are not putting our efforts to cultivate this technique for the betterment of next generation of Indian people? Why our technocrats are not eager to develop indigenous, chip & comfortable techniques for tidal power generation, when we are able to reach at Moon. Looking to the present scenario of gap between world's power supply and its demand and less availability of fossil fuels all over the world, one must have to think for development of new renewable energy sources like geo-thermal, wave technology and tidal technologies to fulfil world's endless demand of electricity. In my full-length paper, I will focus on the various technologies of Tidal Power Generation and the future prospects of India with respect to this most awaiting & unseen renewable technology, which may put India on the top of the world with having economy of 5 trillion $ bench mark. I hope Hon'ble Prime Minister Vision of"Atma-Nirbhar Bharat" dream will be fulfilled in the year 2047 when we will witness 100 years of our Independence. We hope that Indian Engineers will certainly make us prideful by developing at least three to four Tidal Power Generation Project in East & West coast of India and thus making glorious future with a tag of "Developed Country-India."

Keywords: Renewable energy; World & tidal power; Tidal power generation; India@2047

Abstract ID: TET-OP40

Multi Objective Optimization Using Neural Network Modeling to Maximize the Output Power and Efficiency of PEMFCs

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Abstract
Designing a PEM fuel cell model is exceedingly challenging because of its multivariate in nature. Optimization is required to achieve highest operating condition. Neural Network Model is one of the possible methods to solve complex problems. The polarization curve of a PEMFC (Proton Exchange Membrane Fuel Cell) is investigated in this paper in relation to the effects of seven parameters, including temperature, relative humidity in the cathode, relative humidity in the anode, anode stoichiometry, cathode stoichiometry, partial pressure of H_2, and partial pressure of O_2, using an ANN (artificial neural

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network) model. Where model geometric parameters i.e. Channel width, Channel depth, Channel length, Rib width, Cell width, GDL thickness, CL thickness, Membrane thickness of PEMFC was constant. Initially single Objective Function (Output Power) is predicted. The research presented here makes predictions about a PEMFC stack's electrical performance under multiple operating conditions. A PEM fuel cell's maximum output power for different values of the current is predicted for this purpose using a mathematical model which was further verified using laboratory data. Co-efficient of Determination (R2), Mean Square Error (V), and Mean Absolute Error (MAE) was determined using the fuel cell stack voltage model and stack power model. The model results show the possibility of using ANN in the implementation of such models to predict the PEMFC system's steady-state behaviour for different operating scenarios and assist in the optimization process to maximize system performance.

Keywords: Proton Exchange Membrane (PEM) fuel cell (PEMFC); Objective Function; Co-efficient of Determination (R2); Mean Square Error (V); Mean Absolute Error (MAE)

Abstract ID: TET-OP43

Lithium Recycle Technology Research for the sustainability and future needs: A Review

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Abstract

It is envisaged that the entire lithium-ion (Li-ion) battery chain, from mining through recycling, could grow by over 30 percent annually, when it would reach a value of more than $400 billion and a market size of 4.7 TWh in order to have a sustainable power development and to mitigate the climatic change.

The research on the recycling of waste lithium batteries mainly focuses on the recovery of high-value anode precious metals cobalt and lithium. Copper (up to 35%) in the negative electrode of waste lithium batteries is an important raw material for production and has a wide range of uses. Lithium-ion batteries have become a crucial part of the energy supply chain for transportation (in electric vehicles) and renewable energy storage systems. Recycling is considered one of the most effective ways for recovering the materials from spent LIB streams and circulating the material in the critical supply chain.

In the present work, a review on the recycling technologies for lithium-ion batteries is presented discussing the technical and economic feasibilities as well as the environmental impact. The identification of the gaps in knowledge and research requirements for the development of the suitable technologies are reported. Further, an attempt is made to determine a criterion for the optimized value chain for Li ion batteries.

Keywords: Global market; LIB streams; Lithium batteries; Recycling; Climate change

Abstract ID: TET-OP44

Cononsolvency in Thermo-responsive Polymer through Excess Entropy Scaling

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Abstract

Poly-N-isopropyl acrylamide (PNIPAM) is a widely studied Lower Critical Solution Temperature (LSCT) thermo-responsive polymer having LSCT 305K which is nearly body temperature makes it in useful in the numerous applications, including controlled drug delivery, gene delivery, cell engineering and protein attachment. The quantification of the responsive behavior of such polymers is challenging due to the vast configurational space. The existing methods for quantification are either focused on dynamic properties or structural properties, but the changes in structural parameters are small, while those in dynamic properties are significantly larger. We suggest a new computational method to quantify responsive behaviors by scaling the structural properties (Excess entropy) with dynamic properties (Diffusivity).[1] by Rosenfeld's concept that entropy determines properties of liquids like viscosity, diffusion constant, and heat conductivity. Several works utilize excess entropy scaling to provide insights into the protein folding, phase behavior of solids,[2] self-assembly of nanoparticles,[3] behavior of entangled polymers.[4] In this work we will apply this concept in monomers of PNIPAm which is N-isopropyl acrylamide (NIPAm) with aqueous solution of Ethanol and Methanol that are good solvent for PNIPAm separately. And we will check the criteria of co-nonsolvency with solution of different mole fraction of these solvents with water. This excess

entropy scaling calculation will show the precise determination of the transition condition for aqueous NIPAm with some cosolvents.

Keywords: Molecular dynamics simulation; PNIPAm; Cononsolvency; LCST Polymer

Abstract ID: TET-OP45

Hydrogen production from waste plastic using metallic catalyst

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Abstract
The demand for plastic has increased worldwide drastically due to its extreme requirement in day-to-day activities including packaging, building, construction, textiles, transportation, electronic equipment, industrial machinery, and other areas. As a result, concern for the environment and human health has arisen from the widespread usage of plastic. To overcome these issues, many technologies have been developed such as gasification, pyrolysis and catalytic dry reforming to convert waste plastics into various fuels and value-added chemicals to generate economic value instead of polluting the environment. However, very few research work has been done so far in this area. In the present study, the effect of different catalysts and process parameters have been explored well. The possibility of using waste plastics as a source of hydrocarbons for the chemical vapour deposition method for generating carbon nanotubes has also been discussed. The objective of this article is to give readers a thorough introduction to a range of cutting-edge technologies so that it may comprehend their current state of development and future prospects.

Keywords: Waste plastic; Hydrogen; Green Energy; Catalyst; Turquoise hydrogen

Abstract ID: TET-OP46

Comparative Analysis of Models and Simulations for Complex Hydrides Based Hydrogen Storage, Hydrogen Transport and Hydrogen Production

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Abstract
Hydrogen storage system technologies are becoming increasingly relevant in today's expanding hydrogen the global economy. In such times, Chemical hydrides are one of the most reliable ways to store and transport hydrogen gas to various fuel cells-based ground stations to generate clean energy with zero carbon emissions. In order to combat rising carbon emissions, immediate action is required to switch from traditional fuels to green hydrogen-based energy integrated systems. Based on complex metal hydrides like lithium and magnesium alanates, this study will examine and suggest numerous unique models, such as input-output models, supply chain network design models, multistage models, sustainable models, etc.
A critical and thorough comparative analysis on the respective complex hydrides were done to incline the research towards promising hydrides. The study also thoroughly discusses several industrial scale-up processes, cost analysis, and plant design of such hydrogen storage methods. A brief evaluation of various aspects of pillars of hydrogen economy will be addressed by focusing on complex hydrides-based hydrogen storage, hydrogen transport and hydrogen production.

Keywords: hydrogen economy; chemical hydrides; hydrogen storage; simulations; input-output model; plant design; cost analysis

Abstract ID: TET-OP48

Fabrication of electrodes of Alkaline Electrolyzers for production of Hydrogen and Oxygen Mixture

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Abstract
This research paper explores the vital role of alkaline electrolyzers in sustainable hydrogen production. It focuses on electrode fabrication for cost-effective hydrogen and oxygen production, emphasizing the importance of design and material selection in the electrolyzer. The study investigates materials like steel wool and stainless steel meshes and explores nickel electrodeposition for efficiency. Consideration of factors like mass transport, electrode kinetics, and durability underscores the significance of electrode design in optimizing electrolyzer performance. The study showed that fine meshes of stainless steel (30-100 micron) gave the maximum hydrogen production. Along with electrode material another parameter that significantly affected the hydrogen production was the packing density and free volume of the electrolyzer. It was found that at least 60% of the electrolyte volume should be kept free for maximum hydrogen production. The electrodeposition of Nickle was optimized and 5% mass increased coating was set as minimum standard for optimal results. The Experimental results and characterization data are presented to illustrate the improvements achieved through the proposed fabrication techniques. Overall, this study contributes valuable insights into the development of efficient alkaline electrolyzers, with the potential to advance the sustainable production of hydrogen and oxygen mixtures for various industrial and energy storage applications.

Keywords: Alkaline electrolyzer; Electrode fabrication; Green hydrogen

Abstract ID: TET-OP49

Enhanced Hydrogen Production in Scalable Optofluidic Microreactors Using Immobilized Al-Doped $SrTiO_3$ Photocatalysts: Experimental and Hydrodynamics Simulation Insights

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Abstract
Addressing the need for sustainable hydrogen production, this study introduces a scalable fabrication method for optofluidic microreactors with an Al-doped $SrTiO_3$ photocatalyst. Commercial window glass, which serves as the substrate, is coated with epoxy paint mask essential for microchannel etching. A diode laser engraver crafts an optimized geometry to maximize surface area and fluid mixing, aiming to elevate photocatalytic activity. A two-stage chemical etching creates differentiated depths between the primary chamber and embedded microstructures. The Al-doped $SrTiO_3$ is synthesized via molten-salt mediation and coupled with Rh, Cr or Co cocatalyst blend through sequential photodeposition. The powder catalyst is immobilized onto the chamber walls of the microreactor through a binder-assisted spray coating, employing TiO_2/SiO_2 colloid as the binder. Operational efficiency is assessed using COMSOL Multiphysics simulations to investigate hydrodynamic flow characteristics. Key parameters such as peak fluid velocity and shear stress are evaluated to prevent catalyst abrasion and enhance laminar mixing, facilitating efficient hydrogen bubble transport. This work provides a robust framework for cost-effective optofluidic microreactor fabrication, promising enhanced efficiency and scalability in photocatalytic hydrogen production. It paves the way for large-scale green hydrogen generation, meeting increasing global energy demands.

Keywords: Scalable optofluidic microreactors; Al-doped $SrTiO_3$ photocatalysis; Hydrodynamic simulations

Abstract ID: TET-OP50

Significance of strategic models in optimizing the process parameters in biohydrogen production from vegetable waste: present status and future perspective

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Abstract
Food waste is generated in large quantities, which can pose a major threat to the environment. Biohydrogen can be produced from food waste in a cost-effective way by the fermentation process. Biohydrogen is mainly produced by the reducing sugars released from the complex organic substrates. The vegetable waste (VW) is mainly composed of cellulose, hemicellulose (which needs to be hydrolyzed for the release of glucose), and lignin (which needs to be removed) for their availability in microbial anaerobic fermentation during hydrogen production. The anaerobic fermentative hydrogen production can give a higher yield provided the bottlenecks such as (i) VFA production, (ii) low substrate conversion rate, (iii) removal of inhibitor produced, (iv) bioreactor configuration, (v) maintaining same pH throughout, (vi) optimum pH and temperature, (vii) activity of hydrogenase and nitrogenase, (viii) optimum C/N ratio, (ix) light conversion efficiency etc. can be controlled. These parameters can be controlled by implementing mathematical models such as the Modified Gompertz model, Logistic model, Leudeking-Piret model, and Monod model which can be helpful in predicting the maximum production rate and yield of biohydrogen, utilization of substrate, growth characteristics of hydrogen-producing bacteria. This review summarizes the improvement strategies for enhancing the yield of biohydrogen using a fermentative production approach.

Keywords: Biohydrogen; Food wastes; Dark and photo fermentation; Volatile fatty acids; Bioreactors; Optimization

Abstract ID: TET-OP51

Photocatalytic performance of Aluminum (Al)-doped graphene-like ZnO (g-AZO) monolayer

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Abstract

In recent years, two-dimensional (2D) materials have played an important role in photocatalytic water splitting and energy harvesting applications. The Zinc Oxide (ZnO) monolayer (ML) is a popular 2D materials, however, due to low absorption in the visible region and wide optical band gap, restricted its application in the photocatalytic water splitting reaction. Therefore, in this work, we have substitutionally doped Al atom in the graphene like ZnO (g-ZnO) ML and studied the electronic and optical properties of the Al doped g-ZnO (g-AZO) ML under application of biaxial strain. We theoretically investigated the photocatalytic performance parameters such as suitable bandgap, band edge levels and absorption coefficient of g-AZO ML by tuning the biaxial strain from -10% to +10% using Density functional theory (DFT) calculations. Our calculations show that g-AZO ML has suitable band gaps of 2.89 eV and 2.91 eV, suitable band edge positions and absorption coefficient in the visible range at +9% and +10% tensile strain for photocatalytic water splitting reaction.

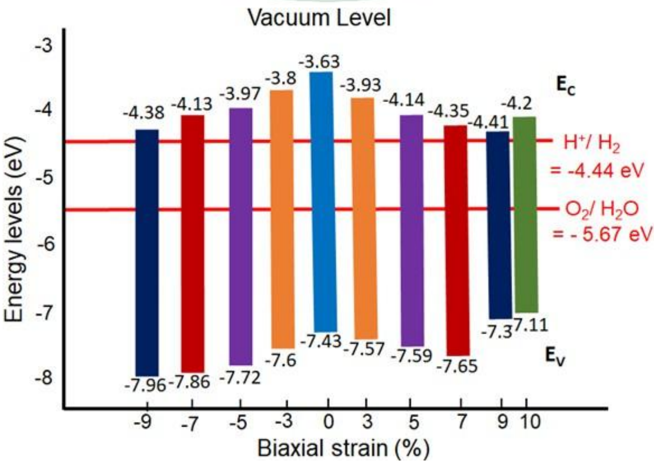

Fig. 1 Energy band edge levels of g-AZO monolayer at unstrained and strained conditions for Photocatalytic performance.

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Keywords: Two-dimensional material; Doping; Biaxial strain; Photocatalysis.

Abstract ID: TET-OP52

Integration of Dark and Photo fermentation with Microbial Electrolysis Cell (MEC) for optimum Biohydrogen production: Structural components of Bioreactor and MEC

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Abstract
Energy is the lynchpin of existence in an industrial society and in the race to achieve industrialization humans have exploited the fossil fuels unreservedly and left footprints in the form of carbon emissions, which has caused various environmental impacts such as climate change. Biohydrogen offers an ecologically friendly, carbon-neutral renewable energy source. Multiple technologies being utilized for Biohydrogen production are electrochemical, biochemical, photochemical, and thermochemical processes. Fermentation (Dark and Photo) and Bio electrochemical systems have shown significant advancements in recent decades. Dark fermentation has a low yield and rate of production and its effluent contains high amounts of VFAs. Dark and photo-combined fermentation is a synergistic process in which total VFA concentrations are significantly reduced. Effluents from dark and photo fermentation provide better substrates with high conductivity to overcome charge transfer challenges associated with Microbial Electrolysis Cell. The economic feasibility and production efficiency of integrated DF-MEC, PF-MEC and DF-PF-MEC needs further optimization. For optimization, an understanding of MEC components and operational parameters is required. Initially, the mechanism, microbiology, thermodynamics, and reactor configurations are explained to comprehend the technology. Further, the critical structural components and major influencing factors such as microorganisms, cathode, catalysts, membrane, anode materials and substrates are also analysed.

Keywords: Biohydrogen; Dark and photo fermentation; MEC; Volatile fatty acids

Abstract ID: TET-OP53

Production of Hydrogen from Agricultural Wastes using Microwave Pyrolysis – An Overview

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Abstract
India is a country that is heavily reliant on agriculture. Every year, a significant amount of agricultural waste is generated, which possesses immense potential for transformation into beneficial products. Hydrogen is one such significant product which is a clean and renewable energy source that can be used for various applications such as fuel cells, power generation, and transportation. This can be done using various processes and Microwave Pyrolysis is one such emerging technique in this field. Microwave pyrolysis is a novel technique that decomposes organic materials using microwave radiation in the absence of oxygen. It has many advantages over conventional pyrolysis such as lower energy consumption, shorter reaction time, higher hydrogen yield, and lower greenhouse gas emissions. Using microwave pyrolysis to produce hydrogen from agricultural wastes is a sustainable approach for both waste management and renewable energy generation. Microwave heating pushes electromagnetic wave energy directly to the absorbing media. This technology can process a wide variety of agricultural waste and generate up to 95% bio-hydrogen and it holds promise for addressing both energy needs and environmental concerns in agriculture and waste management. This paper reviews the recent developments and challenges in microwave pyrolysis of agricultural waste for hydrogen production.

Keywords: Agricultural waste; Hydrogen production; Microwave pyrolysis; Waste

Abstract ID: TET-OP54

New generation battery binder for cathode cative materials Lithium and sodium Ion battery application

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Abstract
Polyvinylidene fluoride (PVDF) is a widely used binder in lithium-ion batteries (LIBs) due to its excellent electrochemical stability, good wettability with electrolyte, and acceptable binding ability between active materials and current collectors. However, PVDF also has some limitations, such as its low ionic conductivity and poor mechanical properties.
There has been a growing interest in developing new PVDF-based binders with improved performance. One approach is to modify PVDF with other polymers or additives. For example, PVDF can be blended with other polymers, such as polyethylene oxide (PEO), to improve its ionic conductivity. PVDF can also be modified with additives, such as silica nanoparticles, to improve its mechanical properties.
Another approach to developing new PVDF-based binders is to design new PVDF copolymers. For example, PVDF copolymers with hexafluoropropylene (HFP) have been shown to have improved electrochemical stability and ionic conductivity compared to PVDF. The thixotropic behavior of PVDF binders is an important property for battery applications. By developing new PVDF-based binders based on the hydrocarbon comonomers with improved thixotropic behavior, researchers are hoping to improve the performance and reliability of lithium-ion batteries and other next-generation batteries.
PVDF binders are also being used in next-generation batteries, such as sodium-ion batteries (SIBs) and potassium-ion batteries (PIBs). PVDF is a promising binder for these new batteries because of its good electrochemical stability and compatibility with a variety of electrolytes.
PVDF is a versatile and important binder in the battery industry. With the development of new PVDF-based binders, PVDF is expected to continue to play a major role in the development of next-generation batteries.

Keywords: PVDF; Composite materials; Coplymer; SIBs; Nanomaterials; Battery

Abstract ID: TET-OP55

Investigating the Candidacy of Duplex Stainless Steel as Corrosion Resistant Alloy for Biodiesels' Storage and Transportation: An Elucidation of Corrosion Mechanism

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Abstract
Biodiesel has become a popular option for green energy in the automotive industry due to its ability to emit less greenhouse gases and particulate matter compared to traditional diesel fuel. However, using biodiesel can lead to corrosion of engine components and reduced engine efficiency due to the formation of corrosion products that can choke the engine valve. To combat this issue, recent studies have proposed the use of duplex stainless steel (ASTM A240) (DSS) as an economical choice for manufacturing tanks and engines. Currently, there has not been a thorough investigation into how microstructure, types of biodiesels, and corrosion product formation affect corrosion rate. This paper explores the use of duplex stainless steel for storing and engine component manufacturing and examines the DSS corrosion performance with different biodiesels (specifically, biodiesel derived from used cooking oil (UCO), Karanja, and Jatropha) using the NACE TM0172-2001 method (by exposing DSS to various biodiesel samples for different time periods (168 to 2160 hours at room temperature)). Findings are relevant for biodiesel handling, transportation, and automotives and help with materials selection by accessing the corrosion database for storage tank and engine manufacturing using DSS.

Keywords: Duplex Stainless Steel; Corrosion; Biodiesels

Abstract ID: TET-OP56

Effect of bed porosity and inlet temperature on hydrogen adsorption inside a cylindrical storage tank: A CFD study

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Abstract

Storing hydrogen with safety poses several technical challenges. Adsorption-based hydrogen storage is one of the convenient methods to use hydrogen energy in an effective way. Numerical investigations of such methods will help to design hydrogen storage devices in an effective manner. The present work demonstrates a 2D axis-symmetric model of a hydrogen storage tank where activated carbon is taken as the adsorbent material. Based on the modified Dubinin-Astakhov model, an adsorption mechanism was simulated using the principles of computational fluid dynamics (CFD). A user-defined function (UDF) was developed under the Ansys Fluent framework for the necessary numerical investigation, which also incorporates mass, momentum, and energy equations. The study elaborates on the impact of variations in bed porosity and inlet temperature on hydrogen adsorption. A higher bed porosity and inlet temperature were found to significantly affect the rate of adsorption and desorption. Activated carbon with a bed porosity of 0.51 exhibited 45% more efficiency than a bed porosity of 0.1. A lower inlet temperature had a good effect on the adsorption, while a higher inlet temperature showed an adverse effect. It was observed that an inlet temperature of 300K showed 14% more efficiency than an inlet temperature of 304K. Dynamic thermal boundary condition has been implemented for analysing the pressure profile within the storage tank. The computational model was well-validated with previous numerical and experimental works.

Keywords: Hydrogen adsorption; Dubinin-Astakhov model; Bed porosity; Temperature; CFD; UDF

Abstract ID: TET-OP57

Investigating the Electrochemical Properties of Ionic-Liquid-Mediated Inorganic Eutectogels Derived from Carboxylic-Acid-Based Hydrophobic Deep Eutectic Solvents

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Abstract

Gel electrolytes have garnered increasing attention due to their capacity to address the limitations of their liquid counterparts while preserving some of their desirable characteristics. In this study, four novel eutectogel electrolytes were developed by confining four hydrophobic deep eutectic solvents (DESs) within a solid titania (TiO_2) matrix using a non-aqueous sol-gel method and further mediating them with the ionic liquid (IL) 1-butyl-3-methylimidazolium tetrafluoroborate ([BMIM][BF_4]). The DESs were carefully formulated by mixing decanoic acid, lauric acid, myristic acid, and palmitic acid with DL-Menthol in optimized molar ratios. The electrochemical properties of these eutectogels were comprehensively investigated utilizing cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) with porous reduced graphene oxide (rGO) electrodes. The findings reveal that the eutectogels exhibit a distinct double-layer capacitive behavior, featuring an impressively broad operating potential window (OPW) of approximately 4 V (-4 V to +4 V) and specific capacitances as high as 159 F g^{-1}. While we observed moderate values of specific power (1.7 – 3.5 kW kg^{-1}) due to relatively higher internal resistance, the gels demonstrated exceptional ionic conductivities of up to 16.28 mS cm^{-1}. These results underscore the considerable practical potential of these eutectogels in various electrochemical applications.

Keywords: Eutectogel; Deep eutectic solvent; Ionic liquid; Gel electrolyte; Supercapacitor

Abstract ID: TET-OP58

Catalytic decomposition of methane to hydrogen and high value carbon using Ni-Ce porous carbon complex

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Abstract

Production of hydrogen through methane decomposition was studied covering mono metallic nickel supported on activated carbon (AC), and promoted by Ce in a fixed bed reactor at 850°C. 30wt% Ni/AC was prepared by incipient wetness method, and was promoted by varying Ce content covering 2.5 to 10%, utilizing ultra-sonication at room temperature. XRD diffraction studies revealed that Ce-promoted Ni catalysts were polycrystalline in nature and showed the presence of NiO, and CeO2 phases in freshly calcined catalysts, urging the requirement of reducing catalysts before carrying out the methane decomposition. A significant increase of 25% was observed with the 5%Ce promoted catalyst, as compared to virgin Ni catalyst, under the same reaction conditions. The stability test showed a drop of 13% in CH4 conversion for Ce promoted Ni catalyst against 28% drop in conversion for unpromoted catalyst over a span of 4 hours. Graphitic carbon and Ni3C phases were observed in XRD patterns of spent 30%Ni-5%Ce/AC catalyst, along with the elemental Ni and Ni-Ce alloy. Morphological analysis showed highly dispersed metallic active-sites over catalyst surface confirming formation of highly dense single-walled carbon-nanotubes, deposited through tip-growth mechanism. Experiments reveal a promising catalyst that can potentially alter the economics of methane decomposition.

Keywords: hydrogen, methane; catalytic decomposition; carbon nano tubes; activated carbon

Abstract ID: TET-OP59

Computationally optimized Cu doping of $ZnTiO_3$ for photocatalytic degradation under visible light illumination

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Abstract
Solar energy is one of the prominent alternatives to conventional fuels, whose direct application is limited because of its low energy density. Photo catalysts are the intermediates that make solar energy directly usable for applications like photocatalytic wastewater treatment, photocatalytic CO_2 reduction, H_2 production, etc. Mixed oxides like $ZnTiO_3$ (ZTO) is a promising candidate photocatalytic material. Our group has demonstrated that the ZTO nanoparticles prepared by sol-electrospinning has band gap lying in the visible region and hence can accelerate reactions in presence of solar radiation [*Solar Energy Materials and Solar Cells*, 2017]. It also overcomes the application limitations of TiO_2 photocatalyst. Experimental studies have shown that ZTO particles can speed up the degradation kinetics of environmental pollutants in contaminated wastewater in presence of sunlight.
In this study, we aim to theoretically explore the possibility of enhancing the catalytic activity of ZTO by further reducing its band gap by doping it with Cu, using the *Quantum Espresso* software. The calculated band gap in ZTO with Cu doped at different geometrical sites (replacing Zn) is found to be reduced from 2.93 eV to 2.44 eV, thereby suggesting a route to enhance its catalytic activity in the presence of sunlight.

Keywords: Photocatalysis; Produced water treatment; Quantum Espresso; Band gap

Abstract ID: TET-OP60

Unraveling the Performance Dependence of the electrochemical HI decomposition on the HI_x composition from the Bunsen section in the Iodine-Sulfur Thermochemical Cycle for hydrogen production

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Abstract
The production of hydrogen (H_2) through the iodine-sulfur (I-S) thermochemical cycle involves an energy-intensive and challenging hydroiodic acid (HI) section. In particular, the challenges arise from the azeotrope formation and the corrosive nature of the HI-iodine (I_2)-water (H_2O) mixture referred as HI_x. The direct electrochemical HI decomposition provides a single-step alternative approach to realize the HI decomposition at high efficiencies without requiring the above azeotropic composition. The performance of the electrochemical HI decomposition depends on the HI_x composition coming out of the Bunsen reaction. In this work, we present a systematic study on the effect of HI_x composition, specifically the variation in the I_2/HI and HI/H_2O ratios on the performance of the electrochemical HI decomposition section. Here, a total of

twelve different HI_x composition variations were studied to obtain a detailed understanding of the effect of I_2/HI and HI/H_2O ratios. Cyclic voltammetry studies were conducted in a three-electrode system with platinum as the working electrode for varying HI_x concentrations. Current peaks corresponding to the iodine-iodide redox reactions were observed for all the electrolyte compositions. The ratio of anodic and cathodic peak current was found to be dependent on the I_2/HI ratio and independent of the HI/H_2O ratio. A lower I_2/HI ratio increases peak current during the oxidation reaction. Increasing the HI/H_2O ratio increases the peak current magnitude corresponding to both anodic and cathodic reactions. H_2 evolution was observed for the catholyte section containing HI without any I_2. Polarization studies were conducted in a two-compartment cell with different HI_x composition in the anolyte section and while catholyte comprised of aqueous HI solution without any iodine with HI/H_2O ratio of 0.186. The polarization data was further fitted with a mathematical model, and the fitting data was used to estimate the different overpotential components in the cell system. Increasing the I_2/HI ratio and reducing the HI/H_2O ratio resulted in an increase in the open circuit voltage and the resistive overpotential losses in the cell. The continuous flow electrochemical HI decomposition for H_2 production is demonstrated with a current efficiency close to 100%.

Keywords: Iodine-iodide redox reaction; Bunsen reaction; Tafel equation; Cyclic voltammetry; Tri-iodide ion; HI electrolysis; Hydrogen production

Abstract ID: TET-OP62

Hydrogen: Fuel of the Future

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Abstract

The demand for hydrogen (H2) is soaring, marking it as a promising energy source in the near future.National Hydrogen Mission is geared towards achieving energy independence and combating climate change. Green hydrogen offers a sustainable solution to the mounting energy needs, with the necessary technologies readily available.However, there are hurdles to overcome before a hydrogen-based economy can be fully realized. These include the high cost of large-scale production, substantial investments in infrastructure, efficient storage, transportation, and distribution, as well as safety considerations and managing supply-demand uncertainties. The chemical industry, in particular, faces a significant challenge in achieving net-zero emissions. While energy efficiency, bio-based feedstock, and material recycling can contribute, hydrogen, carbon capture, and electrification are crucial components.The demand for hydrogen is driven by industry applications, sustainable transportation fuels, and sustainable chemical feedstock like methanol and ammonia.

Keywords: Hydrogen; Sustainable; Energy.

Abstract ID: TET-OP63

Hydrogen storage and generation through nanoparticlised metal hydrides

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Abstract

Hydrogen, as a clean and efficient energy carrier, has garnered significant attention in the quest for sustainable energy solutions. This abstract explores the promising avenue of hydrogen storage and generation through nanoparticlised metal hydrides, a cutting-edge approach aimed at addressing the limitations of conventional storage methods. Basic wellknown hydrogen storage methods, such as physisorption and liquid hydrogen storage, have proven inadequate in terms of efficiency, safety, and practicality. Furthermore, the highpressure hydrogen storage technique is often impractical due to safety concerns and the energy-intensive compression requirements. In contrast, the utilization of nanoparticlised metal hydrides offers a unique opportunity for safe, compact, and reversible hydrogen storage. In addition, this abstract delves into the novel concept of hydrogen generation from magnesium hydride through the use of organic acids, a groundbreaking innovation that further enhances the practicality and sustainability of the metal hydride approach. Such advancements hold great promise for unlocking the full potential of hydrogen as a clean energy source, facilitating its integration into diverse applications and contributing to a greener, more sustainable future.

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Keywords: Physisorption; Nanoparticlised; Metal hydrides

Abstract ID: TET-OP64

Fine Particle Hydrodynamics in Fountain Confined Conical Spouted Beds

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Abstract
The spouted bed is an alternative fluid-particle contact technique to fixed and fluidized beds for the treatment of coarse particles (greater than 1 mm). Despite its benefits, the ratio between the inlet diameter and particle diameter limits the scaling up of spouted beds (the inlet diameter should be smaller than 20-30 times the particle diameter). The use of internal devices, such as draft tubes and fountain confiner ensure stable operation even with fine particles.
The main aim of this work is to study fine particle hydrodynamics in a fountain confined spouted bed, equipped with and without draft tubes. Characteristic curves and particle velocities have been attained for different configurations in order to analyse the operating behaviour using fine particles. Moreover, an optical system fitted with a borescope has been used to track particles.
The characteristic curves of the configurations without draft tube and with open-sided draft tubes show two different regimes before unstable one is obtained. Nevertheless, nonporous draft tubes lead to only one stable regime with no instability at high velocities. The results show that the lowest particle velocities are required in the configurations with nonporous draft tubes.

Keywords: fine particle hydrodynamics; fountain confiner; conical spouted beds

Abstract ID: TET-OP65

DC/ DC boost converter design using a fractional PI controller for a PEM fuel cell application.

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Transformation for Energy Transition (TET)

Abstract
In this study, the performance of PEMFCs was enhanced by controlling a DC/DC converter utilizing the suggested techniques of conventional PI and fractional PI controllers. Simulink models were created for a PEMFC model that included two inputs: oxygen air flow and hydrogen consumption, and controllers. The suggested approaches were then contrasted with the results of a system that was based on traditional PI. Metrics such as rising time, maximum overshoot, and settling time were used to assess how well the techniques performed. The suggested techniques were used to optimize the PI and FOPI parameters, and the outcomes have been compared with traditional PI, in which the ideal parameters were determined by an empirical manner. The results of this investigation show that the suggested approaches outperform the traditional PI method. The simulation's outcome also demonstrates the PEMFC model's respectable control performance when it comes to traditional PI and FOPI controllers, whose controller settings are adjusted via the SIMC technique and the Chen tuning

rule. Additionally, in order to regulate power flow for improved performance, the performance of the straightforward DC/DC boost converter is examined for a range of loads as a power modulator for the PEM fuel cell model.

Keywords: Proton Exchange Membrane fuel cell (PEMFC); PI/FOPI controller; DC/DC Converter; Simple Internal Model Control (SIMC)

Abstract ID: TET-PP3

Electrochemical hydrogen storage using layered double hydroxide material

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Abstract
In recent years, owing to the triple effect of increasing energy demand, depleting fossil fuels, and climate change, significant interest has been attracted in exploring hydrogen (H_2) as an alternative or complementing clean and green energy source. Various methods have been investigated for storing H_2, however, electrochemical H_2 storage has emerged as a viable method since H_2 is generated and stored *in situ* at normal pressure and temperature. The primary challenges associated with electrochemical H_2 storage are low energy density, slow hydrogen uptake and release rates, high costs, and embrittlement associated with H_2 storage materials. To address such limitations, the present research focuses on the fabrication of bimetallic layered double hydroxides-based H_2 storage material. The synthesized material exhibited high discharge capacity and good cyclic stability and hence is less prone to H_2-based embrittlement. Thus, the proposed material synthesized through a facile route may be utilized as a viable potential alternative for efficient electrochemical H_2 storage applications.

Keywords: Electrochemical hydrogen storage; Layered double hydroxide

Abstract ID: TET-PP4

A DFT study of Fe based bimetallic catalysts for thermocatalytic decomposition of methane

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Abstract
Thermocatalytic decomposition of methane over Fe catalysts is an economic route to produce hydrogen without any emission of carbon oxides. The side product is carbon nanotubes which have commercial value. First dehydrogenation step of methane is the rate determining step. In this work, Density Functional Theory calculations were used to model $Fe_3M(111)$ catalysts with M=Co, Cu, Ni. The choice of these transition metals has shown to influence the stability and activity of the catalysts. Phyisorption of methane was found to be less influenced by the use of bimetallic Fe_3M catalysts over monometallic Fe. We have found that activity is influenced significantly, with Fe_3Co exhibiting lowest activation barrier and Fe_3Cu relatively inactive. The adsorption of carbon on these modelled catalysts was studied to check the deactivation tendency of these catalysts. Stronger binding suggests that catalyst would be prone to higher deactivation. In this study, Fe_3Ni adsorbs carbon strongly therefore more likely to deactivate faster in the reaction conditions.

Keywords: Blue Hydrogen; Thermocatalytic decomposition of methane; Density functional theory calculations

Abstract ID: TET-PP6

Alleviation of dendrite formation on Zn anode by an efficient electrolyte additive of potassium chloride for aqueous Zinc-ion batteries

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Abstract
Increasing price, scarcity of lithium resources and safety issues of organic electrolytes limit the sustainable development of Li-ion batteries in energy storage fields. Therefore, metal-ion batteries especially rechargeable aqueous zinc ion batteries (ZIBs) have been considered to be promising alternatives due to their cheapness, high safety, environmental friendliness and assembly ability in air. Zinc metal is considered as most promising anode for Zn-ion batteries due to its low electrochemical potential and high theoretical capacity. However, hydrogen evolution reaction (HER) and formation of dendrites on zinc anode while cycling, severely affects stability of battery. Here, we propose a low-cost, effective and non-toxic electrolyte additive, potassium chloride (KCl) where cation (K^+) and anion (Cl^-) cooperate to improve the efficiency, cycling life, and stability of the battery by triggering smooth Zn deposition during cycling process. We found that potassium chloride (KCl) additive can suppress growth of dendrite where cations (K^+) preferentially adsorb upon Zn surface and provide an electrostatic shielding effect, while moderate number of anions (Cl^-) decreases Zn polarization and facilitates ion transport. As a result, KCl additive induces excellent cycling stability over 870 h at current density of 1 mA cm^{-2} with capacity of 1 mAh cm^{-2} for Zn-Zn symmetrical cell.

Keywords: Electrolyte additive; Dendrite free; Zn-ion battery; Potassium chloride

Abstract ID: TET-PP7

Rapid synthesis of Ni@ $NiCo_2O_4$ heterostructure catalyst for HER

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Abstract
The electrocatalytic hydrogen evolution reaction (HER) facilitates the conversion of renewable energy sources, such as solar or wind power, into chemical energy by efficiently producing green hydrogen (H_2) fuel through water splitting. Currently, state-of-the-art electrocatalysts predominantly rely on precious metals like Pt, Ru, Ir, and, Pd due to their exceptional efficiency and long-term stability. However, the limited availability and high costs of these noble metals raise concerns about the economic feasibility of electrocatalytic green hydrogen production. The primary challenge in developing sustainable HER lies in readily available substitutes (Transition metals, e.g., Ni, Co, Fe, V, etc.) for noble metals without compromising their efficiency. Another challenge is that the transition metals in their bulk form could not compete as HER catalyst with the superefficient noble metals. The efficiency could drastically be improved either by reducing the size of transition metal nanocatalysts (TM-NCs) from bulk to uniformly dispersed nanoparticles (5 nm-20 nm) or by developing hierarchical heterostructure of TM-NCs with transition metal complexes. To address all the challenges, here we are reporting a novel ultrafast flash Joule heating technique, for nano-dispersion of nickel nanoparticles over vertically oriented $NiCo_2O_4$ nano-needle (Ni@$NiCo_2O_4$) firmly anchored to commercial carbon cloth (CC) (Ni@$NiCo_2O_4$@CC). This novel strategy is a facile, low-cost, two-stage process for the synthesis of Ni@$NiCo_2O_4$@CC. The as-developed catalyst (Ni@$NiCo_2O_4$@CC) is exhibiting exceptional performance towards HER, showing very low overpotential of only 59 mV to achieve a current density of 10 mA cm^{-2}, which is comparable to the state-of-the-art Pt/C catalyst.

Keywords: Hydrogen evolution reaction; Electrocatalyst; Nanocatalysts; Heterostructure

Abstract ID: TET-PP9

Enhancement of hydrogen storage in Hythane gas mixture using the gas hydrate technology

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Abstract
The world is moving from the application of liquid-based and highly-emitting fuels to gaseous fuels with better environmental aspects and transport options. Natural gas has been utilized as one of the cleanest energy sources; however, scientific efforts are made to replace it with a hydrogen gas-based economy. Due to operational and safety challenges that lies in storing and transporting hydrogen, this technology requires more adequate time to gain maturity.
Researchers around the world have come up with the transitional solution of blending hydrogen into natural gas for hydrogen storage and as a transport fuel mixture. The standardized 85% methane and 15% hydrogen mixture is called 'Hythane'. In the current investigation, Hythane was converted into ice-like solids using the gas hydrate technology. Gas hydrates are crystalline solids created when gas is enclosed in cages of hydrogen-bonded water molecules. There is a challenge of mass transfer limitation at the water-gas interface in this technology. To overcome this, propane was introduced in the mentioned Hythane gas to shift the thermodynamic hydrate formation requirements. The objective of this research is to enhance the safe and efficient storage of hydrogen in the gas hydrate form. The experimental findings are promising for further research and scalability.

Keywords: Gas hydrate; Hythane; Hydrogen storage

Abstract Id: TET-PP11

Green Hydrogen from Biomass : A Comprehensive ASPEN Simulation Study

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Abstract
In the pursuit of sustainable energy, mature biomass gasification technology offers a combustion-free conversion of biomass into hydrogen and other products. Initial gasification produces synthesis gas, comprising hydrogen, carbon monoxide, and carbon dioxide. Cryogenic methods, including condensation and methane scrubbing, follow CO_2 removal for hydrogen purification. A hybrid approach combines membrane and pressure swing adsorption (PSA) technologies, enhancing hydrogen production efficiency and flexibility. The PSA system also exhibits potential for carbon dioxide removal from process gas streams. Post Combustion Capture (PCC) is a viable method for recovering CO_2 from hydrogen plant flue gases. Innovative subzero temperature utilization emerges for efficient hydrogen separation. Integration of appropriate heat exchangers is explored for economical gas purification. The captured CO_2 holds promise for enhanced oil recovery or recycling into feed for improved conversion. This research employs Aspen Plus simulation for comprehensive analysis and modeling of the process, while acknowledging limitations in default model utilization. The software also proves instrumental in designing and simulating various process scenarios, enabling a robust exploration of potential outcomes. The study highlights a viable greener hydrogen production approach with significant implications for a sustainable energy future.

Keywords: Green Hydrogen; Biomass; ASPEN; Flue Gas; Biomass gasification

Abstract ID: TET PP14

Enhanced Cold Energy Storage Efficiencies in Semi-Clathrate Hydrates by the Application of Quaternized Ammonium Salts

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Abstract
This study addresses the growing demand for cold energy storage in various industrial sectors for efficient cold energy storage solutions, which has escalated across numerous industries, encompassing applications such as space cooling, food

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preservation, and refrigerated transportation systems. However, the substantial electricity consumption associated with traditional cooling methods poses economic and environmental challenges. This study explores the promising potential of semi-clathrate hydrates (SCHs) as a novel cooling system to reduce energy costs in cold energy storage. The proposed approach involves generating and accumulating cold energy during low-demand periods, using cost-effective off-peak electricity, and deploying this stored energy during high-demand peak periods. In this study, we investigate the application of a semi-clathrate hydrate slurry consisting of Tetrabutylammonium Bromide (TBAB). This compound exhibits a latent heat capacity within the 6–14 °C temperature range, making it well-suited for many such cooling applications. Our research focuses on varying TBAB solution concentrations to interpret the kinetics of hydrate formation, i.e., storage of cold energy and melting, which means releasing stored cold energy by gaining heat to the surroundings. Additionally, the research goes through the morphology and stability of these hydrates under diverse temperature conditions. Raman spectroscopy analysis is done to understand the hydrate structure comprehensively. In addition, micro-differential Scanning Calorimetry (micro-DSC) is used to explore latent heat storage capabilities. The study on TBAB-based semi-clathrate hydrates helps us to better understand their formation and characteristics. It also shows there could be more sustainable and energy-saving ways to store cold energy for a long duration whenever available freely.

Keywords: Cold energy storage; Energy efficiency; Semi clathrate hydrate; TBAB hydrate

Abstract ID: TET-PP15

A Review on Reducing Capacity Fade Techniques in Vanadium Redox Flow Battery

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Abstract
Vanadium redox flow batteries (VRFB) have proved to be robust systems for electrochemical energy storage system. One major issue that hinders the long-term performance of these systems is the loss of available capacity over time. Typically, VRFBs experience significant capacity fade during cycling, which occurs primarily due to the undesired transport of vanadium ions through the membrane (known as 'crossover'). Species crossover during operation initiates side reactions which reduce the system capacity, lower the device voltage, and increase the operating cost. Despite these benefits, practical VRFB operation suffers from electrolyte imbalance, which is primarily due to the transfer of water and vanadium ions through the ion-exchange membranes. In this review work we address all the possibilities and techniques to reduce the capacity fade problem occur in VRFB system, such as introducing a hydraulic shunt between the electrolyte tanks, having stacks containing both anion and cation exchange membranes, VRFB operating under asymmetric current condition, a new electrolyte flow management study, electrolyte remixing techniques, numerical modeling study and many other techniques will discuss. Review work will include single cell study as well as stack level study.

Keywords: Vanadium redox flow battery; Capacity Fade; Membrane

Abstract ID: TET-PP16

Cyclability and Capacity Improvement Strategies for Lithium-Ion Batteries: A Comprehensive Review

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Abstract
Lithium-ion batteries have sparked a revolutionary change in the fields of portable electronics and electric vehicles, primarily because of their extraordinary specifications, such as their high energy density and long cycle life. Despite outstanding achievements, the scope of improvement regarding cyclability and capacity retention persists. The main goal of this review article is to embark on a thorough investigation of the most recent advancements in the field of capacity improvement and cyclability enhancement technologies, specifically designed to address these lasting Li-ion battery difficulties. With a focus on crucial elements, including silicon-based anodes, high-capacity cathode materials, conductive additives, and enhanced protective coatings, our review has encompassed the rigorous and thorough curation of a wide range of research publications and findings. This review conducts a comprehensive analysis of various tactics developed to address the related problems of cyclability and capacity within this complex and varied landscape. These include but are not limited to, the investigation

of sulphur-based cathodes, composite electrodes, and the incorporation of solid-state electrolytes. These observations are meant to guide the development of battery research, policy-making, and sustainable energy storage solutions.

Keywords: Lithium-ion batteries; Cyclability; Capacity improvement; Material innovation

Abstract ID: TET-PP17

Crypto Currents: Navigating the Energy Transition for Sustainable Bitcoin Mining Opportunities

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Abstract
The rapid growth in the Bitcoin network has drawn more attention toward its energy consumption in terms of environmental sustainability and investments. Our study approaches this issue from a chemical engineering perspective. For better efficiency, we consider innovative cooling methods, more efficient hardware designs, and the utilization of waste heat from mining rigs to improve energy efficiency, aiming to assess the energy storage and energy efficiency of Bitcoin mining. In this analysis, we look into the basic principles of Bitcoin mining and their requirements and their involvement in energy demands. To analyze the energy resources used by miners worldwide, including fossil fuels and renewable energy, to understand the environmental impact of Bitcoin mining operations. Our study explores the challenges and opportunities faced by miners throughout the world. To reduce the carbon footprint of cryptocurrency mining and greenhouse gas emissions. The transition in using more renewables instead of non-renewables to reduce the environmental impact and promote clean energy. Providing a deep understanding of the supply and demand of the energy market. We believe that there are better opportunities for chemical engineers to contribute to sustainable practices within the cryptocurrency industry.

Keywords: Bitcoin mining; Sustainability; Energy transition; Energy storage

Abstract ID: TET-PP19

Studies on the types of hydrogen based on their mode of production

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Abstract
Hydrogen is a clean energy source that has the potential to revolutionize the way of life. This study compares green, grey, and blue hydrogen production methods, focusing on their environmental impact and future potential. Green hydrogen, produced by electrolysis using renewable energy sources, is ideal for decarbonizing industries. Grey hydrogen, produced from natural gas through steam methane reforming, produces significant carbon dioxide emissions. Grey hydrogen includes carbon capture and storage technology to reduce emissions. The study assesses the environmental effects of each hydrogen generation technique, considering factors like carbon footprint, water use, and air pollution. It also explores the potential uses of green, grey, and blue hydrogen in manufacturing, transportation, and energy production. The study emphasizes the importance of environmentally friendly hydrogen production to reduce climate change. The advantages and limits of green, grey, and blue hydrogen are discussed in detail in this comparative study. It emphasizes the significance of shifting to environmentally friendly hydrogen production techniques in order to reduce climate change and promote the development of a cleaner energy future.

Keywords: Renewable energy; Green hydrogen; Grey hydrogen; Blue hydrogen; Carbon emissions

Abstract ID: TET-PP20

Synthesis of Butyl butyrate in aqueous and organic solvents using lipase as a catalyst

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Abstract
Condensation of butyric acid and n-butanol produces butyl butyrate, a jet-fuel additive as well as a flavoring agent. Enzyme-based biological methods for producing butyl butyrate are more friendly than the conventional chemical route. Lipase is used as an enzyme as it demonstrates pH memory, enhanced enzyme activity, and stability at high temperatures. In this piece of research, the amounts of the substrate (butanol [Make: Sigma Aldrich; CAS No.:71-36-3] and butyric acid [Make: Sigma Aldrich; CAS No.: 107-92-6]) and organic solvent (Hexadecane) [Make: Sigma Aldrich; CAS No.: 544-76-3] are varied to determine the optimal production of butyl butyrate. Additionally, two distinct sources of lipase, namely, (a) lipase from Candida *rugosa* (Make: Sigma Aldrich, CAS No.: 9001-62-1) and (b) a recombinant version of lipase expressed in Aspergillus *niger* and immobilized in acrylic resin (Make: Sigma Aldrich, CAS No.: 9001-62-1) are used. A preliminary kinetic study is carried out to optimize the production of butyl butyrate in the presence of unavoidable inhibitors. Independent process parameters will be optimized employing response surface methodology using a Box-Behnken design. Also, a variety of machine learning models for predicting the yield of Butyl Butyrate will be developed. Further improved methods to modify the activity and thermostability of lipase, which are economical and environmentally friendly, will also be performed.

Keywords: Lipase; Butyl Butyrate; Hexadecane; Box Behnken Design; Machine learning models

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Synthesis of nanomaterials; Nanophotonics and Nanoelectronics; Nanobiotechnology; Nanomagnetism; Self assembly of nanomaterials; Nanoparticles for Biomedical Applications; Nanofibers and Nanotubes; Gold Nanoparticles and Carbon Nanotubes; Application of Functional Nanomaterials and 2D Materials; Synthesis, Characterization and Applications of Sustainable Advanced Nanomaterials; Novel Green Nanotechnologies Applied in Environmental Protection and Health; Quantum Dots.

Abstract ID: ANN-OP1

Biopolymer Supported ZnO Bionanocomposites Film and their Application in Environmental Remediation and Controlling of Contagious Diseases

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Abstract
Bionanocomposites are innovative sustainable materials that possess multifunctional attractive nature in various fields. Cellulose/chitosan/ ZnO bionanocomposites (CCZBC) films were synthesized by utilizing water extracts of *Livistona jekinsiana* as reducing as well as capping agents to synthesize ZnO NPs impregnated chitosan/cellulose bionanocomposites thin film. X-ray diffraction pattern of CCZBCC revealed the wurtzite structure of ZnO nanoparticles. Fourier transform infrared spectroscopy revealed the presence of plant extracts, cellulose, and chitosan in CCZBC. Scanning Electron Microscope (SEM) images provided information about the morphology of the surface of CCZBC. The elemental composition of CCZBC was determined by Energy Dispersive X-ray (EDX) analysis. Transmission Electron Microscope (TEM) provided the shape and size of CCZBC. CCZBC possessed efficient photocatalytic degradative properties in the remediation of two anthropogenic dyes, Eosin blue and Bromocresol green, potential antimicrobial activity against *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*)., and antioxidant property in DPPH assay. Therefore, the chitosan/cellulose/Ag NPs bionanocomposites film can be considered an efficient material for biomedical and environmental applications.

Keywords: Bionanocomposites; ZnO nanoparticles; Cellulose; Chitosan; Thin film

Abstract ID: ANN-OP2

Surface Functionalization and Antimicrobial Activity of Transition Metal Complexes of Co (II) and Ni (II) derived from Cefadroxil with SBA-15 Nanoporous Silica

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Abstract

Recently, nanoporous silica SBA-15 known a rapid development in curative applications due to its highly ordered hexagonal topology and controllable pore size and intensively studied as bio-materials for controlled drug delivery. SBA-15, with a large surface area, nanosized pores, thick walls, and easy surface modification has attracted much attention in academic research for the delivery of natural and chemical drugs. This study aims to be able to address whether the surface functionalization of SBA-15 with transition metal complexes of Co(II) and Ni(II) derived from Cefadroxil would improve the loading of a drug into these complexes. The synthesized SBA-15 with metal complexes of Cefadroxil were surface functionalized by post-grafting synthesis method and the study of antimicrobial activity of functionalized CEFDX-SBA-Co(II) and CEFDX-SBA-Ni(II) are proposed. The uniform incorporation of these complexes inside the SBA-15 framework was confirmed by the Powder X-ray Diffraction method, Nitrogen adsorption-desorption isotherm studies and SEM etc. The formation of CEFDX-metal complexes as connectors to the SBA-15 surface was confirmed with high activity and selectivity. It is also observed that on functionalization, such materials exhibit a greater capacity for drug loading and insure a selective and controlled release of drugs, and play an important role in the antimicrobial application.

Keywords: Nanoporous; SBA-15; Metal complexes; Cefadroxil

Abstract ID: ANN-OP7

Molecular Dynamics Simulations: Modelling and Analysis of Single Crystal Au-Pt Alloy Nanowires

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Abstract

Research into the mechanical properties of metal-alloy nanowires has enhanced our knowledge of the unique characteristics of these nano-components for development of various sensing and actuating devices. In this work, mechanical properties of Au-Pt alloy nanowires of two different compositions namely Au_{50}-Pt_{50} and Au_{25}-Pt_{75} have been analyzed and are compared with pure Au and pure Pt nanowires. Molecular dynamics simulatiosssns using open-source software LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator) has been utilized to comprehend the variation in mechanical properties with temperature as well as composition. Results demonstrate that all the mechanical properties of nanowires studied in this work, namely Yield stress, Elastic modulus, and Modulus of Resilience, deteriorate with temperature. It is also concluded that Au-Pt alloys with composition of Au (25%), i.e., Au_{25}-Pt_{75} show improved mechanical behavior than Au (50%) i.e., Au_{50}-Pt_{50}. Au_{50}-Pt_{50} alloy nanowires also have poorer mechanical properties than both pure Pt and pure Au nanowires, whereas Au_{25}-Pt_{75} nanowires have better properties than pure Au as well as Au_{50}-Pt_{50}. The significance of elastic modulus in specific electrochemical sensing applications has also been described.

Keywords: Metal-alloy nanowires; Mechanical properties of Au-Pt alloy nanowires; Largescale atomic/molecular massively parallel simul

Abstract ID: ANN-OP8

Green synthesis of monometallic, bimetallic and trimetallic nanoparticles: Its applications on pharmaceutical industries: A review

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Abstract

Nanotechnology is a rapidly developing technology with a wide range of uses in the field of science especially in pharmaceutical industries as catalysts, anti-microbial agents, anti-oxidant inhibitor, cancer therapy etc. The size of the synthesized nanoparticles usually ranges from 1nm to 100nm. Nanoparticles can be synthesized with either of the two methods i.e., bottom-up method or top-down method. The green synthetic route falls under the bottom-up method is also environment friendly. The plant extracts, fungi and bacteria are used for synthesizing nanoparticles in green synthesis pathway. Nanoparticles are of various types viz., monometallic (metal), bimetallic (metal-metal) and trimetallic (metal-metal-metal) etc. Metallic or metal oxide nanoparticles in particular have some benefits like a straightforward preparation procedure including desirable size and shape. The green synthesized nanoparticles have demonstrated excellent outcomes in a number of biological activities, including anti-diabetic, anti-cancer, anti-inflammatory, anti-oxidant, and anti-microbial activities. The study of various green synthesized metal oxides and metallic nanoparticles (monometallic, bimetallic and trimetallic) including its applications in the field of pharmaceutical industries are the main focus of interest of the present review paper.

Keywords: Nanotechnology; Nanoparticle; Green synthesis; Biological activity; Pharmaceutical

Abstract ID: ANN-OP9

Plant-mediated green synthesis of noble metal nanoparticles for thermoelectric application

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Abstract
In light of increasing environmental pollution and alternative energy sources, developing environment-friendly synthesis techniques for thermoelectric materials has gained significant attention. This article reports a noble synthesis method for silver telluride chalcogenide (Ag_2Te-Ch) developed using plant extracts as capping agents to avoid toxic chemicals. Methodologically, the precursor materials are blended in the correct quantities and dissolved in a solvent as part of our two-step process. After this, the solution is allowed to react to produce the thermoelectric material. Ag_2Te-Ch nanoparticles were characterized using various techniques, including X-ray diffraction, scanning electron microscopy, and transmission electron microscopy. Bi_2Te_3 and Sb_2Te_3 nanoparticles were synthesized using a hydrothermal method with chitosan, which is found to have a size of 50-80 nm, exhibiting good thermoelectric properties. Green reducing agents such as water or ethylene glycol synthesized graphene-based thermoelectric. The method used here to synthesize graphene oxide nanosheets decorated with Bi_2Te_3 nanoparticles exhibited a high Seebeck coefficient and Peltier effect. Our findings suggest binary chalcogenides doped with oxides for developing low-cost thermoelectric materials with potential applications in wearable devices and energy harvesting systems.

Keywords: Chalcogenide; Green synthesis; Nanostructured materials; Thermoelectric; Power generation

Abstract ID: ANN-OP11

Brewery Waste as starting material in the synthesis of AuNPs: Its application in degradation of organic fabric colours

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Abstract
Brewery waste has been utilized in the green synthesis of nanoparticles due to its ability to reduce the use of potentially harmful chemical precursors and negative effects. Rice based fermented ethnic beverage "*Joubidwi*" is produced with the help of native yeast culture *Amao* and consumed by local tribal peoples of Kokrajhar district of Assam, North-East India. The residual waste biomass from fermentation is often thrown or to fed pets. In this study, waste produced after the fermentation of liquor (brewery waste, BW) was collected and dried; extracted in ethanol for 48 hr. AuNPs was synthesized using BW ethanolic extract in 1:20 ratio from 1mM $HAuCl_4$ solution and the formation of AuNPs were confirmed with visual detection of colour changes from yellow to purple to tomato red. The reducing capacity of BW-extract is due to containing biomolecules like soluble proteins, carbohydrates, polyphenols etc. The synthesized AuNPs were characterized by UV-vis spectroscopy, FTIR, SEM, TEM, XRD etc. Here, produced AuNPs were investigated for catalytic degradation of two

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organic fabric colours-methylene blue (80%) and congo red (90%) at 22 minutes and 14 minutes respectively. The products formed during catalytic degradation for both dyes were analyzed by GC-MS methods.

Keywords: Nanoparticles; Degradation; Organic dye

Abstract ID: ANN-OP14

Development of Solar Active Ag-ZnO Heterostructure Photocatalyst for Wastewater Treatment

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Abstract
In current day the scarcity of fresh water is a very serious issue. Water is getting polluted day by day by natural cause, domestic application and industrialization. So in this situation to remove the water scarcity, the only solution is recycling the wastewater after proper treatment. Considering the textile, paint, and pharmaceutical industries the two of the main pollutants which cause water pollution is synthetic dyes and pharmaceuticals products. Photo-catalysis is one of the methods to degrade all these pollutants in presence of suitable light source. Herein, we studied efficacy of synthesized ZnO nanoparticles (Band Gap ~ 3.36 eV) in the presence of UV as well as solar lights. ZnO have limitation because of its high band gap, it is effective under UV light only. Now to enhance the catalytic activity further noble metal Ag nanoparticles are doped with ZnO which increased the removal efficiency under both UV and solar light source. Different characterized techniques (UVVis, FESEM, TEM, XRD, BET) were used to characterize ZnO and heterostructured AgZnO nano photocatalyst. Under both UV and visible light source Ag-ZnO shows higher photocatalytic activity compare to the base ZnO nanoparticles.

Keywords: Photo-catalyst; Wastewater treatment; solar light; Noble metal

Abstract ID: ANN-OP16

Green synthesis of Zinc Oxide nanoparticles and its adsorptive studies on removal of Congo red dye

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Abstract
The present study, aims to exploit the experimental determination of biosorptive characteristics of synthesized zinc oxide nanoparticles (ZnO-Np's) with Tabernaemontana divaricata green leaf extract. Synthesized ZnO-Np's were characterized by SEM, XRD and FTIR analysis. The resultant nanoparticle size obtained is 189 nm. The process variables such as Agitation time, Initial concentration of CR dye, pH, Dosage of ZnO-Np's and Temperature were performed and compared by using response surface methodology (RSM). At the optimized parameter conditions, the dye adsorption was studied from Isotherms, Kinetics and Thermodynamics, respectively. At the optimized conditions, maximum removal (93.1%) of CR dye occurred. It was found that the Langmuir isotherm, pseudo second order kinetics fitted the data better as compared to other isotherm and kinetic models. The results of thermodynamic studies give exothermic nature, thermodynamically feasible nature of adsorption.

Keywords: Tabernaemontana Divaricata; Congo red; ZnO-Np's; Isotherms; Kinetics

Abstract ID: ANN-OP17

Lipid Based Drug Delivery Systems: Promising Carriers for Bioactive Compounds and Therapeutic Agents

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Abstract
Bioactive compounds, owing to their antimicrobial and antioxidant characteristics, have attracted a great interest in the field of drug delivery as a potential strategy to cut out the use of synthetic ingredients being replaced by bioactive compounds. Various drug delivery systems are now being used as promising carriers for the delivery of bioactive compounds to products such as food, pharmaceuticals, health science, agriculture, cosmetics, and so on. This study focuses on lipid-based drug delivery systems (LDDS), which have gained significant attention in the field of drug delivery due to their ability to improve the solubility and bioavailability of poorly water-soluble drugs. LDDS are versatile and capable to deliver both hydrophilic and hydrophobic drugs with improved and targeted drug delivery. This study describes different lipid-based systems, including liposomes, solid lipid nanoparticles, nanostructured lipid carriers and self-emulsifying drug delivery system, and discusses their advantages and limitations with potential applications in drug delivery. It also covers recent advancements, such as the use of hybrid lipid-based systems and development of new lipid materials. The overall goal of this study is to provide a comprehensive knowledge of LDDS and their potential application in the development of novel drug carriers, making them a crucial area of research from industrial viewpoint.

Keywords: Lipid-based systems; Bioactive compounds; Drug delivery; Nanoemulsions; Solid lipid nanoparticles; Liposomes

Abstract ID: ANN-OP18

Covalent Organic Framework for Detection of NH_3

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Abstract
A family of crystalline porous organic polymers with polygonal porosity and highly organized structures are known as covalent organic frameworks (COFs). Industrial waste gases such carbon oxides, nitrogen oxides, NH_3, sulphur oxides, H_2S, and volatile organic compounds (VOCs) are being released into the environment at a rising rate due to the quick expansion of human society. For the protection of human health and security, the identification of toxic gases is crucial. A new imine linked covalent organic frameworks (COFs) sensor NH_3 gases has been designed and synthesized under scandium (III) trifluoromethanesulfonate [$Sc(OTf)_3$] catalysis in a 1,4- dioxane/mesitylene mixture. Different characterization was done for the prepared COF like XRD, FT-IR, UV-Vis, SEM, BET. The synthesized COFs structure is effects by amount of $Sc(OTf)_3$ catalyst. With increasing the catalyst amount, synthesized COFs evolves to a disordered structure. The better electric conductivity found in disordered structure than the crystalline COF. The NH_3 sensing ability is good including large response value, short time response and high sensing. The density functional theory (DFT) and UV-Vis experiment support the establishment of a hydrogen bond between NH_3 and imine linkage during the NH_3 sensing process.

Keywords: Covalent organic frameworks; NH_3 sensing; $Sc(OTf)_3$

Abstract ID: ANN-OP19

A morphology-based study of novel Gd_2MoO_6 nanoparticle and its photocatalytic activity

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Abstract
Gd_2MoO_6 nanoparticle was developed by using different solvents and capping agent to observe its photocatalytic activity towards pharmaceutical degradation. Effect of solvents (N, N dimethylformamide and ethylene glycol) and capping agent (cetyltrimethylammonium bromide, CTAB) on chain elongation and nucleation mechanism of nanocatalysts was observed. Four synthesis routes were implemented to observe the morphological variation of the nanoparticle, revealed by FESEM images, indicating the effect of solvents as well as CTAB. The addition of CTAB helped to form ultrathin nanoflakes like morphology (Gd-DC) whereas, broken and distorted flakes like nanoparticle (Gd-D) was observed for the route used only DMF. Agglomerated diffused morphology (Gd-E) was found in EG-based route. The optical characteristics revealed more optimized band gap of Gd-DC samples under visible light. Density Functional Theory (DFT) calculation verified its optoelectronic properties with the experimentally obtained one. Along with high crystallinity and better electrochemical property, the Gd-DC sample was able to show outstanding photodegradation ability of complex hazardous drug, chloramphenicol to more than 90% under visible light. The catalyst also showed excellent results in photoelectrochemical water splitting and photocurrent generation.

Keywords: Nanoparticles; Photocatalysis; Pharmaceutical; DFT

Abstract ID: ANN-OP20

Studies on biogenic synthesized nanoparticles from solid waste with functional evaluation

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Abstract
Nanoparticles, size ranges 1 nm to 100 nm in diameter. In recent years the silver nanoparticles play an important role in various field such as nanoscience, nanotechnology particularly in Nano medicine. Various nanoparticle synthesis can be done by many researchers among them biogenic silver nanoparticles is most essential because of their tremendous medicinal values. Green synthesis of silver nanoparticles can be done using bio-waste is most acceptable rather than others chemical and physical extraction method. In my recent study we have synthesized environment-friendly silver nanoparticles using pomegranate peel extract as a stabilizing and reducing agent. Formation of silver nanoparticles is confirmed by apparently an intense colour change from yellow to brown and appearance of a peak in a UV-vis around 400-430nm. The synthesized Pomegranate peel extract silver nanoparticles (PG-AgNPs) were characterized and evaluated for their antioxidant and antimicrobial and anticancer and antidiabetic potential.

Keywords: Biogenic synthesis; Silver nanoparticles; Antimicrobial; Antioxidant; Anticancer; Antidiabetic

Abstract ID: ANN-OP21

Biogenic synthesis and characterization of silver nanoparticles using Mango (Mangifera indica) seed kernel extract and evaluation of the functional properties

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Abstract
Mangifera indica is an indigenous herb in medical and Ayurvedic formulations for over 4000 years with various pharmaceutical properties. Nanoparticles particularly silver nanoparticles have gained considerable attention in recent days

for its broad spectrum of properties which includes antimicrobial activity, gene therapy, drug delivery, cosmetic therapy etc. Also, silver nanoparticles are inexpensive and nontoxic for applications on human and other animals. In mango seed kernel presence of phenols, alkaloids, flavonoids, terpenes and reductase operate as reducing agent in metallic nanoparticle synthesis. In this study silver nanoparticles are synthesized in a simple and ecofriendly way by utilizing mango seed kernel extract and characterization of the nanoparticles was evaluated using ultraviolet-visible spectrophotometry, Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), scanning electron microscope (SEM), and X-ray diffraction (XRD). Antioxidant properties were evaluated using DPPH assay method and antibacterial activity of the prepared nanoparticles were analysed on four pathogenic bacteria, namely *Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis, Staphylococcus aureus*.
Keywords: Bio-compatible; Silver nanoparticles; Antioxidant property; Antibacterial property

Abstract ID: ANN-OP22

Effect of Ag loading on anatase-rutile phase transformation of Titania

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Abstract
In the field of semiconductor photocatalysis and new generation solar cell technology, TiO_2 is one of the most suitable metal oxide materials, exist in three different polymorphs - anatase, rutile and brookite. Among them, mixed phase TiO_2 with appropriate anatase-rutile phase ratio show superior performance than its pristine counter parts due to its efficient charge carrier separation. However, the performance of the titania in its both pristine and mixed phase is limited due to its wide band gap leading to the inability to utilize the visible part of the total solar spectrum. Therefore, various research groups are exploring different modification techniques to reduce its bandgap and to increase its photon absorption in visible range and reduce its charge carrier recombination through anionic/cationic doping, formation of heterojunctions. In addition, modification of TiO_2 with noble metal loading is another suitable technique to improve photon absorption in visible region through surface plasmon resonance (SPR). In this study, TiO_2 is modified with noble metal- silver (Ag) and studied the effect of Ag loading on the phase variation. This study confirms that Ag loaded TiO_2 resist the phase transformation of anatase to rutile as seen from the XRD pattern. The change phase ratios are evaluated by both Spurr-Meyer's formula and Rietveld analysis.

Keywords: Mixed phase TiO_2; Noble metal loading; Surface plasmon resonance

Abstract ID: ANN-OP23

Contemporary Research on Synthesis of Silver Nanoparticles & it's Applications

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Abstract
Nanomaterials due to their unusual properties at the nano regime compared to their bulk composition, have led to huge progress in the research of materials in biomedical, chemical, and biological sciences over the last couple of decades. The development of different methodologies to synthesize precise shapes and sizes has boosted the application of nanoparticles in the fields of medicine and agriculture. Silver nanoparticles (AgNPs) have been the solution to various hurdles. Silver has generally been associated with its ornamental features, but with the decrease of its size (1-100nm), it shows a huge potential improvement in its chemical properties as well as physical properties. The distinctive properties of AgNPs are determined by their size and shape. It suggests astounding applications, many of which are in the fields of biopharmaceuticals, biosensors, chemotherapy, optical imaging, theranostics, and photothermal therapy. Because of their

unique properties, AgNPs have piqued the interest of many researchers. This review aims to summarize all the titbits of information associated with the various synthesis method such as physical, chemical, and green synthesis of AgNPs, and their application for advanced technological development.

Keywords: Nano material; Biomedical; Synthesis; Silver Nanoparticles

Abstract ID: ANN-OP24

Remarkable performance of new generation catalyst-support combination serving for EOR and ORR in low temperature fuel cell

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Abstract
Fuel cells have been recognized as one of the emerging power generation devices that can explore the renewable technologies to derive clean and quite power. Although, high purity H_2 oxidation is kinetically favored on Pt electro-catalyst, stringent catalyst requirement has become a challenging issue for ethanol oxidation reaction (EOR) being a C-2 molecule. On the other hand, irrespective of the anode feed (hydrogen/alcohol), oxygen is invariably reduced at cathode and thus oxygen reduction reaction (ORR) stands as a ubiquitous reaction which demands for in-depth electro-catalytic studies. However, use of Pt in fuel cell is now a limiting factor due to its exorbitant cost. Use of carbon support also suffers from deactivation of active sites that majorly contributes to catalyst failure.
In this context, the present article focuses on designing and fabrication of low-level Pt reinforced with transition metal (TM) Ni and Co supported on MnO_2, transition metal oxide (TMO) and their validation for EOR and ORR catalysis. The metal NPs were deposited by chemical reduction on MnO_2 which is obtained through a green synthetic approach adopting solid phase synthesis. The catalysts were subjected to structure and morphology determination and subsequently to electro-catalytic studies. The novel materials eventually intervene in the anode and cathode reaction sequences delivering appreciable power density in an in-house fabricated membrane fuel cell.

Keywords: Low level Pt catalyst; Transition metal; EOR; ORR; Fuel cell

Abstract ID: ANN-OP26

Biogenic synthesis of silver nanoparticles: Characterization and antimicrobial activity

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Abstract
With the increasing necessity of sustainable environment, the importance of green synthesis of silver nanoparticles have gained special focus because of its unique properties which has countless applications in the sector of antimicrobial, anticancer, catalytic, medicine and water-treatment activities. The synthesis of nanoparticles using environment friendly/ non-hazardous materials such as various microbes, natural biomolecules, leaves, flowers and other parts of plants which is known as green chemistry, are emerging as substitute technique of conventional physical and chemical methods, due to their eco-friendly nature. Biogenic synthesis of silver nanoparticles (AgNP) possesses additional advantage in producing nanoparticles of various size, shape and morphology. In this study, green synthesis of silver nanoparticle is carried out by following extracellular mechanism. UV–Vis spectroscopy, Scanned Electron Microscopy (SEM), X-Ray Diffraction (XRD), Energy Dispersive X-Ray Spectroscopy (EDX) and Fourier Transform Infrared Spectroscopy (FT-IR) were performed to determine the characteristics of prepared AgNPs. Four strains of microorganisms were used to investigate the antimicrobial efficacy of the produced AgNP by disc diffusion and minimum inhibitory concentrations (MICs) method. The given result exhibited the effectiveness of the synthesized nanoparticles along with its possible future applications against infectious diseases.

Keywords: Green synthesis; Silver nanoparticle; Antimicrobial efficacy

Abstract ID: ANN-OP 27

Ultra Sound Assisted Green Synthesis of Silver Nano Particles from Green Algae and Its Applications

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Abstract
Green synthesis is an innovative and novel approach for the environmentally friendly and non-hazardous synthesis of nanomaterials using environmental solvents such as water, ethanol, and others. In this case, ultrasound is used to extract phytochemicals from microalgae that function as reducing and capping agents in the synthesis of silver nanoparticles. The shape and crystallinity of silver nanoparticles are studied utilising spectroscopic, microscopic, and diffraction methods. Because nanoparticles are appealing in technical applications. Thermal conductivities are also quite important in chemical engineering applications, Because of its large surface area, the nanomaterial has significantly higher heat conductivity than the base fluid. Antimicrobial and DPPH scavenging properties were also studied.

Keywords: Green synthesis; Solvents; Phytochemicals; Capping agents; Silver nano particles

Abstract ID: ANN-OP28

XRD analysis of PbS nanoparticles synthesized with CTAB at room temperature

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Abstract
Lead sulfide (PbS) nanoparticles were prepared with a cetyl-trimethylammonium bromide (CTAB) at room temperature. Three different samples of PbS were synthesized using three different concentrations of CTAB such as 0.0025 M, 0.005 M, and 0.01M respectively using the co-precipitation method. These samples were characterized by X-ray diffraction (XRD) and analyzed by the Scherrer equation, Size-Strain plot, and Williamson-Hall plot. Lattice constants were calculated from the Bragg's law equation and the (hkl) value of the planes of PbS crystal which was obtained by matching the XRD data with the Joint Committee on Powder Diffraction Standards (JCPDS) data and rectified by Nelson-Riley function. Analyzed data of these synthesized PbS samples were compared. It was found that the particle size of the synthesized PbS nanoparticles decreased with the increased concentration of CTAB.

Keywords: Lead Sulfide; Nanoparticles; CTAB; XRD

Abstract ID: ANN-OP29

Similarity Transform-based Numerical Analysis of Natural Convection over an Inclined Flat Plate using Nanofluid

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Abstract
Convection heat transfer is the predominant mode of energy transport in many industrial heating or cooling equipment. Nanofluids, with favourable physico-chemical attributes as heat transfer medium, have replaced conventional fluids in novel heating or cooling processes. Several of these energy-efficient applications are based on natural convection as the predominant heat transfer mechanism, across a wide range of length scales. Literature review indicates relatively fewer studies devoted to evaluation of heat transfer coefficients of nanofluids, whereby reliable predictions of energy transport rate remain relatively unaddressed. In this perspective, the main objective of the present simulation study is to investigate natural convection in a simplistic configuration, where coupled effects of temperature-dependence of different physical variables and parameters are considered. Effects of variable flow parameters, physical properties of fluid medium, shape factor and

concentration of nanoparticles, and thermal boundary conditions are considered. The study considers variable flow parameters and thermo-physical properties of fluid medium, shape factor and concentration of nanoparticles, and thermal boundary conditions, in an attempt to build up a physically consistent theoretical and computational model of heat transfer.

Keywords: Natural convection; Nanofluid; Similarity transformation; R-K method

Abstract ID: ANN-OP31

Emerging 2D nanostructures and nano-heterostructures for electronic, optoelectronic and energy applications

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Abstract
Recent advances in atomically thin two-dimensional (2D) materials have led to a variety of promising future functional applications in post-CMOS nano-electronics and efficient energy generation and storage. Graphene and other atomically-thin layered 2D transition metal dichalcogenides (TMDs) have created enormous research activities for the past decade. Scalable synthesis and functionalization of various 2D-materials and their structural, electrical, and electrochemical properties are elaborated in this work. In specific, tailoring the structure of the surface and interface of the 2D-heterostructured materials lead to tailor properties via nano-engineering are discussed in this work. This talk is also focused on thoroughly illustrate the current status and prospects for 2D heterostructured materials, which have been contemplated for synergistic high-end technological applications for nextgeneration electronics and energy devices. For example, 2D-MoS_2 based photosensitive MOS capacitors have been demonstrated as low-powered photosensors. Furthermore, synergistic 2D graphene-based composite films and their electromagnetic applications are discussed. Various other forms of applications are covered, including supercapacitors, electrochemical sensors, photoelectrocatalysis, energy-harvesting, and so on. In recent times, 2D-semiconducting quantum dots (QDs) viz. MoS_2 QDs has received extensive attention because of its significant inherent characteristics like electronic and photoluminescence properties. 2D-MoS_2 QDs based systems will be shown to develop various optoelectronic devices due to their remarkable optical properties, large surface area, chemical stability, biocompatibility, and lower cytotoxicity. An overview of 2D-MoS_2 quantum dots will also be illustrated for demonstrating some novel aspects in optoelectronic and sensing devices. Finally, utilizing the unique properties arising from these materials, how this field of research would lead to innovative various high-end electronics, energy, and sensing devices will be emphasized in this talk.

Keywords: Functional nanostructures; Nano-heterostructures; Two-dimensional materials; Functional nanomaterials and 2D materials; Nanophotonics and Nanoelectronics; Energy harvesting

Abstract ID: ANN-OP34

Morphological Effects of $ZnCo_2O_4$ for Catalytic Soot Oxidation

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Abstract
Diesel particulate filter (DPFs) are widely employed for the abatement of soot emissions. The degree of interaction between a soot and catalyst has significant impact on soot oxidation. The catalyst morphology greatly influences the number of contact points during the solid-solid interaction. In this study, three different $ZnCo_2O_4$ catalyst morphologies have been investigated for soot oxidation. Structural and morphological verifications were carried out by XRD and SEM. The

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reducibility property of catalysts was studied via Soot – TPR. The catalytic soot oxidation performance of all samples was analysed using thermogravimetric analysis. The phase formation of $ZnCo_2O_4$ from three methods were confirmed with XRD analysis. Rod shaped, rose petal shapes and aggregated spherical morphologies were observed in SEM analysis. $ZnCo_2O_4$ with aggregated spherical morphology had shown higher amount of surface adsorbed oxygen species. $ZnCo_2O_4$ with aggregated spherical morphology exhibited the best soot oxidation activity with $T_{50\%}$ of 402 °C.

Keywords: $ZnCo_2O_4$; Catalytic oxidation; Catalyst morphology

Abstract ID: ANN-OP35

Amine Functionalised Graphene Derivatives sourced from wood dust as CO_2 capture device

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Abstract
This study focuses on the production of wood dust-derived amine functionalized graphene derivatives for CO_2 capture applications. Wood dust has been employed has been used as the Carbon Precursor. A quick and scalable one-step procedure is used to covalently attach long chain amine groups (APTES & TEPA) to the surface of graphene derivatives in order to functionalize it. FTIR, Raman spectroscopy, XRD, TEM, and TGA are the analytical methods used to characterise the resultant graphene derivatives. Using a CO_2 analyser setup, the effectiveness of the amine functionalized graphene derivatives as CO_2 collection devices have been assessed. The findings demonstrate the strong CO_2 adsorption ability of graphene derivatives, with an acceptable adsorption performance in ambient conditions (0.4 mmol/g at 32°C and 1 bar). The findings of the research on the adsorption kinetics and thermodynamics of CO_2 capture point to reversible CO_2 adsorption-desorption cycles. As compared to previous graphene-based CO_2 capture materials, the discovered amine functionalized graphene derivatives exhibit comparable CO_2 capture capability. This is a sustainable route for developing CO_2 adsorbents.

Keywords: Graphene; Amine functionalized graphene derivatives; Wood dust; CO2 capture; Sustainable; Adsorption; Kinetics; Thermodynamics; Environmentally friendly; Cost-effective

Abstract ID: ANN-OP36

Functionalization of TEMPO-BNC for Direct Air CO_2 Capture

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Abstract
With rising CO_2 concentration in the atmospheric air, it has become necessary to work on reducing the concentration of this greenhouse gas and prevent global warming. Adsorption-based CO_2 capture has shown good prospects of achieving this goal, and in this current work, a novel adsorbent has been developed for Direct Air Capture of CO_2. A high molar-mass amine (APTES) functionalized TEMPO-oxidized BNC in a 1:1 mass ratio has been prepared via a freeze-drying process and studied for DAC in this work, under atmospheric conditions. The long chain branched structure of APTES makes it suitable for the functionalization of TEMPO-oxidized BNC molecules as it can trap CO_2 molecules efficiently and act as a crosslinker simultaneously. This novel adsorbent showed a remarkable CO_2 adsorption capacity of 1.78 mmol/g at 25℃ temperature and 1 atm pressure during the study. Experimental results showed a significantly low adsorption half-time of 84 seconds.

Keywords: DAC; Amine-functionalization; Adsorption; CO_2 capture

Abstract ID: ANN-OP37

B-TiO_2/g-C_3N_4-based nanocomposites for photocatalytic degradation of methylene blue under simulated sunlight

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Abstract
Photocatalysis based on semiconductors has been viewed as a promising technique to address global energy shortage and environmental degradation. Despite substantial research into graphitic carbon nitride (g-C_3N_4) and TiO_2, their potential applications for semiconductors are constrained by the high rate of recombination of photoinduced charge carriers. Reduced/black titanium dioxide (B-TiO_2)/graphitic carbon nitride (g-C_3N_4) heterojunction nanocomposites employing commercial TiO_2 and urea were successfully made to address society's pressing need for enhanced photocatalytic materials. A variety of techniques were used to evaluate the produced composites, including X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), ultraviolet-visible spectroscopy (UV-Vis), and Raman spectroscopy. The degradation of methylene blue under simulated sunlight was used to gauge the photocatalytic performance. The experiment also showed that pure g-C_3N_4, B-TiO_2, and pristine TiO_2 did not perform as well as B-TiO_2/g-C_3N_4 in terms of photocatalytic performance for degrading methylene blue under simulated solar light irradiation. Moreover, as assessed by free radical trapping experiments, superoxide radicals (O^{2-}) and photoinduced holes (h^+) were found to be the main active species for photodegrading methylene blue.

Keywords: Reduced/black titanium dioxide; Graphitic carbon nitride; Photocatalytic degradation; Methylene blue

Abstract ID: ANN-OP40

Separation of Argon from Oxygen by using Silver-Exchanged Hierarchical Engelhard Titanosilicate

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Abstract
Argon is a crucial industrial gas with diverse applications includes radioisotope dating; therefore, it is important to produce it with high purity. ~ 0.94 vol% Ar is available in the atmospheric air, which is a cheap source. Besides Ar, N_2, and O_2 are also present in the air in huge amounts. Due to the similar polarizability of O_2 and Ar, it is very difficult to separate using the porous adsorbent. In this research, a silver-exchanged hierarchical Engelhard titanosilicate (Ag-H-ETS-10) zeolite with tailored adsorption properties was synthesized and evaluated for its ability to selectively adsorb argon over oxygen. The Ag ion-exchange batch process, which enhances its affinity for argon through specific interactions between silver species and argon molecules. The synthesized sorbent was characterized using XRD, BET, and HR-TEM to understand it physical properties. Static adsorption experiments were performed under various operating conditions to assess the Zeolite adsorbent performance. The influence of temperature and pressure on the separation efficiency was investigated. The developed Ag-H-ETS-10 zeolite exhibited promising results and demonstrated the improved adsorption capacity of the silver-exchanged zeolite Ag-H-ETS-10 for argon, facilitating efficient separation from oxygen. This study contributes to advancements in gas separation technologies, particularly in the realm of argon production and purification techniques.

Keywords: Adsorption; Argon; Engelhard titanosilicate; Separation; Silver; Oxygen

Abstract ID: ANN-OP41

Hydrothermal Synthesis of Carboxylated Activated Carbon from Jute Stick and Reduced Graphene Oxide Based ZnO Nanocomposite Photocatalysts: A Comparative Study

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Abstract

The presence of dyes in the environment is an alarming fact to its sustainability. The harmful effect of colored compounds in ecology and human health is well understood. Therefore, the purpose of this study is to find out a new way of producing low cost and environmentally benign nanophotocatalyst form native resource for removing dye from the effluent of wastewater sources, particularly textile industry. In this study, nanostructure semiconductor photocatalysts ZnO, carboxylated activated carbon from jute stick (local source) based ZnO (ZnO/JSAC-COO⁻), and reduced graphene oxide based ZnO (ZnO-rGO) composites were fabricated by a facile low-cost hydrothermal process. The crystallinity, morphology, particle size, chemical characterization and optical properties were characterized by X-ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FE-SEM), Fourier Transform Infrared Spectroscopy (FT-IR) and UV–visible spectroscopy. The results showed that ZnO has a wurtzite, hexagonal structure without any impurities. The removal of methylene blue dye in water under UV light was then studied to evaluate the photocatalytic performance of these composites. The photocatalyst ZnO/JSAC-COO⁻ composite exhibited greater photocatalytic activity than ZnO and ZnO-rGO. The highest degradation efficiency was achieved 97.56% for methylene blue over ZnO/JSAC-COO⁻ within 300 min under UV light irradiation. The results point out that ZnO/JSAC-COO⁻ composite prepared by hydrothermal method has a potential application in photo-catalysis which leads to the removal of harmful organic pollutant from the environment.

Keywords: Semiconductor; ZnO; Reduced graphene oxide; Jute sticks; Photocatalyst; Photodegradation

Abstract ID: ANN-OP43

Synthesis of Zinc Aluminate nanoparticles: A comparative study on the effect of two different methods on the band gap energy

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Abstract
Stoichiometric zinc aluminate precursors were synthesized through the coprecipitation route and the sol-gel auto combustion method. Synthesized precursors were characterized by particle size analyzer, FTIR spectroscopy, differential thermal analysis (DTA), X-ray diffractometry and scanning electron microscopy and compared. The DTA study showed the formation of the spinel phase at about 400°C. The precursor powders were calcined at different temperature and were analyzed by the X-Ray diffraction technique. The XRD pattern established the complete phase formation of zinc aluminate phase only at 700°C. Particle size was determined from XRD data using the Debye-Scherrer equation and the results clearly showed that nanoparticles produced by the sol-gel auto combustion method with average particle size of 28 nm which is much less than the particle which was produced by the coprecipitation route only. The optical band gap energy is calculated by the Tauc equation based on the UV-Vis spectrum in wave length range from 200 nm-800 nm, and it is found that band gap energy of zinc aluminate produced by the sol-gel auto combustion method is higher than that produced by the coprecipitation route.

Keywords: Nanoparticles; Band Gap energy; Zinc Aluminate

Abstract ID: ANN-OP45

CdSe quantum dot conjugated with ZnO nanoparticle demonstrate an enhanced photocatalytic activity on various azo dyes under sunlight excitation

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Abstract
Here, we have developed CdSe quantum dot (QD) conjugated ZnO nanoparticle (NP) for the sunlight based photocatalytic degradation of congo red (CR) and rhodamine B (RhB). TEM imaging confirmed the formation of CdSe quantum dots with approximate size of 4 nm conjugated with ZnO nanoparticles (~25 nm). Further, FTIR spectroscopy confirmed the presence of various ligands on the conjugate surface. The incorporation of CdSe QD has helped tremendously to reduce the band gap of ZnO to 2.5 eV from 3.2 eV. Also, the conjugation with ZnO NP has significantly enhanced the photocatalytic activity of CdSe QD, as it slowed down the exciton recombination rate in CdSe QD, and acted as an acceptor molecule. The results demonstrated that the prepared conjugate was highly efficient in degrading 20 ppm of CR and RhB under sunlight, with degradation efficiency of 95%. The conjugate also demonstrated high

degradation percentage of 92% even at low pH (pH 2) for both the dyes. The complete degradation of dyes was further confirmed using FTIR analysis of the used photocatalyst. Hence, the prepared conjugate provides a cost-effective solution for photocatalytic degradation of various toxic dyes in aquatic medium using sunlight as the sole source of energy.

Keywords: Quantum dots; CdSe QD; ZnO NP; Photocatalysis; Azo dyes

Abstract ID: ANN-OP46

Hydrothermal Synthesis of Cerium Oxide Nanoparticles and Their Photodegradation Assessment Using Methylene Blue Dye

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Abstract
Cerium oxide (CeO_2) nanoparticles (NPs) have been one of the most important semiconductive materials used for photocatalysis due to their unique material properties and remarkable performance. In this paper, we used hydrothermal methodology to synthesize CeO_2 NPs. The prepared materials were characterized using different analytical techniques such as ultraviolet-visible spectroscopy (UV–vis), Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), transmission electron microscopy (TEM), and energy-dispersive X-ray spectroscopy (EDS). The characteristic absorption peak for CeO_2 was observed from the UV–vis spectrum at 370 nm which primarily indicated the NPs formation. The optical bandgap of synthesized samples was measured from the extrapolation of the linear portion of Tauc plot. The estimated bandgap of CeO_2 were found 3.05 eV. The cubic structure is confirmed by XRD analysis. The average particle size of CeO_2 NPs was 15 nm. The photocatalytic performance of CeO_2 was carried out by the degradation of methyl blue (MB) dye solution under UV light irradiation. The degradation efficiency of CeO_2 were 72% for 3 h which is inspiring.

Keywords: Hydrothermal; Cerium oxide; Nanoparticles; Cubic; Photodegradation; Methyl blue

Abstract ID: ANN-OP49

Dual-layered Antibacterial Scaffold with Zero-Order Release for Critical Wound Healing

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Abstract
Scientific investigations in Electrospinning have been found to escalate in recent years for nanofiber fabrication with enhanced surface area for use in various biomedical applications. In this work, a dual-layered antibacterial scaffold was fabricated using a hydrophobic solvent-casted PLA layer and a hydrophilic electrospun layer of Pullulan, PVA, and Gum Arabic loaded with Gentamicin. The hydrophilic layer prevents scarring during wound dressing removal, and the hydrophobic layer improves mechanical properties and safeguards against the outer environment. The scaffold exhibited antibacterial properties against *Escherichia coli* and *Staphylococcus aureus*. Drug release profile indicated Zero-order controlled release of Gentamicin from the scaffold. In-vitro cytotoxicity analysis against Human Dermal Fibroblasts revealed its non-toxic characteristic. Contact angle measurements of hydrophilic and hydrophobic layers were recorded to analyze the wettability of the fabricated scaffold. These results interpret the potentiality of prepared scaffold to be used in wound healing applications.

Keywords: Pullulan; PVA; Gum Arabic; PLA; Electrospinning; Nanofiber; Scaffold

Abstract ID: ANN-OP52

The molecular arrangement of surfactant and counterion near air/water surface: new insights obtained under electrostatic field

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Abstract
Ionic surfactants are an important class of reagents used in many industrial processes. The macro properties of surfactants are determined by the amphiphilic nature of surfactant tails and ionic interactions with counter ions. Yet, the molecular interaction at the surface remains unclear. Recently, we developed a new method to study the surfactant layer under an electrostatic field. The results showed that the surfactant-generated tension decreased linearly with the strength of the electrostatic field. The experimental observation was also confirmed by molecular simulations. More importantly, the simulation revealed the molecular nature of the interaction. In contrast to conventional notation, the electrical field did not separate the counter-ion from the surfactant head. Instead, the water arrangement around surfactant and counter-ion was re-arranged. The result, from both cationic and anionic surfactants, confirmed the role of water arrangement in surfactant adsorption. The new insights provide an important foundation for predicting surfactant behaviour at the air/water surface.

Keywords: Surfactants; Film tension; Electrostatic field

Abstract ID: ANN-OP53

Zinc intercalated nanostructured electrodes for high performance Zn-ion batteries

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Abstract
Recently metal-air and metal-ion batteries have attracted wide attention as potential replacements for Li-ion batteries. Among these zinc-ion batteries are promising due to their high theoretical energy density and favorable electrochemistry of zinc. A bifunctional cathode that allows for both oxygen reduction reaction (ORR) and oxygen evolution rection (OER) is a basic requirement for rechargeable Zn-ion batteries. Transition metal vanadium oxides (TMVO) such as zinc vanadium oxide (ZVO) possess a layered structure that facilitates intercalation of zinc and multiple oxidation states of V make it bifunctional. This work systematically explored synthesis strategies for formation of zinc vanadium oxide ($Zn_{0.25}$ $V_2O_5.nH_2O$) nanostructures as a Zn-intercalating cathode material for rechargeable Zn-ion batteries. A one-step hydrothermal method without any additives was used to synthesize the material. Controlling the hydrothermal reaction time (12 h, 24 h, 48 h and 60 h) the aspect ratio, crystallite size, chemistry and the crystalline water content between the layers of ZVO were regulated. These parameters were found to greatly affect the specific capacitance (145 $mAh\,g^{-1}$ for 24 h sample to 275 $mAh\,g^{-1}$ for 48 h sample @ 1 C rate), coulombic efficiency (95.4% and 99.6 % for 24 h and 48 h, respectively), reversibility (94% capacity retention after 200 cycles for 48 h) and charge transfer resistance (98 Ω and 61 Ω for 24 h and 48 h, respectively). Subsequently, varying the vanadium precursor the structure of ZVO cathode was altered with unique morphologies (nanobelt, nanoflower and nanoflakes) displaying effective improvement in cycling stability (99% capacity retention after 200 cycles). Finally, we report the first demonstration of 3D porous ZVO cathodes employing freeze-casting as a shaping technique. The freeze-cast electrode exhibited enhanced specific capacitance compared to conventional composite electrodes. In addition, a high cycling stability (99% capacity retention after 500 cycles) with no obvious degradation was attained. This better electrochemical energy storage performance is attributed to its highly porous morphology, which provides large reaction surface, increased interfacial reaction activity, short ion diffusion paths and structural integrity.

Keywords: Zn-ion batteries; Energy storage; Nano materials

Abstract ID: ANN-OP54

Rheological Analysis of Polymer grafted silica dispersions

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Abstract
Surface modification of silica particles with various chemical entities is an effective method for tuning the rheological behaviour. Grafting polymer molecules onto the surface of silica particles through chemical means is done by two methods "grafting from" and "grafting to" techniques. After modification process, the length of the polymer chains plays a

crucial role in determining the classification of the tethered polymers which can either be polymer brushes or polymer mushrooms. The classification as polymer brushes or polymer mushrooms depends on factors such as the polymer chain length, grafting density and solvent conditions. In this work, we have taken Aerosil 200 and grafted it with a product of the reaction between isocyanate terminated methoxy silane and mono amine terminated copolymer of ethylene oxide and propylene oxide. The synthesized polymer and the modified silica particles were characterized using techniques like FTIR, TGA, DSC and SLS. Further, the modified nanomaterials were dispersed in Silicon oil matrix and the detailed rheological study has been performed to understand how the conformation of grafted polymer affects the rheological behaviour. Our results clearly show that such surface modification plays a crucial role towards dispersion quality, which is very critical parameter for producing nanocomposites of optimal properties.

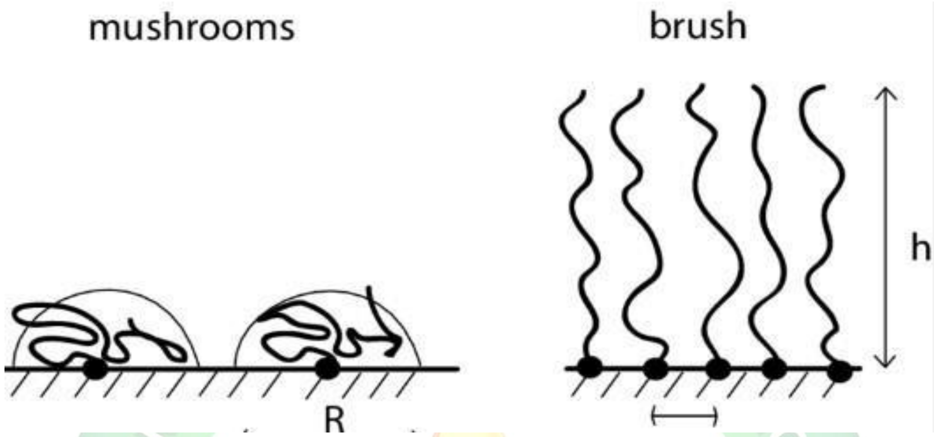

Fig 1: The structure of Polymer Brush of and Mushroom

Keywords: Polymer brush; Grafting density; Surface modification

Abstract ID: ANN-OP55

Bio-based Formation of 1D Surface Vertically Aligned Bi_2S_3 Nanorods for Electrochemical Sensing of Agriculture Pesticides

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Abstract
A huge number of synthetic pesticides is applied for an accelerated agricultural productivity across the entire globe. The remnant pesticide residues pose a rising hazard to ecosystems and human health. The very first step towards the preventive measure to control pesticides pollution is the development of a highly efficient and low-cost device for pesticides determination at their source irrespective to the geographical location. Electrochemical sensors have shown great promises for in-situ detection and determination of targeted analytes such as pesticides, pharmaceuticals, heavy metals, etc. They are merited with low cost, high sensitivity, selectivity, and low detection limit towards the target analytes. Moreover, modifying the working electrode surface with nanostructured-based catalysts such as Bi_2S_3, ZnO, AgNPs etc., could further improve the performance of sensors by several folds. However, the embedded catalysts are delaminated quickly. It could deter reproducible sensing response and shorten its life. Whereas vertically aligned nanorods (VANs) are grown directly onto the base electrode. VANs provide high surface area and surface roughness. Therefore, VANs could eliminate the potent problem of catalyst delamination from the electrode surface. Conventionally, VANs synthesis is carried out in chemical-intensive processes. Herein, we report synthesis of 1D VANs of Bi_2S_3 on the FTO glass in a bio-based route by employing the phytochemicals present in plant and plant organs. Bi_2S_3 VANs were then tested for electrochemical sensing of agricultural pesticides.

Keywords: Bio-based formation; 1D Bi_2S_3 nanorods; Electrochemical pesticides sensing

Abstract ID: ANN-OP56

A Novel method of Synthesis of copper Nanosuspensions from E-waste

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Abstract
E-waste also called electronic waste is one of the fastest growing, most concerning and the most dangerous category of waste in today's world. The reason behind this is that when this kind of waste is simply dumped into landfills or inappropriately disposed of, several factors like rains and surface runoffs facilitate in the leaching of harmful, toxic components and heavy metals present in this kind of waste into water bodies or groundwater reserves. As these sources are the matter of dependency for living beings for the sustenance of the life, along with the water consumed, these unwanted and harmful components also enter the food chain. This can lead to very harmful consequences and also affect living beings and humans in particular. To solve this problem, it is important to tackle this problem of dealing with E-waste. Keeping this intention in mind, a novel method has been devised which consumes the metallic components present in E-waste, transforming it into a nanosuspension which is a value-added product that not only helps in tackling the problem of E-waste, but also helps generate appreciable income and is favourable from a commercial point of view. As, much work has not been done on copper and as copper is present in appreciable amount in E-waste, the focus is on recovery and transformation of copper metal. This process of transformation has been accomplished by chemical reduction method. This step is just the beginning in solving the humongous problem of tackling E-waste and through this effort more players would be interested in the related work and application in the commercial advantage solving this problem on a large scale. Only with the combined efforts of industry and academia, this problem of effectively tackling E-waste on a large scale can be accomplished.

Keywords: E-waste; Nanosuspension; Chemical reduction method

Abstract ID: ANN-OP57

Potential Applications of Carbon Nanotubes in Environmental Remediation

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Abstract
Nanomaterial has revolutionized many scientific and technological areas; environmental remediation is no exception. In the recent year, carbon nanotubes (CNTs) based nanomaterial have received the special attention in the field of environmental applications such as water remediation due to their lucrative properties, such as a high specific surface area, uniform and macroscopic bulky shape, and interconnected porous structures. In this chapter, we have summarized the recent development in the field of design, preparation, and applications of CNTs based nano-composites for environmental remediation and particularly in water treatment by different technologies. After a brief introduction of these materials, water remediation through different mechanisms including adsorption of heavy metals, dyes and other pollutants and transformation of toxic materials into less toxic compounds are summarized.

Keywords: Adsorption capacity; Carbon nanotube; Water treatment; Organic pollutants.

Abstract ID: ANN-OP59

Insights on Slip-layer Dynamics Using Electrorheology

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Abstract
The phenomenon of wall slip is ubiquitous in industrial and natural flows of various soft materials. Such slip occurs near the wall due to formation of very thin layer (~ few nm to μm) of low viscosity, very often termed as slip-layer, having velocity gradient within it. Such presence of wall slip is desired for transport of fluids in many processes: hydraulic transport of complex dispersions, heavy oil transport, usage of cosmetics product, mud flow in estuarine areas, blood flow in confined arteries etc. Wall slip also plays a great role in designing of many modern technologies: wall-surface modification, enhancing

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the printing accuracy during 3D/screen printing, establishing core-annular flow for hydraulic transport of concentrated dispersions. Therefore, deep understanding of slip behaviour is of great significance. In this work, we have studied the extent of jamming on wall slip characteristics using Electrorheological (ER) Fluids which has never been explored before in context of wall slip dynamics. We have adopted methodology based on creep test. The novelty of this work is to understand the effect of interparticle interaction-controlled jamming on slip characteristics. We have also investigated the effect of wall roughness on slip behaviour.

Abstract ID: ANN-OP60

XRD analysis of nanosized silicon derived from broken glassware

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Abstract
Recently silicon (Si) nanomaterial has drawn substantial interest owing to its versatility in chemical, and physical characteristics. The reduced size, and high surface area, unlike the bulk Si, has made it appropriate for diverse applications. There are numerous sources reported so far responsible for the production of nanostructured Si. However, the advantage of using broken glassware is that it doesn't require to undergo any purification process such as pre-heating or pre-acid leaching. Herein, we describe the synthesis of silicon nanomaterial from broken glassware collected from the laboratory employing the magnesiothermic reduction method. To explore the structure-property relationship, X-ray diffraction (XRD) patterns act as the fingerprint of the material. XRD study has been performed to qualitatively and quantitatively analyze the synthesized nanomaterial. From the qualitative analysis, the diffraction pattern observed after heat treatment has exhibited the formation of Si along with magnesium oxide (MgO) and magnesium silicate (Mg_2SiO_4). Whereas after the subsequent HCl and HF leaching, peaks for only Si have been observed. Incorporating Scherrer's Equation on the intense (111) plane, the crystallite size of Si has been estimated to be 49 nm. Using Rietveld analysis, the weight percentage of Si has been found to increase gradually with each treatment step.

Keywords: Laboratory glass; Silicon; Nanomaterial; XRD; Rietveld analysis; Crystalline solid; Lattice parameters

Abstract ID: ANN-OP63

Toward industrial Production of Linde Type A Zeolite for Various Applications from Nigerian Kaolin Deposit: A first attempt at Investigation of Process variables

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Abstract
This study investigates the effects of alkalinity (5,6.5,8 M), metakaolinization temperature (600, 725, 850 ˚C), crystallization temperature (80, 115,150 ˚C), and stirring time during aging (1,2,3 h) on zeolite A synthesis. The hydrothermal method of synthesizing zeolite A was used in the study, and the synthesized zeolite was characterized for XRD and SEM. The findings showed that, alkalinity of 5M, metakaolinization temperature of 850 ˚C, crystallization temperature 115 ˚C and stirring time of 2h gave the best crystallinity and cubic morphology, a feature that is widely associated with zeolite A. Further, findings reveal that increasing crystallization temperature increases crystallinity and crystal size while stirring time did not have significant effect on zeolite a synthesis.

Keywords: Zeolite; Synthesis; Nigerian Kaolin

Abstract ID: ANN-OP64

S-Scheme Visible Light Active Nano Photocatalysts for Decomposition of Toxic Dyes and Kinetic Studies

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Abstract

A visible light active S-scheme nano photocatalyst g-C_3N_4/ZnO/CdS was prepared using a two-step method. First graphitic carbon nitride (g-C_3N_4) was synthesized by pyrolysis method using urea. In the second step, the calculated quantity of g-C_3N_4, $ZnCl_2$ and $CdNO_3.4H_2O$ in presence of Thiourea, ground well and heated in a crucible at 300 °C for four hours at atmospheric conditions. The desired product g-C_3N_4/ZnO/CdS was obtained. The obtained photocatalysts were characterized through XRD, FTIR, SEM-EDX, and UV-DRS. The composite obtained is a promising nano photocatalyst for the degradation of toxic dyes which are disposed mainly from textile industries into environments that are carcinogenic in nature. The degradation of Indigo Carmine dye was carried out under visible light and the time of degradation was observed. 99 % of the dye degraded in 75 min. The results were recorded and kinetic studies were carried out by observations recorded using UV-Visible Spectrophotometer. The kinetic study indicated that the photodegradation process was best described by the pseudo-first-order kinetics and adsorption followed Langmuir–Hinshelwood model.

Keywords: G-C_3N_4/ZnO/CdS; S-scheme photocatalyst; Visible light; Indigo Carmine dye

Abstract ID: ANN-OP66

Role of Gemini Surfactants with Variable Spacers and SiO_2 Nanoparticles in ct-DNA Compaction and Applications Towards in vitro/in vivo Gene Delivery

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Abstract

Compaction of calf thymus DNA (ct-DNA) by two cationic gemini surfactants, 12-4-12,2Br^- and 12-8-12,2Br^- in absence and presence of negatively charged SiO_2 nanoparticles (NPs) (~100 nm) has been explored using various techniques. 12-8-12,2Br^- having a longer hydrophobic spacer induces a greater extent of ct-DNA compaction than 12-4-12,2Br^-, which becomes more efficient with SiO_2 NPs. Time-resolved fluorescence anisotropy measurements show changes in the rotational dynamics of a fluorescent probe, DAPI, and helix segments in the condensed DNA. Fluorescence lifetime data and ethidium bromide exclusion assays reveal the binding sites of surfactants to ct-DNA. 12-8-12,2Br^- with SiO_2 NPs displays the highest time and dose-dependent cytotoxicity in murine breast cancer, 4T1 cell line. Fluorescence microscopy and flow cytometry are performed for *in vitro* cellular uptake of YOYO-1-labelled ct-DNA with surfactants and SiO_2 NPs. The *in vivo* tumor accumulation studies are performed using real-time *in vivo* imaging system after intravenous injection of the samples into 4T1 tumor-bearing mice. 12-8-12,2Br^- with SiO_2 has delivered the highest amount of ct-DNA in cells and tumors with time. Thus, the proved application of a gemini surfactant with hydrophobic spacer and SiO_2 NPs in ct-DNA compacting can be further exploration in nucleic acid therapy for cancer treatment.

Keywords: Gemini surfactant; SiO_2 nanoparticles; ct-DNA compaction; Rotational dynamics of DAPI; Cell viability; HEK 293 cell lines; 4T1 cell lines; In vitro/in vivo gene delivery

Abstract ID: ANN-OP68

Computational Study of Gold Based Chalcogenide Clusters: A DFT Study

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Abstract

Chalcogenide clusters have attracted huge attention owing to their wide range of applications in optoelectronics, solar cells and other areas. In this study, we have investigated electronic properties of Au_2Y (Y= S, Se, Te) using Density Functional

Theory (DFT) methodology. DFT based descriptors – Highest Occupied Molecular Orbital (HOMO) - Lowest Unoccupied Molecular Orbital (LUMO), molecular hardness, softness, electronegativity, electrophilicity index and dipole moment of these clusters have been computed. The computed data exhibits a decrease in HOMO-LUMO gap in the order of S>Se>Te. The range of HOMO-LUMO gap signifies that the materials can be suitable candidate for solar cells as well as optoelectronic devices.

Keywords: Density functional theory; Metallic cluster; Chalcogenide materials; HOMO-LUMO energy gap; DFT based descriptors

Abstract ID: ANN-OP69

Computational analysis on thermal and mechanical properties of silver nanoparticles (Ag-NPs) at melting temperature

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Abstract
The nanomaterials represented many unique and industrial application based on their peculiar properties at nanoscale. Due to these significant properties nanomaterials shows huge applications in medical and agricultural field including all other allied areas. These applications become more promising as the nanomaterials can be developed with different shape and size by using unique synthesize methods and techniques which are quite frequently available at present scenario. In continuation, the coated metal nanoparticles contain the electrical, magnetic, optical, and physical capabilities, as per their size consistency. Out of all other, the silver nanoparticles (Ag-NPs) diverted the special attention towards the scientific community and industrialists for many such applications. Therefore, in this work we have performed computational analysis on (Ag-NPs) and studied their properties and behaviour at melting point. Since melting properties of silver nanoparticles (Ag-NPs) significantly increase the correlative technological level. Hence, the melting processes of silver nanoparticles are examined by using molecular dynamics (MD) simulation to study their melting features along with its deformation rate while computing stress, strain, and relevant thermodynamic properties at melting temperature. The findings of simulations demonstrate that the microscopic melting of nanoparticles involves an uneven transition from order to disorder of atomic structures. The predicted results over this study are consistent and may be applicable to identify the top-grade silver nanoparticles (Ag-NPs) at industrial level.

Keywords: Ag-NPs; MD simulations; Nanoparticles

Abstract ID: ANN-OP70

Statistical analysis on the effect of chirality on thermal conductivity of computationally designed single walled carbon nanotubes

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Abstract
The carbon nanotubes (CNTs) are a type of carbon allotrope that exists in a one-dimensional form. A carbon nanotube is a great material for scientific research as well as industrial application because of its exceptional properties. The exceptional properties such as physical, chemical, mechanical, thermal, and electronic that offer exciting opportunities for nanometer-scale electronic applications. The mechanical and thermal properties of carbon nanotubes plays a very important role to analyze their unique structure and shapes. Because of these significant thermal and mechanical properties, the carbon nanotubes are able to identify as an ideal material to perform the scientific study on low dimensional phonon physics, and thermal management at both micro and macro scale. In this work, we performed a computational analysis on the effects of thermal conductivity of single walled carbon nanotubes (SWCNTs) with different length scale and different chirality. The Müller-Plathe method was used to calculate the thermal conductivity through the Non-equilibrium Molecular Dynamics

(NEMD) simulation. Based on the computational analysis we found that, the SWCNTs with lower chirality (i.e. (5,5)) shows higher thermal conductivity in comparison with higher chirality (i.e. (10,10)) while increasing the length of SWCNTs. The predicted results over this study are quite significant and shows interesting changes of SWCNTs in terms of thermal conductivity.

Keywords: Single Walled Carbon Nanotubes (SWCNTs); Chirality; Thermal conductivity

Abstract ID: ANN-OP71

Aqueous synthesis of MOF nanoparticles for efficient treatment of textile wastewater

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Abstract
Metal-Organic Frameworks (MOFs) have gained a lot of attention for wastewater treatment due to their high crystallinity, high surface area, tunable aperture size, and the capability of functionalization. Here in this work, we showcased the impact of the metal salt precursor addition rate to the organic linker solution using water as a green solvent on the size and morphology of the synthesized MOF nanoparticles and their potential for adsorbing capacity of cationic and anionic dyes. The scanning electron microscopy revealed the differences in size and morphology of the nanoparticles due to varying flow rates of the salt precursor. The particles showed high specific surface area and high thermal stability with a yield of about 90%. Further, adsorption studies were carried out, and the particles prepared at an intermediate flow rate showed the best performance with a removal efficiency of ~82% and ~76% for cationic and anionic dyes, respectively. The high adsorption capacity of the nanoparticles can be attributed to their microporous nature and surface functionality. Therefore, this study demonstrates an environmentally friendly method to prepare MOF nanoparticles at ambient conditions, which hold promise as effective adsorbents for dye removal in textile wastewater treatment.

Keywords: MOF nanoparticles; Aqueous synthesis; Adsorption; Wastewater treatment

Abstract ID: ANN-OP73

Continuous Flow Microreactors for Efficient Graphene Oxide Synthesis: Advantages, Process Considerations, and Potential Applications

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Abstract

Continuous flow microreactors have emerged as a promising platform for the synthesis of graphene oxide (GO), a versatile nanomaterial with numerous applications. This work provides an overview of the utilization of continuous flow microreactors for GO synthesis, highlighting the key advantages and process considerations. The microreactor system enables precise control over reaction parameters, such as temperature, residence time, and reagent concentrations, leading to improved reproducibility and scalability. The enhanced heat and mass transfer within microreactors facilitate rapid and efficient oxidation of graphite, resulting in the formation of high-quality GO. Furthermore, the continuous flow nature of microreactors enables continuous production, minimizing batch-to-batch variation and increasing productivity. The Computational fluid dynamics (CFD) study discusses the influence of different reactor designs and operating conditions on the GO synthesis process. The use of continuous flow microreactors for GO synthesis offers exciting opportunities for the development of high-performance graphene-based materials in various fields, including energy storage, electronics, and biomedical applications.

Keywords: Micro reactor; Process Intensification; Microchannel; Computational fluid dynamics (CFD)

Abstract ID: ANN-OP74

High-Quality 3D Graphene on Cobalt Catalyst: CVD Synthesis and Kinetic Study

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Abstract
In addition to inviable large-scale production, major other disadvantages like high inter-sheet junction resistance and irreversible stacking of individual graphene layers on top of each other limits the utility of conventional two-dimensional (2D) graphene sheets in practical applications as in energy storage and conversion devices. However, researches in the past decade have made it possible to grow inherently inter-connected graphene layers in three dimensions (3D) which, in addition to maintaining the bulk properties of 2D graphene, is free from all such shortcomings. We propose here for the first time a unique approach to grow 3D graphene via thermal chemical vapor deposition (CVD). Cobalt powder, formed into slurry and then cast into a solid template has been used as catalyst framework for growing 3D graphene. Methane (1% vol./vol.) along with hydrogen (400 sccm) and argon (1000 sccm) are used as precursors. The formed 3D graphene is flower-like and free of defects. Activation energy of the reaction was found to be 51.9 kJ mol^{-1} which indicates that the reaction is free of all diffusive effects and falls in the surface-reaction controlled regime. This method is facile, scalable and more economical than the costly nickel foam used elsewhere.

Keywords: 3D Graphene; Cobalt powder; slurry; Chemical Vapor Deposition

Abstract ID: ANN-OP76

Nanoparticles Synthesis in Microchannels

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Abstract
The Self-organizing ability of nanoparticles has reduced occupied space, equipment costs, and reaction times while enhancing the quality of the synthesized products. Due to this series of advantages compared to classical synthesis methods, microfluidic technology has managed to gather considerable scientific interest in nanomaterial production. Thus, a new era of possibilities regarding the design and development of numerous applications within the pharmaceutical and medical fields has emerged.
In this context, the present review provides a thorough view of the factors affecting the size and shape of nanoparticles. The assembly of polymers was controlled by changing the structure of the polymers. The variation in the molecular weight of the polymer molecules and their relative location with respect to the long side of the nanorods (NRs) resulted in two competing association modes of the nanorods, that is, their side-by-side and end-to-end assembly, and produced bundles, chains, rings, and bundled chains of the NRs. The superposition of the two variables controlling the organization of NRs allowed for the creation of a map showing the variation in the longitudinal plasmonic bands of the NRs achieved by their self-assembly. Another factor to be considered was the hydrophilic behavior of the particles. The nanomaterial properties can be tuned as desired by precisely controlling the size, shape, synthesis conditions, and appropriate functionalization.

Keywords: Nanoparticle; Nanomaterial; Nanorods (NRs); Hydrophilic

Abstract ID: ANN-OP79

Chemical Bath Deposition of ZnO nanorods Over Glass and FTO Surface: Insights on Effect of Noble metal (Au/Pt) Deposition on the Photo(electro)chemical and Photocatalytic Properties

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Abstract
Due to excellent thermal stability, and intriguing optical, chemical, and electrical properties zinc oxide (ZnO) nanorods are the center of focus in research communities. In this study, the Chemical Bath Deposition method (CBD) was used to deposit ZnO nanorods (with hexagonal heads) over solid surfaces (such as glass slides and Fluorine-doped tin oxide, FTO

substrates). X-ray diffraction (XRD), UV-Visible spectroscopy, Scanning Electron Microscopy (SEM), and photoluminescence (PL)-based methods were used for the characterization of these ZnO nanorods. The study aims to get insights into the photoelectrochemical and photocatalytic properties of CBD-synthesized ZnO nanorods over conducting glass substrate (FTO) after metal (Au/Pt) deposition. The gold (Au) and platinum (Pt) were deposited over the ZnO nanostructures using a light-mediated in-situ photoreduction method. The photocatalytic response of such nanostructures was examined by UV-Visible light-assisted degradation of rhodamine B.

Keywords: Zinc-oxide nanorods; Chemical bath deposition; Composite; Photocatalysis; Photo(electro)chemistry

Abstract ID: ANN-OP81

Green Synthesis of Size Controlled Silver Nanoparticles (AgNPs) for Antioxidant, Antimicrobial and Catalytic Application

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Abstract
Due to the special attributes and applications of silver nanoparticles (AgNPs) in a diverse range of industries, its demand is rising swiftly. Several chemical and physical processes are used to synthesis the AgNPs. The cost of the synthesis processes and the use of numerous toxic chemicals are the main drawbacks of them. AgNPs synthesis relies heavily on green nanotechnology to solve these issues. In the present study, a simple method was used to synthesize eco-friendly AgNPs using plant extracts (*Ophiorrhiza mungos)* for the first time and to assess their different activities. A sharp peak of UV-Vis spectrum at 415 nm has primarily indicated the formation of AgNPs due to surface plasmon resonance. The formed AgNPs were well characterized by XRD, FTIR, SEM-EDX and TEM analyses. The synthesized AgNPs possessed free radical scavenging activity evaluated by DPPH radical scavenging assay having IC_{50} of 89.04 µg/mL. The synthesized AgNPs also showed antimicrobial properties. Moreover, the adsorptive and photocatalytic removal of methylene blue (MB) was found by using biosynthesized AgNPs.

Keywords: Silver nanoparticles; Green synthesis; Catalyst

Abstract ID: ANN-OP83

Production of Citrate stabilized Copper Nanopowderwith Recycling of Reagents for Nanofluid Applications

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Abstract
Copper is gaining ground as a substitute for silver in various electricity and heat transfer applications, despite its 7% lower conductivity. The metal's abundant availability (1000 times more than silver) and cost-effectiveness (100 times cheaper) make it an attractive choice. CuNPs are emerging as valuable components in nanofluids, particularly for their potential in dispersed phases. To enable their widespread use, large-scale synthesis is crucial. In this study, copper NPs were synthesized in a semi-batch reactor, using Na citrate as a stabilizer and hydrazine hydrate as a reducing agent. The process involved introducing a precursor solution containing ammonia (25%, 0.94 M), Na citrate (0.06 M), and copper acetate (0.2 M) alongside another solution of hydrazine hydrate (80%) fed to the reactor through two peristaltic pumps. Operating at a constant 60 ºC for 20 minutes, the resulting dry nanopowder was isolated via centrifugation and vacuum oven drying. The recycled supernatant, enriched with makeup hydrazine and copper salts, supports sustainable synthesis. Characterization using FESEM unveiled NPs clusters of 70-200 nm size, composed of smaller primary particles. When dispersed in ethylene glycol to form Cu-EG nanofluid, these copper NPs exhibited a remarkable 12% enhancement in thermal conductivity at 0.18 vol% loading.

Keywords: Copper Nanoparticles (NPs); Semi batch synthesis; Recycle; Nanofluid; Thermal conductivity

Abstract ID: ANN-OP84

Structural, surface morphological and photocatalytic properties of MOF derived CuO catalysts

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Abstract
In this study, the novel nanomaterials such as MOF@CuO and pure CuO were synthesized with the aid of urea and PVP substance using solvo-thermal method. These nanoparticles were carefully investigated using XRD, SEM-EDAX, BET Surface area, XPS and UV-vis-NIR DRS techniques. XRD spectra reveals well defined monoclinic crystalline structures were observed with formation of minor impurities of Cu_2O on the surface. The crystal sizes of pure CuO and MOF@CuO samples were obtained as 49 and 36 nm respectively. SEM images confirms the formation of bar-like morphology and spherically shaped particles for pure CuO and MOF@CuO samples respectively. However, both the sample surfaces exhibited a very rough or sintered particles indicating the blockage of pores or lower surface area was confirmed through BET surface area analysis. XPS analysis reveals the formation of Cu^{+}/Cu^{2+} cations on the surface and higher amount of mobile oxygen species were observed for both the samples, signifying the samples are highly active for catalytic reactions. UV-vis-NIR DRS evidenced the excitation of electrons from O2p to conduction band (Cu^{+}/Cu^{2+}) in the range of 200- 600 nm, with band gap energy was found to be ~1.1 eV. Thus, as-prepared MOF@CuO sample exhibited excellent photocatalytic properties.

Keywords: MOF; CuO; Photo catalyst; Band gap energy

Abstract ID: ANN-OP86

Development of green synthesized *Azadirachta indica* nanoparticle-loaded alginate-*Aloe vera* hydrogel and its antimicrobial activity and release behavior study

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Abstract
Azadirachta indica or Neem plant is widely recognized in folk medicine (and Ayurveda) for its antimicrobial and wound healing properties. The leaves of *A. indica* plant are known to possess many medically beneficial phytochemicals. These phytochemicals can also be utilized in green chemistry, specifically as non-toxic reducing agents and capping agents for synthesis of metallic nanoparticles. In this study the antibacterial activity of *A. indica* leaf extract and that of green synthesized silver nanoparticles (AgNPs), prepared using a microwave assisted green synthesis procedure, was investigated against Gram-positive and Gram-negative bacteria respectively. The stability of the green synthesized AgNPs was found to be comparable to that of chemically capped AgNPs. The nanoparticles were characterized by UV-Visible spectrophotometry and scanning electron microscopy (SEM). The present work also focuses on loading these green synthesized AgNPs onto *Aloe vera* based hydrogel (Ag/AV), which can be used as antibacterial dressing for cutaneous wounds. Green synthesized AgNPs showed significantly higher antimicrobial activities in comparison to crude plant extracts. Ag/AV showed gradual release behavior making it appropriate for sustained delivery of nanoparticles to the wound surface. This bio-based hydrogel is a novel method of employing green nanoparticles for a medicinal purpose. This method provides a basis for the formulation of a biocompatible, biodegradable, sustainable and cost-effective solution for wound care.

Keywords: *Azadirachta indica*; Green synthesis; *Aloe vera*; Wound dressing; Hydrogel

Abstract ID: ANN-OP87

Study of Silica Nanoparticles Stabilized Glycerol in Benzaldehyde Pickering Emulsions

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Abstract

The utilization of renewable feedstocks for the synthesis of value-added products has gainedsignificant attention in recent years. Glycerol, a byproduct of biodiesel production, offers a promising opportunity as a renewable carbon source and can be converted to fuel additives through acetalization reaction with benzaldehyde. However, it also presents a challenge due to their immiscibility and high mass transfer resistance. We have proposed an innovative approach for converting glycerol using a pickering emulsion system to address this. First, glycerol in benzaldehyde pickering emulsion is prepared using high-shear homogenization. 100 nm to sub-micron-sized silica nanoparticles (SiNPs) were used as the stabilizer. Functionalized SiNPs are suitable for stabilizing emulsions due to their amphiphilic nature. Pickering emulsions are characterized using optical microscopy. Effects of pH, temperature, glycerol to benzaldehyde ratio, particle loading, homogenization speed, and time are studied on the stability and microscopic properties of the emulsions. Phase inversion is observed with a higher glycerol-to-benzaldehyde ratio. Droplet size is inversely varied with the homogenization speed. Prepared stable glycerol-benzaldehyde pickering emulsions can be efficiently used for interfacial acetalization reactions without stirring and any external common solvent.

Keywords: Silica nanoparticle; Pickering emulsion; Interfacial catalysis; Acetalization

Abstract ID: ANN-OP88

Fabrication of anti- corrosive and superhydrophobic copper surface via electrochemical methods

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Abstract

Copper, a widely used metal exhibits properties such as high thermal and electrical conductivity, malleability, and mechanical strength. But its long-term application is hindered by its susceptibility to corrosion. The main purpose of this study is to develop a superhydrophobic coating on a copper surface. The developed superhydrophobic copper surface exhibits anti-corrosive properties and is attained by a two-step process (i) creation of roughness on the surface and (ii) coating low surface energy material. The rough structures are developed on the copper surface via a controlled electrodeposition method. Electrodeposition on the copper surface is performed using a solution of copper sulphate pentahydrate ($CuSO_4.5H_2O$) and sulphuric acid (H_2SO_4) in an optimum molar ratio. The electrodeposited copper is further functionalized in the low surface energy solution. The wettability of the modified surface was characterized by goniometer and the corrosion resistance properties were analyzed using the potentiostat. The developed coated surface shows excellent water repellancy and anti-corrosive properties. The developed copper surface can be widely used in industrial application such as in heat exchangers, air-conditioners and atmospheric water- harvesting systems.

Keywords: Electrodeposition; Anti-wetting; Corrosion-resistant

Abstract ID: ANN-OP89

Electrodynamic Instabilities in Levitated Droplets: A Molecular Insight

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Abstract

Deformation of levitated droplets under uniform electric fields has been a matter of study1 for decades owing to its natural occurrence, such as the bursting of water drops in thunderstorms, as well as its numerous technical applications.2,3 In this study, we emphasize elucidating the interplay between the surface and electric components of the forces acting on a levitated droplet, i.e., electrodynamic instabilities causing their deformation in a uniform electric field. Using molecular dynamics simulations, we figure out the extent of deformation of a water droplet in terms of the components of the radius of the gyration tensor of the droplet with time, fitting the time evolution of the droplet, along with the comparison of the

components of surface force to the force acting due to the prevailing electric field. Further, we correlate those findings with other structural and thermodynamic parameters, like radial distribution functions, second virial coefficient, and the temporal variation of the excess entropy based on the extent of interactions between the water molecules at different electric fields to engineer their deformations for selective applications.

Keywords: Levitation; Electrodynamic instability; Deformation; Radius of gyration; Second virial coefficients; Excess entropy

Abstract ID: ANN-OP90

Synthesis and Functionalization of Silica Nanostructures for Stabilization of Pickering Emulsions

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Abstract
The synthesis of silica nanostructures has garnered significant attention due to their unique structural properties, such as well-defined pore structures, high surface area, and tunable surface chemistry. The sol-gel method, known for its versatility and controllable synthesis parameters, has been employed to fabricate these nanomaterials with tailored structural characteristics. This study delves into the synthesis process, discussing key factors determining particle size and morphology, such as reagent concentration, temperature, aging period and method. The pH and aging are vital factors in determining the shape and size of these silica nanomaterials. Furthermore, these silica nanomaterials are functionalized with silane and acids to modify their wettability and make them partially hydrophobic. Functionalized silica nanomaterials are used to stabilize n-decane in water pickering emulsions, which can be used as a model biphasic system for food, cosmetics, or catalytic applications. Finally, silica-stabilized emulsions have been systematically characterized to exploit the effect of particle size, morphology, and loading on the stability of the emulsion.

Keywords: Silica Nnanomaterials; Sol-Gel method; Functionalization; Pickering emulsion

Abstract ID: ANN-OP91

Green Synthesis of Sliver (Ag) Doped Zinc Oxide Nanoparticles And Its Adsorptive Studies On Removal Of Methylene Blue Dye

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Abstract
The present study aims to exploit the experimental determination of biosorptive characteristics from a Synthesized Silver (Ag) doped Zinc Oxide Nanoparticles (Ag doped ZnO-Np's) with “Peltophorum Pterocarpum” leaf extract. Synthesized Ag doped ZnO-Np's were characterized by XRD, SEM, EDX, and FTIR analysis. The process variables studied are Agitation time, Initial concentration of “Methylene Blue” dye, pH, Dosage of Ag doped ZnO-Np's and Temperature were performed and compared by using Response Surface Methodology (RSM). At the optimized parameter conditions, the dye adsorption studies were examined using different Isotherms, Kinetics and Thermodynamics models respectively. It was found that the Freundlich isotherm, pseudo second order kinetics were fitted well as compared to other isotherm and kinetic models. The results of thermodynamic studies exhibit exothermic nature, thermodynamically feasible nature of adsorption.

Keywords: Peltophorum Pterocarpum; Methylene blue; Ag doped ZnO-Np's; Isotherms; Kinetics

Abstract ID: ANN-OP93

Computational Study of Ni_n (n=1-6) Nano Clusters by using DFT Approach

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Abstract
Nano clusters is an important domain which help to study the evolution that exists between the microscopic and macroscopic framework of materials. Recently, investigations into transition metal clusters have received a lot of focus. To deep insight the physical and chemical properties for instance catalysis, optoelectronic and magnetic devices, understanding the composition and configuration of these clusters are very significant. In this work, we have investigated small nickel clusters Ni_n (n=1-6) by means of Density Functional Theory (DFT) technique. The result displays that HOMO-LUMO energy gap of these clusters vary between 4.966 eV to 0.107 eV. It is noticed that HOMO-LUMO energy gap decreases with the increase in the cluster size. It follows the similar trend as reported previously by uisng experimental and theoretical approach. DFT based descriptors like molecular hardness, softness, electronegativity, electrophilicity index and dipole moment of these nickel clusters are investigated. DFT based descriptors show a remarkable correlation with the HOMO-LUMO energy gap of Ni clusters.

Keywords: Nickel clusters; Density Functional Theory; HOMO-LUMO energy gap

Abstract ID: ANN-OP94

First Principles Investigation of Graphene-Based Sensors for Dioxin Detection

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Abstract
Graphene is thought to be a promising candidate for nano-scale sensing materials due to its exceptional electrical conductivity, high surface area, and high sensitivity to surface interactions. In the present work, the periodic density functional theory (DFT) calculations were performed on 8x8 supercell of 2-D graphene sheet for sensing dioxins and dioxin-like compounds. The Perdew-Burke-Ernzerhof (PBE) functional, a generalized gradient approximation, and the projector augmented wave (PAW) potential were adopted during calculation as implemented in Vienna Ab initio Simulation Package (VASP). Dioxin like compounds are stable tri-cyclic ring compounds, commonly known for its extreme toxicity. The three highly toxic dioxins viz., 2,3,7,8-tetrachloro dibenzo-p-dioxin, 1,2,3,7,8- pentachloro dibenzo-p-dioxin and 2,3,4,7,8-pentachloro dibenzofuran are considered for the study. The different position of dioxin congeners with respect to graphene surface were investigated and their interactions were compared to find out the sensing capabilities of graphene. The interaction of dioxin was found to be due to the delocalized π–electron of graphene with the dioxin molecule and the charge transfer between the graphene surface and dioxin molecules. Furthermore, the sensitivity of graphene-based sensor is reported in terms of recovery time which represents the time required by the adsorbed dioxin to completely desorb from the graphene surface.

Keywords: Periodic DFT; Sensor; Dioxin; Graphene; Toxicity; Nano-Materials

Abstract ID: ANN-OP95

Enhanced photocatalytic and antimicrobial performance of ultrasound-assisted BiOCl multicomposite for water treatment

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Abstract
A highly promising approach for both environmental conservation and wastewater treatment involves the development of semiconductor-based photocatalysis. These photocatalysts, particularly those with semiconducting properties, have garnered significant interest for their exceptional efficiency in water treatment applications. This study focuses on creating bismuth oxychloride (BiOCl) and a modified version with silver nanoparticles (Ag@BiOCl) using precipitation technique. Additionally, a composite material Ag@BiOCl/g- C_3N_4 was constructed using ultrasound assistance. Several characterization

methods were employed to analyze the fabricated samples. X-Ray diffraction analysis results confirmed the successful creation of the catalysts, while Scanning electron microscopy images revealed their distinctive structures. Fourier-transform infrared spectroscopy and Energy dispersive x-ray analysis were utilized to confirm the functional groups present and the elemental composition of the developed photocatalysts. Additionally, experiments were conducted to assess the efficiency of charge separation and recombination rates of the species. The composite Ag@BiOCl/g- C_3N_4 exhibited notably higher degradation efficiency compared to BiOCl and Ag@BiOCl which is around 93.9% for the dye and 48.24% for phenol. Furthermore, the composite material displayed exceptional antibacterial performance against bacterial strains.

Keywords: Bismuth oxychloride; Photocatalyst; Water treatment

Abstract ID: ANN-OP96

Synthesis and Characterization of Magnetic Carbon Nanofiber Nanocomposite for Design of Sensitive Electrochemical Biosensors

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Abstract

Carbon nanofibers, a type of carbon nanomaterial is sp^2- based linear non-continuous filaments, that exhibit high specific surface area, flexibility, strong chemical and thermal stability, good electrical conductivity and superstrength due to their nanosized diameter. These exquisite properties of carbon nanofibers make them ideal for fabrication of biosensors including that are used for electrochemical sensing. Iron oxide based magnetic nanoparticles are a class of nanomaterials that can be manipulated using magnetic fields. These particles exhibit superparamagnetic property which allows them to exhibit magnetic properties only in the presence of external magnetic field. There are several literature evidences wherein modified carbon electrodes have shown potentials for having better sensitivity in biosensor applications. However, the use of CNFs has been limited.

In this work, we aimed to combine the properties of CNFs with that of the magnetic materials, by synthesizing a novel nanocomposite material Carbon Nanofiber modified Magnetic Nanoparticles (CNF-MNP) using a thermal coprecipitation method combined with an ultrasonication process. The magneticity in a material is desirable in a biosensor as this property waives out the need for surface modification of the electrodes and hence enhances its reusability. Our proposed sensor aims to use CNF modified magnetic nanomaterials with the use of required functional groups. The material characterization was performed using Fourier Transformed Infrared Spectroscopy (FTIR), Scanning Electron Microscope (SEM), measuring Magnetic susceptibility measurements were employed to confirm the synthesis of the Nanocomposite material. Further they were implemented on the electrodes and characterized using electrochemical characterization techniques like using Cyclic Voltammetry and Electrochemical Impedance Spectroscopy. This novel nanomaterial was further investigated for fabrication of ultrasensitive electrochemical biosensors.

Keywords: Carbon nanofiber; Magnetic nanomaterials; Electrochemical biosensors

Abstract ID: ANN-OP98

Plant mediated synthesis of Silver Nanoparticles: Leveraging the Antimicrobial Properties for Water Disinfection

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Abstract

The rapid increase in global water pollution and the emergence of microbes resistant to antibiotics have propelled the search for eco-friendly and efficient water disinfection methods. Water sanitation challenges need to be addressed worldwide, paving the way for the development of cost-effective and environmentally friendly water treatment technologies. This study explores the plant-mediated synthesis of silver nanoparticles (AgNPs) and utilizing the inherent antimicrobial properties of AgNPs for water disinfection.

In this paper, silver nanoparticles were successfully synthesized employing the leaves of a local medicinal plant Ocimum Basilicum (Basil). The plant extract acted as both a reducing and capping agent, facilitating the formation of stable AgNPs. The synthesized nanoparticles were characterized using various analytical techniques, confirming their size, shape, and stability.
The antimicrobial efficacy of these AgNPs was investigated against a spectrum of microorganisms. The mechanism behind this antimicrobial action was further elucidated, shedding light on the potential application of AgNPs for water disinfection.

Keywords: Antimicrobial properties; Plant mediated synthesis; Silver Nanoparticles (AgNPs); Water disinfection

Abstract ID: ANN-OP99

Functionalization of Titanium Metal Oxide Nanoparticles with Synthetic Polymer

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Abstract
Functionalization of titanium dioxide (TiO_2) nanoparticles with synthetic polymers is an important area of research due to the wide range of potential applications in fields such as catalysis, sensors, drug delivery, and photovoltaics. The process involves modifying the surface of TiO_2 nanoparticles with synthetic polymers to improve their stability, dispersibility, and interaction with other materials. This abstract elucidates the rationale behind this dynamic field, encompassing the enhancement of TiO_2 nanoparticle stability, surface modification for tailored reactivity, controlled release mechanisms, and improved photocatalytic properties. With applications spanning from catalysis to drug delivery and photovoltaics, the functionalization of TiO_2 nanoparticles offers transformative potential. Characterization techniques such as Transmission Electron Microscopy, FTIR Spectroscopy analysis are essential for understanding the resulting nanoparticle-polymer hybrid materials structural and physicochemical properties. This process involves modifying the surface characteristics of TiO2 nanoparticles through the integration of synthetic polymers, thereby imparting diverse functionalities and enhancing their utility in a myriad of applications.

Keywords: Nanoparticles; Titanium metal oxide; Synthetic polymers

Abstract ID: ANN-OP100

Synthesis of TiO_2np/Silicone Composites for Application as Dressing Bandage in Topical Treatment Procedure of Microbial Infections

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Abstract
This study focuses on the preparation of a novel TiO_2np/Silicone composite material and investigating its use as a dressing bandage against microbial infection. The material synthesis involved impregnation of TiO_2 nanoparticles, prepared by Sol-Gel process, on medical-grade polymeric silicone matrix. The TiO_2np/Silicone composite material has been studied for its antimicrobial activity. The photocatalytic properties of TiO_2 nanoparticles led to the production of reactive oxygen species (ROS) like H_2O_2 and OH• radicals when exposed to UV light. The ROS reacted with and degraded organic molecules, such as bacterial cell membranes, leading to antimicrobial activity. Medical grade silicone polymeric matrices are ideal for bandages due to their biocompatibility, non-toxicity, flexibility, and easy sterilization, promoting patient comfort and wound healing. The structural and morphological properties were extensively characterized using techniques such as XRD and SEM. Toxicological evaluation of the synthesized material was conducted to ensure its safety for medical applications. The composite material has shown to have antimicrobial activity against various types of microbes, and it could potentially be successfully incorporated into a topical wound dressing against microbial infections.

Keywords: TiO_2 np/Silicone composites; Dressing bandage; Antimicrobial activity; Photocatalytic effect; Biocompatibility

Abstract ID: ANN-OP101

Myeloperoxidase mediated degradation of zero-dimension carbon quantum dots

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Abstract
Human myeloperoxidase (MPO) is a key enzyme which is most abundantly expressed in neutrophil granulocytes during inflammation. It has been observed that Myeloperoxidase enzymes catalyze the biodegradation of the graphitic structure of carbon quantum dots and other carbon nanomaterials through the oxidation reaction. MPO is a member of peroxidases family that produces hypochlorous acid (HOCl) and other reactive intermediates to kill pathogens. Due to highly tunable photoluminescence and good photostability, Carbon quantum dots (CQDs) have emerged as a promising tool for bioimaging, biosensing, photo-catalysis, ions sensing, heavy metal detection and therapy. Hence, the study of biodegradability of CQDs in living systems is essential to speed up the innovations. Here, we have investigated the oxidative biodegradation of CQDs using an MPO-based peroxide system. The degradation of CQDs was catalyzed by human myeloperoxidase (MPO) enzyme and the reaction was facilitated by the addition of H_2O_2 and NaCl.

Keywords: Myeloperoxidase enzyme; Photoluminescence; Carbon quantum dots.

Abstract ID: ANN-OP102

Comparative Analysis of MWCNTs and GO reinforced Cellulose Derived Nanocomposites for Biomedical and Packaging Applications

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Abstract
Recent advancements are gradually transforming traditional nanocomposites into bionanocomposites, a novel class of multiphase nanostructured materials that must comprise at least one phase of biological origin and the particles with at least one nanometer-scale dimension. In order to qualify as bionanocomposites, standard nanocomposites must meet these requirements. In this article, we discuss and compare the synthesis of bionanocomposite films that are based on the biopolymer cellulose acetate phthalate (CAP), which already has been subjected to chemical modification. Additionally, we detail the film's characteristics. The solution casting method has been utilized to incorporate carboxylated multiwalled carbon nanotubes (MWCNTs-COOH) and graphene oxide carbon nanotubes (CNT-GO) as reinforcement nanomaterials in a number of compositions using cellulose acetate phthalate. The nanotubes have been used to create composites with improved mechanical properties. Both MWCNT and GO-CNT bionanocomposites have been examined in relation to concentration to see how their degradation and stabilization patterns change. To determine the best material for packaging and biomedical applications, samples were characterised using FT-IR spectroscopy, contact angle measurements, scanning and transmission electron microscopy, wide angle X-ray diffraction, and a universal testing machine.

Keywords: Bionanocomposites; Cellulose; Cellulose acetate phthalate; Contact angle measurement; Fourier transform infrared spectroscopy; Reinforcement; Multiwalled carbon nanotubes

Abstract ID: ANN-OP103

Effect of Metal Cluster Size and Architecture on Photocatalytic Properties of Metal Deposited Anatase Agglomerates

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Abstract
Supported metal catalysts have garnered significant attention due to their multifunctional abilities in a myriad of catalytic applications. Titanium dioxide supported metal clusters, in particular, have been extensively investigated for photocatalytic applications. To synthesize highly functional M/TiO_2 catalysts, it is necessary to develop a comprehensive understanding of the mechanistic aspects of support material.
Here we present a novel, economically feasible and simplistic wet chemistry approach to synthesize titania crystals with high index facets with particle size control over 3 orders of magnitude (5 nm-3000 nm).
Herein, unique structures were generated such as coral -shaped structure, which provides high surface area while faceted crystals formed serve as host for active metal sites. Further, we have also explored the crystallization pathways of anatase crystals. These uncontrolled pathways were intervened using modifiers (organic molecules and inorganic salts) to generate more desired faceted crystals. The as synthesized anatase agglomerates were evaluated for their photocatalytic performance. The particles with faceted morphology and a novel architecture having corrugated surface exhibited highest dye degradation efficiency of 65% which was even higher than degradation efficiency of the commercial anatase crystals (~40%). The synthesized anatase nanoparticles also resulted in a high dye degradation efficiency of 60%. It is evident from these results that the morphology of particles plays a decisive role in determining their catalytic performance. A complete blueprint will be presented for rational design of titania crystals. Here, we controlled three aspects of particle physiology: (i) size, (ii) dimensionality, and (iii) morphology. Titania is a multifunctional material with substantial industrial applications and therefore a facile synthetic strategy to produce particles with varying morphology becomes essential.

Keywords: Catalysis; Crystal growth; Nonclassical mechanism; Growth modifiers

Abstract ID: ANN-OP104

Revolutionizing Packaging Sustainability: Harnessing Nanocellulose from Watermelon Peel Waste

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Abstract
The demand for consumer packaging has rapidly expanded, culminating in a global market size estimated to range between US$400 billion to US$500 billion. Given this context, the imperative to innovate new products, processes, and materials is paramount. Such innovation should be rooted in principles like sustainability, industrial ecology, eco-efficiency, and green chemistry. Among the innovative materials, cellulose nanocrystals have gained significant importance, warranting substantial attention in the production of cellulose-based packaging materials. Despite their identical chemical compositions, diverse cellulose nanocrystal variants exhibit variations in properties due to differences in sources, extraction methods, shapes, particle sizes, and crystallinity. The exploration of various sources has led to substantial research, with watermelon peel emerging as one viable extraction candidate among numerous options. Presently, an innovative study focuses on the extraction of nanocellulose from watermelon peel waste. The synthesized nanocellulose is confirmed through an array of analytical techniques, including Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Scanning electron microscopy (SEM), and Thermal gravimetric analysis (TGA). The nanocellulose extracted from watermelon peel waste holds promising applications within the packaging industry. This material's unique characteristics and properties make it a valuable resource for sustainable and effective packaging solutions.

Keywords: Nanocellulose; Watermelon peel; Packaging

Abstract ID: ANN-OP105

Morphological Evolution in Solvent-Free Zeolite Synthesis

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Abstract
Zeolite, for its unique pore architecture and tunable acid site distribution has emerged as a prominent candidate in the multi-dimensional application field. Conventional hydrothermal synthesis of zeolite includes several disadvantages like high amount of wastewater, low yield, high operational pressure, etc. To mitigate these challenges, researchers have recently developed a new pathway called solid-state transformation which is a greener approach to synthesizing zeolite with high commercial profitability. Although studies have successfully postulated the formation mechanism of several zeolite frameworks, the control over morphological growth and hence the intrinsic properties are still elusive. From this viewpoint, we have established a mechanistic insight into the process. Pure cancrinite framework was synthesized and morphological evolution was tracked. Our investigation reveals the presence of a concurrent process where phase and morphological growth takes place simultaneously. Initially formed nanoparticles act as building units to undergo agglomeration process to form a multipod shaped bulk particle. Nanoparticles attach through a unidirectionally oriented crystallographic registry to form nano-domains. Different nanodomains have different common crystal plane. These nanodomains agglomerate randomly to form the final mesocrystal. A non-classical growth pathway was observed. Again, our work had direct commercial impact on yield improvement (> 400 wt%) for mass production of zeolite.

Keywords: Solid-state transformation; Cancrinite; Oriented attachment; Nanodomains; Mesocrystal; Non-classical growth; Yield

Abstract ID: ANN-OP110

Advanced Materials for Sustainable and Innovation Applications

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Abstract
This review paper aims to provide a comprehensive overview of advanced materials and their applications in various industries. The focus is on sustainable and innovative applications that contribute to the development of environmentally friendly technologies. The paper discusses the properties synthesis methods and potential applications of advanced materials such as nanomaterials, biomaterials, composite materials, and smart materials, additionally, it highlights the challenges and future prospects associated with these materials in terms of scalability, cost-effectiveness, and commercialization. This review serves as a valuable resource for researchers, engineers, and policymakers interested in advancing sustainability through the utilization of advanced materials.

Keywords: Nanomaterials; Biomaterials; Composite materials; Smart materials

Abstract ID: ANN-OP112

Design of Coumarin-Conjugated Nanoliposomes to target Thrombus and Their Applications in Thrombolytic Therapy

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Abstract
Thrombosis is a global health issue and one of the leading factors of death. However, its diagnosis has been limited to the late stages, and its therapeutic window is too narrow to provide reasonable and effective treatment. In addition, clinical thrombolytics suffer from a short half-life, allergic reactions, inactivation, and unwanted tissue haemorrhage. Nano-medicines have gained extensive attention in drug delivery, due to their convertible properties. Furthermore, treatment of thrombosis using nano-liposomes have also been widely studied. In the current study coumarin conjugated nanoliposomes were created targeted delivery systems and microenvironment responsive drug delivery systems. Coumarin is an antioxidant with numerous therapeutic properties. Coumarin conjugated nanoliposomes can provide camouflage to these platforms and help to extend their circulation time while also imparting them with the biological functions of cell membranes, thus providing them with precise targeting capabilities. In addition, these nanoparticles exhibit a photothermal effect to induce

thrombolysis. Herein, combined with the mechanism of thrombosis and thrombolysis, achieved with thrombus-targeting nanoparticles with regard to thrombosis treatment.

Keywords: Thrombosis; Coumarin; Liposomes; Nanoparticles

Abstract ID: ANN-OP114

Cobalt-based Leaf-like ZIF for Cr(VI) Removal: A Novel Nanomaterial

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Abstract

Metal-organic frameworks (MOFs) are endowed with exceptionally attractive physicochemical properties. One such example of MOFs is zeolitic imidazolate frameworks (ZIF)-L Cobalt (Co). Hexavalent chromium [Cr(VI)] is one of the heavy metals, which is considered carcinogenic. The objective of the work is to evaluate the efficacy of ZIF-L nanoparticles (NPs) to remove Cr(VI) from the wastewater. Herein, ZIF-L NPs were synthesized using the hydrothermal method, wherein cobalt salt, 2-methyl imidazole as the linker, and water as the medium, were used as precursors. The produced NPs were subjected to physicochemical characterization using scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR) techniques. SEM images confirmed the leaf-like structure of ZIF-L, and the average size of the NPs was found to be 250 ± 88 nm. Further, the XRD diffractogram showed all the peaks, 11°, 15°, 18°, and 22°. FTIR revealed the functional groups on the ZIF-L NPs, the important peaks are at 427, 754, 1143, and 1384 cm^{-1}, which are important to confirm the ZIF-L formation. Batch adsorption studies were conducted to study the effect of contact time and initial dosage of adsorbent (g/L). The results exhibited that the equilibrium was reached within 20 min for the initial concentration of 20 mg/L of Cr(VI) when the adsorbent dosage was 0.6 g/L. This study recommends the use of ZIF-L for the adsorption of Cr(VI) and further studies are required to use this material for the industrial remediation of the Cr(VI) contaminated water.

Keywords: ZIF-L; MOF; Heavy metal; Cr (VI); Adsorption

Abstract ID: ANN-OP115

Enhancing yield of Nano-biofertilizers production using automated bioreactor technology

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Abstract:

Nano fertilisers are plant growth enhancers containing nutrients of nano scale, having both micro and macro nutrients, delivered to crops in a controlled way. Nanoparticles (NPs) are defined as single-unit devices between 1 and 100 nm in size on at least one side. Nanostructured fertilizers can increase the efficiency of nutrients through application methods such as targeted delivery and controlled delivery. Nitrogen (N), phosphorus (P) and Potassium (K) are essential nutrients for plant growth, hence the use of these nutrients in the form of chemical fertilizers has been growing which may cause a number of environmental drawbacks. The development and use of new fertilizers using nanotechnology are proving themselves to be the most effective and eco-friendly options for improving the global agricultural production needed to meet the future demands. IoT network applications in the agricultural sector are gaining popularity with the advancement of technology. IoT networks are used in agriculture to measure field parameters like temperature, humidity, soil moisture level, NPK content in the soil, groundwater quality and so on. The measured parameters are then sent to remote stations where they are processed and analysed to actuate necessary responses. Similarly, the principles applied in Smart agriculture can be implemented in making Smart manufacturing systems for Nano structured fertilisers, In this study we focused on the implementations of IoT principles in making such smart systems using wireless networks and sensors with a special focus on agro residue based nanobiofertilisers fertilizers and their advantages. In the present study we have integrated the sensors like NPK, soil moisture, temperature to the standardized lab scale nanofertilizer production system using bioreactor technology to enhance the yield . The innovative technique helps to produce quality nanobiofertilizer from agroindustrial residue value added with precision essential for regulatory approval. This leads to the commercialization of the process to use in organic agriculture. The proposed automation yielded 40 percent increased yield of nanobiofertilizer compare to manual monitored system which is found to be highly productive.

Keywords: Agro industrial residues; Nanostructured fertilizers; IoT principles; Sensor technology; Biosensors; Wireless networks; Smart systems; Automation of bioreactors and yield enhancement

Abstract ID: ANN-OP116

SYNTHESIS AND APPLICATIONS OF NANO PARTICLES – AN OVERVIEW

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Abstract
Nanotechnology has revolutionized the perspective of today's scientists and engineers towards smart materials. The study and application of very tiny materials (1–100 nm) has become one of the fastest growing research areas in wide variety of science and engineering fields. There are many types of nano particles like gold nano particles, metal-based nano particles, carbon-based nano particles, polymeric-based nano particles, semi-conductor based nano particles. Nanoparticles are used for a variety of purposes, including medical treatments, various branches of industry such as solar and oxide fuel batteries for energy storage, and are widely used in diverse materials for daily use such as cosmetics or clothes, optical devices. Some other applications include catalysis, bactericidal, electronic, sensor technology, biological labelling, and treatment of some cancers. Nanoparticles have received a lot of interest in recent years because of their outstanding properties such as bio-compatibility, strong oxidation, high surface area, high thermal conductivity and magnetic properties. The nano particles can be synthesized by physical methods (like vapor deposition, laser ablation etc.), biological methods (using microorganisms, bacteria, enzymes), mechanical methods (like milling, grinding etc.). This comprehensive review focuses on the synthesis of the nano particles, suitable applications of them in various fields.

Keywords: Nano particles; Carbon-based nano particles; Gold nano particles

Abstract ID: ANN-OP117

Synthesis of magnetic nanoparticles by Watermelon Rinds Extract for Biomedical applications

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Abstract
Scientists and physicians have shown keen interest in the biological synthesis of nanoparticles, driven by their significant environmental and biomedical potential. In this study, iron nanoparticles (FeNPs) were produced using watermelon rind extract. Nanoparticles, with their diverse applications, have brought about revolutionary advancements across various sectors. Over the past decade, magnetic nanoparticles (MNPs) have gained immense attention, particularly for their specialized applications in medicine, cancer diagnostics and therapy (theranostics), biosensing, catalysis, agriculture, and environmental solutions.MNPs have proven highly effective in roles like imaging agents, drug delivery carriers, and biosensors. In this review, we first provide a concise overview of the primary synthetic methods for MNPs, followed by discussions on their characterizations and compositions.and delve into their chemical, functional, and morphological properties through standard experimental techniques, including UV-Vis spectroscopy, Fouriertransform infrared spectroscopy (FTIR), X-ray diffraction (XRD).

Keywords: Nanoparticles; Watermelon rinds extract; Biomedical; Characterization

Abstract ID: ANN-OP118

An Investigative Analysis of Nanoparticle Integration in Cosmeceuticals

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Abstract
The fields of food, pharmaceuticals, nutraceuticals and cosmeceuticals have seen the fastest integration of nanoparticles. It has significantly impressed the worldwide market due to its substantial utilities and immediate results. The incorporation of nanotechnology provides added benefits, challenges and future trajectories like accomplishing safe and precise delivery of therapeutic agents and cosmetic compounds via nano-particles with high effectiveness. Utilization of carrier mechanisms, drug delivery, in nanotechnology provides added benefit of enlarged dermal permeation, deposition phenomenon, and prolonged positive results. Gold and silver nano-particles have been used extensively in barrier restoring creams, claiming to increase collagen production and UV protection creams. Titanium dioxide and Zinc oxide are excellent nano emulsion components in cosmeceutical formulation for broad UV spectrum protection, protecting skin damage from UVA and UVB. There are advantages of nano sized particles to penetrate better and have high performing anti-aging cream formulations on an extensive user-based scale, however production of reactive oxygen species (ROS) is a potential risk due to the very small size of particles. Oxidative stress, and damage to RNA and DNA is a possibility. The advancement and seamless incorporation of nano-technologies have become a crucial augmentation to conventional industries, propelled by speedily increasing demands from customers for improved and groundbreaking products.

Keywords: Nano-particle; Cosmeceuticals; Integration

Abstract ID: ANN-OP120

Bio-chemo sequential synthesis of silver oxide nanoparticles embedded in TiO_2 shell ($BioAg_2O@TiO_2$): A visible light active photocatalyst for dye degradation

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Abstract
$BioAg_2O@TiO_2$ nanocomposite particles were synthesized by a novel two step bio-chemo sequential synthesis method, wherein Ag_2O nanoparticles were synthesized using extracellular bacterial based synthesis method using the cell free supernatant of *Alcaligens sp.* followed by chemical method for the formation of TiO_2 shell embedding the Ag_2O nanoparticles. XRD and XPS confirmed the presence of Ag_2O and TiO_2 in $BioAg_2O@TiO_2$ with average crystallite size of 7.44 nm and 9.31 nm respectively. The TEM images revealed the embedment of biosynthesised Ag_2O nanoparticles in TiO_2 shell, with the average particle size of 8.83±2.4 nm. The $BioAg_2O@TiO_2$ nanocomposite with the band gap energy of 1.7 eV, exhibited photocatalytic activity under visible light in terms of degradation of Reactive blue 220 (RB-220), a textile dye. The photocatalytic activity was favored at acidic pH and the kinetics followed the second order kinetic model. The synthesis of $BioAg_2O@TiO_2$ is a potentially more economical and greener method with lower chemical foot print as compared to the existing chemical methods. $BioAg_2O@TiO_2$ nanocomposites can be effectively used as visible light active catalysts in treating the textile effluents, with solar energy utilization as a viable option to offer economical solution to the industries to mitigate environmental pollution problems.

Keywords: Dye degradation; Microbial synthesis; Nanoparticle synthesis; Photocatalysis

Abstract ID: ANN-PP4

Cr^{3+} doped $ZnAl_2O_4$ nanophosphors for energy efficient solid state lighting applications

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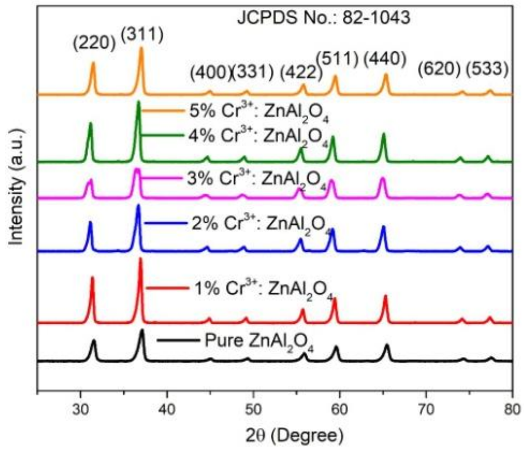
Abstract
Luminescent materials (both rare-earth and non-rare-earth based) have an important role in current technology with applications in various fields like sensors, solid-state lighting display, optoelectronic devices, etc. In recent days, non-rare-earth doped nanophosphors have gathered a lot of attention in the field of luminescence for lighting and low energy display applications. Herein, a solid state light emitting $x\%Cr^{3+}:ZnAl_2O_4$ (x =1, 2, 3, 4, 5%) nano-phosphors has been successfully synthesized by a sol-gel technique. The structural and optical properties of Cr^{3+} doped $ZnAl_2O_4$ nano-phosphors were examined by XRD, UV-VIS, FT-IR, and photoluminescence (PL) spectroscopy. The energy bandgap of the nanophosphors

was calculated by UV-Vis Diffuse Reflectance Spectroscopy (DRS) and the value was found to be ~3.2 eV. The phase purity and crystal structure of the nano-phosphors were analyzed by XRD patterns and all XRD planes perfectly matched with the standard JCPDS card no: 82-1043. PL spectra of nanophosphors exhibit strong IR light suitable for night vision applications.



Abstract ID: ANN-PP5

Evaluation of antioxidant and catalytic activity of Phaseolus vulgaris mediated Nickel oxide and Copper doped Nickel oxide bimetallic nanoparticles

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Abstract
In this study, NiO nanoparticles (NPs) with Cu doped NiO bimetallic nanoparticles (Cu@ NiO BMNPs) were synthesized using Phaseolus vulgaris extracts as reducing and stabilizing agents by sol gel methods. The chemical and physical properties of synthesized NiO NPs and Cu@ NiO BMNPs were confirmed by using various techniques - UV Visible spectrophotometer (UV-Vis), Fourier transform infrared spectroscopy (FTIR), Scanning Electron Microscope (SEM), Energy Dispersive X-ray (EDX), Transmission Electron Microscope (TEM), X-ray diffraction (XRD), Dynamic light scattering (DLS). The biological acivities of P. vulgaris extracts mediated NiO NPs and Cu@ NiO BMNPs were examined using DPPH scavenging radicals for antioxidant activity at wavelength 517 nm. Catalytic activity of the NPs was screened in the degradation of Methylene blue for photocatalytic activity at wavelength 663 nm with different time intervals. The percentage of scavenging activity and degradation activity of Cu@ NiO BMNPs were found to be more as compared to NiO NPs. The NiO NPs and Cu@ NiO BMNPs were synthesized for the first-time using P. vulgaris extracts. This study clearly showed that P. vulgaris extracts mediated mono- and bimetallic NPs (BMNPs) were more stable and biocompatible than their respective bulk particles.

Keywords: Phaseolus vulgaris; NiO NPs; Cu doped NiO NPs; DPPH; Methylene blue

Abstract ID: ANN-PP7

Green Synthesis of Various Metal Nanoparticles and the Evaluation of their Photocatalytic Applications

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Abstract
The presence of synthetic dyes in water bodies through effluent discharge can have toxic effects on aquatic as well as on human life and can disrupt the entire ecosystem and harm the food chain. Some dyes have shown highly carcinogenic traits

due to amine and benzidine emissions and are classified as environmental hazards. The use of metal nanoparticles in the photocatalytic degradation of dyes has shown high efficiency among other methods of treatment due to their high surface area and reactivity. Ricinus communis mediated Iron, Zinc and Silver nanoparticles were synthesized through green synthesis method because it is non-toxic, easy to scale up, less time consuming and eco-friendly. The synthesized nanoparticles are characterized by UV-spectroscopy, X-ray diffraction (XRD), Scanning Electron microscopy (SEM), and Fourier Transform Electron Microscopy (FTIR). The results from photocatalytic degradation of MB dye under UV light showed complete degradation of dye in presence of Iron and Zinc species, Iron having a higher rate of degradation and silver species showed partial degradation of dye. This report discusses the green synthesis of different metal nanoparticles and evaluates their photocatalytic activity in the degradation of dyes.

Keywords: Nanoparticles; Photocatalysis; Green synthesis; Dye degradation

Abstract ID: ANN-PP10

Synthesis and evaluation of Nanoparticles based demulsifiers and their application in oil industry

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Abstract
The most difficult aspect of the petroleum industry is the high produced water that emerges with crude oil extraction. Due to the large amount of produced water, environmental awareness has risen substantially in recent years. Water produced throughout crude oil extraction is a complex combination of inorganic, organic, and other elements. One of the main obstacles to the development of phase separation and demulsification techniques in the Petroleum industry is the complexity of crude oil emulsions. The majority of this water is emulsified into crude oil during production, adding viscosity and challenging flow. As a result, there are operational difficulties in production, transportation, and refining, which affect business efficiency. Simultaneously, limitations in treatment techniques for produced water have compelled researchers to conduct research on demulsification techniques for several years. Demulsifying crude oil emulsions also reduces the risk of corrosion and catalyst poisoning, increasing the industry's overall profitability. In enhanced oil recovery, a chemical demulsification method utilizing surface active agents (surfactants) has received significant attention. A chemical demulsification process destabilizes the interfacial layers of an emulsion, thus increasing emulsion breakdown time. Chemical additives are commonly employed to dewater crude oil emulsions because they are both efficient and economical. In the recent past, various researchers have successfully designed a chemical demulsifier which has demonstrated efficient demulsification of various types of crude oil emulsion at a temperature ranging from 100°C-200°C and a dosage ranging from 250-1000ppm. Moreover, various research has also been conducted on nanoparticles-based surface-active agents, which additionally increases active surface area of demulsifier resulting in enhanced wettability of emulsion and reduction in interfacial tension.
In the present work we have designed a surface active chemical demulsifier using sustainable green approach, and incorporating various nanoparticles for efficient optimization which exhibits enhanced dewatering of oil field emulsion at lower temperature ranging 50°C-150°C and with optimum dosage of 100-200ppm. The petroleum industry recognizes the significance of an effective demulsification procedure for treating oil field emulsions. One of the main drivers propelling the market's growth is the crude oil industry's rapidly expanding extraction activities.

Keywords: Nanoparticles; Demulsification; Surface-active agent

Abstract ID: ANN-PP16

Development of anti-termite, self-cleaning and stain resistant superhydrophobic corrugated sheet for packaging and storage purpose

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Abstract

Now these days corrugated boxes are widely used because of their biodegradable nature, easy handling, light weight, low cost and for better support. But due to their hydrophilic nature of the material it easily absorbs water or liquids and get deformed. Therefore, a layer needed on the surface of the corrugated box which can repel water and keep away from liquids. Considering the above feature on box surface it requires a superhydrophobic coating such that it can protect the surface as well as the things inside the box. In this present work we have modified the hydrophilic corrugated surface to superhydrophobic corrugated surface by using simply spray coating on it. The modified box exhibits excellent water repellent nature with contact angle more than 150° and tilt angle less than 10°. Furthermore SEM, FTIR of the coated and uncoated sample were done. To examine the performance of the modified box in harsh environment such as highly acidic, basic, high temperature and effect of mechanical forces separately chemical, thermal and mechanical stability test were done. In chemical stability test modified samples were immersed in different pH solution for time, similarly in thermal stability test sample was exposed to high temperature. Because it has numerous applications such as anti-termite, self-cleaning, and anti-stain, it has been extensively examined. These features like, self-cleaning anti-termite and anti-stain ability, makes it suitable for domestic and industrial applications.

Keywords: Superhydrophobic corrugated sheet; Self-cleaning; Anti-stain; Anti-termite

Abstract ID: ANN-PP17

Electric field induced expeditious buildout of ion based MXene aerogels for electromagnetic shielding and electrothermal energy conversion

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Abstract

The burgeoning demand of portable electronic devices have increased the necessity of building up lightweight electromagnetic interference (EMI) shielding materials which are immensely desirable for restricting EMI pollution in the environment. Herein, we have implemented a novel gelation strategy to assemble MXene sheets into a hydrogel structure via voltage-controlled release of metal ions at the electrode interface. Through this process, MXene hydrogels could be realised in seconds to minutes which are subsequently freeze-dried to prepare the aerogels. The conducting network and porous structure of the aerogels promote more EMWs absorption in the interlayer galleries showing an EMI shielding effectiveness above 45 dB for a 1-minute assembled aerogel at 25 mg mL^{-1} MXene concentration. This can also be enhanced by tuning the gelation time. The aerogels encapsulated with polymeric agent also displayed excellent electrothermal energy conversion at low applied potential with rapid responses. For instance, an input supply voltage of 4 V raised the temperature of the aerogels above 200 ℃ within few seconds and maintained a steady state temperature throughout. Therefore, the prepared aerogels offer a facile solution to multimodal applications with diverse characteristics.

Keywords: Gelation; Electromagnetic interference; Electrothermal energy conversion

Abstract ID: ANN-PP19

Nano Revolution: Unleashing the Potential of Nanorobots in Healthcare and Beyond

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Abstract

This paper explores the application of nanomaterials for improved cybersecurity in financial transactions. As the finance industry increasingly relies on digital platforms and stores sensitive data, ensuring robust cybersecurity measures is crucial. Nanomaterials, with their unique properties at the nanoscale, offer promising solutions to address cybersecurity challenges. The paper discusses specific applications of nanomaterials in this context, including nanomaterial-based encryption, nanosensors for fraud detection, nanomaterials in biometric authentication, nanocoatings for secure data storage, and nanotechnology in secure hardware development. It highlights the benefits and advancements in each area, supported by case studies and research examples. The paper concludes by acknowledging the limitations and challenges of implementing nanomaterials for improved cybersecurity in finance, while also recognizing emerging trends and future directions. Overall,

this research provides valuable insights into the potential of nanomaterials to enhance cybersecurity in financial transactions, serving as a foundation for further exploration and advancements in this critical field.

Keywords: Fraud detection; Biometric authentication; Data storage; Secure hardware development; Nanosensors; Encryption; Regulatory compliance

Abstract ID: ANN-PP20

Revolutionizing Taste: Exploring Nanotechnology's Impact on the Food and Beverage Market

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Abstract

Nanorobots, Nanotechnology has emerged as a transformative force in the food and beverage industry, revolutionizing taste experiences and offering exciting possibilities for innovation. This manuscript explores the impact of nanotechnology on taste enhancement, examining its practical and social implications. The manuscript delves into the science behind taste perception, showcasing how nanosensors can analyze and understand the intricate components of taste. It highlights how nanotechnology is utilized to enhance taste perception by modulating flavor release and optimizing texture, resulting in novel taste sensations. Additionally, the manuscript explores the targeted delivery of taste modulators, enabling personalized taste preferences and healthier options. The practical implications encompass enhanced product development, improved shelf life, targeted delivery systems, and consumer-centric approaches. Furthermore, the social implications encompass health and wellness, sustainability, ethics, consumer empowerment, and perception. Understanding consumer attitudes, effective communication, and education play vital roles in driving acceptance and building trust. Embracing nanotechnology's transformative potential, while addressing regulatory considerations and ethical concerns, can pave the way for a future of personalized and extraordinary taste experiences in the food and beverage market.

Keywords: Taste enhancement; Flavor release; Targeted delivery; Consumer perception; Personalization; Sustainability

Abstract ID: ANN-PP21

MXene-Polyaniline Hybrid Hydrogel for Supercapacitive Energy Storage

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Abstract

Transition metal carbides, nitrides and carbonitrides, generally known as MXene, have gained tremendous research interest in the field of supercapacitive energy storage thanks to its unique combination of properties like high surface area, metallic conductivity, hydrophilicity and pseudocapacity. However, the supercapacitive performance of MXene can be further improved by hybridization with suitable conductive and pseudocapacitive materials like polyaniline. Being a 2D material, MXene has face-to-face restacking issue while being assembled into macroscopic electrode structure from nano-sized building blocks. Although, formation of interconnected porous network in hydrogel form can minimize the restacking problem, the development of MXene hydrogel has been a great challenge due to stiffness of MXene sheets and its stability problem at high temperature. Here, a room temperature, metal plate-assisted layer-by-layer gelation strategy is adopted to obtain MXene-polyaniline hybrid hydrogel. The porous structure of hydrogel allows complete utilization of electrode surfaces and redox active sites. As a result, the obtained hybrid hydrogel delivers a high specific capacitance of 527 $F\ g^{-1}$ at 2 $mV\ s^{-1}$ scan rate and 43% capacitive retention at 1000 $mV\ s^{-1}$ at sufficiently high mass-loading of 3.5 $mg\ cm^{-2}$. This facile scalable assembly technique can pave the way of different hybrid electrode preparation in future.

Keywords: MXene; Polyaniline; Hydrogel; Supercapacitive energy storage

Abstract ID: ANN-PP22

Radiation Shielding

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Abstract

Radiation spill is the accidental release or leakage of radioactive materials into the environment, in the form of radioactive particles or liquid, which occur in laboratories and medical facilities. Exposure to high levels of radiation can have a range of harmful effects on humans like acute radiation syndrome, cancer, organ damage and sometimes even genetic mutations. Radiation shields are used to attenuate the incident radiation and mitigate the harmful effects. Radiation shields can be used to contain radioactive materials, and can also be used as barriers to protect patients and healthcare professionals from unnecessary exposures. Concrete and lead based materials are efficient solutions for radiation containment in nuclear reactors. But for radiation shielding in laboratory and medical environments the shielding material demands more intricate designs and additional features. The shielding materials need to be flexible, light , efficient and less expensive, while not utilizing heavy or runoff materials. While low energy radiation shielding is easy and established, attenuation of gamma and neutron radiation is difficult and less explored unless it is in a nuclear reactor set-up. There have been attempts to use HDPE based polymer composites for gamma ray and neutron shielding but the reports are inconsistent and limited to a few polymeric materials. With this problem in mind, we have attempted to develop a polymer nano-composite without the inclusion of any runoff material, is light, flexible and can attenuate both gamma and neutron radiation. With the help of this material, our aim is to assist both workers and patients in efficiently managing exposure to radiation and handling radiation spills.

Keywords: Polymer nanocomposites; Gamma rays; Neutron radiation; Radiation shielding

Abstract ID: ANN-PP23

Synthesis of Nano-Cellulose from Agro wastes and making a fiber film as alternative of plastic film

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Abstract

With rapid increase in consumption of plastic films for different purposes it becomes crucial to develop films which are made from agro waste materials like rice husk and wheat straw so that it can be helpful for sustainable development. As cellulose is most abundant polymer and we can easily extract it from different resources like rice husk. So, firstly we extract cellulose naturally and then using different mechanical and chemical treatment methods we will obtain film. The research has been focused to isolate Nano cellulose from rice husk. For characterization of film, we will use FTIR, SEM and XRD techniques. These techniques are used to determine surface morphology, size and characteristics of Nano cellulose. The main objective of the following research is focused on to obtain valuable products from agro waste and one such product is Nano cellulose.

Keywords: Nano cellulose; Agro waste; FTIR; XRD; SEM

Abstract ID: ANN-PP24

Histamine binding with small silver (Ag6) nano-cluster: DFT Approach

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Abstract

The present communication reports interaction of histamine and silver nano-cluster. The interaction of Ag_6 nano-cluster with histamine governs through Ag-X (X = N) anchoring bond and Ag···H-X unconventional hydrogen bonding. The interaction mechanism of histamine with silver nano-cluster is investigated by computing the electronic and geometrical properties in addition to the adsorption energies in different possible configurations of Ag_6@histamine bio-molecular complex. The theoretical computations such as optimization and computation of harmonic vibrational frequencies of all possible configurations of Ag_6@histamine bio-molecular complex have been executed at B3LYP/LanL2DZ/6-31++G (d, p) level of density functional theory. Moreover, we have also computed some important electronic properties viz. energy gap between HOMO-LUMO, Fermi level and work function and discussed in detail. Also, the effect of aqueous media on adsorption energy and electronic parameters in the most favourable configurations has been investigated to explore the influence of corporeal biological circumstances.

Keywords: Histamine; Nano-cluster; silver; DFT

Abstract ID: ANN-PP25

MXene based nanomaterial for Sensing of CO_2: An Overview

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Abstract
MXenes are a new family of two-dimensional materials that are finding use in a variety of fields, including gas sensing, energy storage, catalysis, biomedicine, and many more. Among them, the gas sensing use of MXene materials is the one that is least researched; nonetheless, it is gaining attention due to the increased sensitivity these materials have towards a variety of gases. It has emerged as a suitable host material for use in chemical gas sensors due to the various benefits it offers, such as a high surface area, strong electrical conductivity, and a rich surface functional group content. Increasing emission of carbon dioxide (CO_2) have adverse effects on environment, human health and crop production. Therefore, it is necessary to monitoring the concentration of CO_2 with high response using various techniques. In this review we discuss the recent advances on Mxene based nanomaterial as sensor for detection of CO_2. Finally, we discuss the challenge and future perspective of Mxene based gas sensor.

Keywords: MXene; 2D materials; Gas sensor; CO_2

Abstract ID: ANN-PP26

Exploring Synergistic Advantages: A Comprehensive Study of the Physicochemical and Electrochemical Sensing Characteristics of $CuO\text{-}ZrO_2$ Mixed Metal Oxide Nanocomposites

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Abstract
The development of swift and precise electrochemical techniques holds significant importance in overseeing synthetic colorants within food and beverage items due to potential toxicity and pathogenicity concerns upon excessive consumption. In this study, an innovative electrochemical sensor is introduced, featuring modifications to a glassy carbon electrode (GCE) through the integration of a CuO-ZrO2 mixed metal oxide nanocomposite. This modification aims to enable the

quantification of the azo colorant Sunset Yellow (SY), frequently found in consumables. The incorporation of CuO-ZrO2 mixed metal oxide nanocomposite amplifies the electron transfer current response pertinent to azo colorants. A comprehensive analysis of the electrochemical behavior, in the context of the modified GCE, is carried out using cyclic voltammetry, linear sweep voltammetry, and electrochemical impedance spectroscopy. Morphological attributes of the nanomaterials are scrutinized, revealing high porosity characteristics, as observed through scanning electron microscopy (SEM). The structural and chemical composition aspects are investigated through Fourier-transform infrared spectroscopy (FT-IR), Raman spectroscopy (RS), and X-ray diffraction (XRD). The optimized operational parameters for the modified GCE manifest most effectively at pH 5 in a phosphate-buffered saline (PBS) solution with a concentration of 0.01 M, encompassing all assessed colorants. Additionally, a scan rate of 0.1 V s^-1 proves optimal for SY.Under the established optimal conditions, the developed sensor is subjected to diverse concentrations of standard SY, exhibiting a linear detection range spanning from 0.01 to 50 ppm. The limits of detection for the system are quantified at 7.699 μA, while the sensitivity value is computed as 19.43 $\mu A/\mu M \cdot cm^2$. This uncomplicated yet highly sensitive sensor presents an economical and rapid avenue for detecting specific colorants, eliminating the necessity for specialized operators and sophisticated instrumentation.

Keywords: Electrochemical sensing; $CuO-ZrO_2$; Nanocomposites; Physicochemical

Abstract ID: ANN-PP27

Synthesis, Characterization, and Photocatalytic Activity of Fe and I co-doped TiO_2 nanoparticles

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Abstract
Photocatalysis is a promising technique for the removal of environmental pollution. The interest in metal oxides as effective photocatalysts is surging, especially for dye degradation under Ultraviolet (UV) light. The research on the use of photocatalysts with exceptional stability and activity in the degradation of dyes under UV light has garnered significant interest. Here, we synthesized Fe-I co-doped TiO_2 nanoparticles using a solution-combustion method. Various techniques were employed for characterization: Field Emission Scanning Electron Microscopy (FE-SEM) and High-Resolution Transmission Electron Microscopy (HR-TEM) for morphology and particle size, X-ray Photoelectron Spectroscopy (XPS) for surface composition, and Fourier Transform Infrared Spectroscopy (FTIR) for functional group identification. Transmission X-ray Diffraction (XRD) confirmed crystal structure, while Band Gap Energy was determined by Diffuse Reflectance Spectra (DRS). The co-doped nanoparticles exhibited anatase phase and crystalline structure. The synergistic effect of Fe and I narrowed the band gap of TiO_2 nanoparticles and delayed the e^-/h^+ pair recombination rate. The present experimental study demonstrated promising results for the photocatalytic degradation of methylene blue dye through the simultaneous doping of TiO_2 with Fe and I. A quartz-tube UV reactor achieved approximately 82% dye degradation in 60 min with 30 ppm dye concentration and 0.01 g catalyst dose, the degradation followed a pseudo-first-order rate kinetics.

Keywords: Photocatalysis; Co-doping; Methylene blue

Abstract ID: ANN-PP28

Advancements in Electrochemical Glucose Sensor Materials

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Abstract
Increased health awareness has called for better health monitoring devices. Continuous research is ongoing to enhance the efficacy of glucose sensors. Rapid innovations and breakthroughs are visible in both, conventional enzymatic sensors & non-enzymatic sensors, towards the control of diabetes. Although enzymatic sensors are known for their excellent sensitivity and selectivity, non-enzymatic sensors are being preferred for their stability and affordability, progressing towards the ultimate goal of developing rapid and accurate glucose tests. Progress in development of glucose sensor is being achieved by improvements in electrode materials as well as sensor design. The selection of electrode materials is crucial in both enzymatic and non-enzymatic glucose sensors for attaining optimum values of sensing time as well as accuracy. Numerous electrode materials, including graphene, carbon nanotubes, metal oxides (such as platinum and gold), and conductive polymers, have

been developed and studied by researchers to be employed in glucose sensors. Among the most critical factors being considered for developing glucose sensor materials are the selectivity for glucose molecule without interference due to the presence of another molecules. Furthermore, the long-term stability of the developed electrode to enhance the stability and reliability of the sensor system. In this work, we would be exclusively providing a detailed account of these advancements in past decade to trace the sensor developmental research.

Keywords: Glucose sensor; Enzymatic sensor; Non-enzymatic sensor; Electrode; Nanomaterials

Abstract ID: ANN-PP30

Effect of etching agents on porous colloids

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Abstract
In this work, we address the effect of different etching agents on the pore size, distribution, and surface morphology of colloids like silica and 3-(Trimethoxysilyl) propyl methacrylate (TPM). First, we synthesized silica and TPM colloids by the well-known Stober's method and emulsion polymerization process, respectively. Subsequently, to make the colloids porous, particles were etched with sodium hydroxide (NaOH) and hydrochloric acid (HCl) solution without employing any template molecule. The porous structures of the colloids were visualized by the field emission scanning electron microscopy (FESEM) and the pores were analyzed by Brunauer-Emmett-Teller (BET) method. The results reveal that the concentration of etching agents and the duration of exposure have significant impact on the pore size, pore distribution and surface morphology of the colloids. Furthermore, different etching agents displayed different strengths in manipulating pore size resulting in a wide variety of colloidal morphologies. The findings of this study provide the fundamental components of the etching process for porous colloids, providing useful insights for modifying their properties to specific applications. Understanding the effect of etching agents on porous colloids aids in the design and development of new materials with customizable structural and surface properties, increasing their utility in a variety of technical and biomedical domains.

Keywords: Colloids; Porous colloids; Etching

Abstract ID: ANN-PP33

Effect of Contact time and Temperature on adsorption of U (VI) on Tri-n-butyl Phosphate Functionalized Multi Walled Carbon Nanotubes

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Abstract
Adsorption of U(VI) on in-house developed Tri-n-butyl Phosphate functionalized Multi Walled Carbon Nanotubes (MWCNTs-COO-TBP) was studied for bioassay applications. Adsorption Kinetics studies were carried out by equilibrating MWCNTs-COO-TBP with aqueous uranium solution in acid medium to evaluate the rate of adsorption (effect of contact time). Estimation of uranium in the supernatant was carried out using UV-VIS Spectrophotometer by complexing with Arsenazo (III). It was observed that equilibration time of 2 h is sufficient for complete adsorption process. Thermodynamic parameters such as ΔH^o, ΔS^o and ΔG^o were evaluated from adsorption thermodynamic studies carried out at various temperatures between 297K and 338K. It is observed that adsorption of uranium on MWCNTs-COO-TBP is spontaneous and endothermic in nature. Adsorption studies carried out with MWCNTs-COO-TBP on removal of trace levels of uranium indicates that TBP functionalized MWCNTs possess potential applications in in-vitro monitoring.

Keywords: Uranium, Adsorption, Tri-n-butyl Phosphate, MWCNTs-COO-TBP, Bioassay

Abstract ID: ANN-PP34

Variations in Magnetic Behavior of Ferrimagnetic Nanoparticles with Temperature

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Abstract
This study successfully synthesized ferrimagnetic nanoparticles (FMNPs) at a temperature of 28℃ using the chemical co-precipitation method. Comprehensive characterization of the FMNPs was performed through XRD, FTIR, FESEM, zeta potential analysis, hydrodynamic particle size measurement at 28℃, and VSM over a temperature range of 100 - 500℃. Our findings unequivocally confirm the composition of the synthesized nanoparticles as pure magnetite, featuring a spinel structure devoid of impurities. Morphologically, the FMNPs exhibit a nearly spherical shape, characterized by a uniform size distribution with an average particle diameter of 19 nm. Studying the magnetic properties across the temperature range of 100–500 ℃ reveals a striking trend: as temperature increases, both coercivity and remanence in the hysteresis loop experience a gradual reduction, thereby demonstrating a superparamagnetic behavior. To elucidate this intriguing superparamagnetic behavior, we employ a developed model rooted in the core-shell theory, which yields calculated data closely aligning with the experimental magnetization results. These observations underscore the potential of these synthesized FMNPs for diverse applications, ranging from heat transfer and enhanced oil recovery to phase change materials and magnetic separation, positioning them as promising candidates in these fields.

Keywords: Ferrimagnetic nanoparticles; chemical co-precipitation; VSM; magnetic properties; core-shell theory; superparamagnetic behavior

Abstract ID: ANN-PP35

Superconductors -A Futuristic outlook

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Abstract
The superconducting materials work at extremely low temperature with characteristics such as zero resistance and high magnetic fields. These exceptional qualities make them the perfect materials to conduct several complex and revolutionary experiments. These have the potential to benefit human race in everyday activities such as electricity generation without energy loss, smaller and cheaper MRI units, maglev trains, levitating hoverboards, etc. But hurdles such as cost factor, extreme low temperature requirements make this difficult. A solution to this problem raised with recent research being made to produce superconductors at room temperature and make it cost efficient, but there was a one big caveat than researches perceived that is very high working pressure about 267 GPa (3000 atm) which showed that temperature isn't the only factor, there are many more other factors to be observed and modified.

Abstract ID: ANN-PP36

Phytosomes for Effective Delivery of Waste-derived Polyphenols Drugs

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Abstract
While phytochemicals, the secondary metabolites of plants, exhibit important pharmaceutical properties, a main challenge in wide-scale application is their low bio-availability due to their structure and poor water or lipid solubility. Thus, phytochemical-phospholipid complexes, i.e., phytosomes are one potential solution wherein the phytochemical is loaded onto the phospholipid, forming a nano-carrier of the drug molecules through hydrogen bond between phospholipid and the pharmaceutically active molecule such as polyphenols. To ensure a sustainable operation, use of natural phospholipids is preferred. In our study, firstly polyphenols (mainly consisting of phenolic acids and flavonoids) are extracted from banana peel. In parallel, the phospholipids are extracted from egg yolk. The phytosomes are then prepared using solvent evaporation in a rotary evaporator. Various operating parameters such as solvent type, amount, and temperature are varied to optimize the process. Apart from yield, our study also focuses on the techno-economic viability of the operational conditions. The

structural profile of the produced phytosomes are characterized as per standard protocols using different instrumentation techniques. The findings would be useful in obtaining a techno-economically optimized protocol for manufacturing phytosomes of desired characteristics from inedible plant biomass, facilitating the maximum valorization of the waste by-products.

Keywords: Phytosomes; Polyphenols; Techno-economics; Waste valorization

Abstract ID: ANN-PP37

Enhancing Oxygen Concentration in Enclosed Spaces to Mitigate Air Pollution: Zeolite 5A as a Cost-effective Solution

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Abstract
Addressing the critical issue of air pollution and its detrimental impact on human health, this study focuses on elevating oxygen levels within confined environments like offices and hospitals. A significant challenge in pursuing this objective lies in the cost associated with utilizing zeolite 13X, a highly efficient adsorbent for increasing oxygen concentration. To overcome this obstacle, our research concentrates on optimizing zeolite 5A, a more cost-effective alternative, to render it a practical solution for enhancing oxygen levels in confined spaces. Our methodology involves a comprehensive investigation into the performance of zeolite 5A, particularly regarding its N_2/O_2 selectivity when compared to zeolite 13X and LTA zeolites. The preliminary findings suggest that while zeolite 13X exhibits superior N_2/O_2 selectivity. Subsequently, our ongoing work endeavours to optimize zeolite 5A, aiming to achieve efficiency comparable to zeolite 13X. This effort aims to position zeolite 5A as a viable, cost-efficient adsorbent for improving oxygen concentration in confined spaces, contributing to a sustainable solution for mitigating air pollution's health impacts.

Keywords: Oxygen concentration; Zeolite 13X; Zeolite 5A

Abstract ID: ANN-PP40

Synthesis And Characterization Studies of Polymeric Nanocomposite of Cobalt Oxide and Its Industrial Application

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Abstract
Nano cobalt oxide was synthesized by wet chemical method using Cobalt chloride as precursor. Cobalt oxide-chitosan nanocomposites were synthesized by chitosan in the presence of as-synthesized nanocrystalline cobalt oxide. The synthesized nanocomposites were characterized by FTIR, UV-VIS and SEM analysis. In FTIR spectra, the presence of the chitosan peaks in addition to that of Cobalt oxide at 614 and 558 cm^{-1} confirmed that Cobalt oxide molecules interact with the chitosan. SEM images show that chitosan was incorporated in nano Cobalt oxide, which confirms the formation of nanocomposites. Fourier transform infrared and ultraviolet visible spectroscopy show that Cobalt oxide nanoparticles get bound to the specific sites of chitosan. Cobalt oxide-chitosan nanocomposites show electrical properties. Furthermore, the antioxidant capacities of the prepared nano-composites thin films were validated using the DPPH free radical scavenging method and showed good antioxidant activities with the DPPH radical.
Key words: Nano cobalt oxide, SEM studies, chitosan nanocomposites

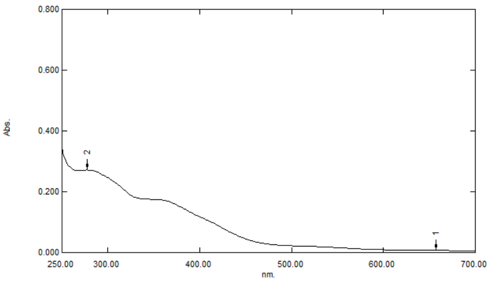

Figure 1: UV-vis spectroscopy of chitosan nanocomposite of cobalt oxides

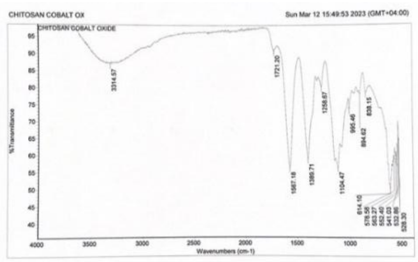

Figure 2 : FTIR of chitosan nanocomposite of cobalt oxides

Abstract ID: ANN-PP41

Synthesis of single and two-side flattened colloids and their self-assembly

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Abstract
Anisotropic particles with non-spherical shapes have the potential to serve as fundamental components for creating specific colloidal structures through spontaneous self-organization. Using the traditional dip-coating process, we describe a simple yet straightforward method for producing particles with varying shapes. In this technique, positively charged spherical latex particles, like polystyrene (PS), undergo unequal deformation at an oil-water interface caused by heating and partial swelling. Subsequently, particles are dip-coated onto a glass substrate. These spherical particles transform into non-spherical forms resembling flat shapes. The self-assembly of these particles displays intriguing patterns, including linear and branched polymeric chains, worm-like chains and micelle-like spherical clusters. These particles possess specific orientations and interactions, mimicking biological macromolecular systems. Such orientation-dependent interactions lead to generating intriguing self-assembled structures and complex clusters. The as-synthesized single and two-side flattened colloids are further characterized by electron and light microscopy for obtaining the size, shape, and number distribution. The dip coating technique can be easily scaled up to produce large quantities of flattened colloids, which is one of the significant limitations of other methods of producing non-spherical particles at fluid-fluid interfaces.

Keywords: Non-spherical particles; Self-assembly; Interface; Flat colloids

Abstract ID: ANN-PP43

In situ Preparation of oil and nanocellulose from pineapple peel- Characterization studies and its application

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Abstract
This study determined the chemical compositions of oil extracted from the fruit peels of pineapple. Oil was extracted by using solvent extraction. The extract was analyzed using UV-VIS spectrophotometer and Fourier Transform Infrared (FTIR) spectrometer. Nanocellulose is also prepared from pineapple peel powder by using alkali treatment and acid treatment. SEM studies of nanocellulose used to identify the surface morphologies of nanocellulose. FTIR studies revealed the presence of amorphous nature of nanocellulose. X-ray studies showed the crystallinity nature of the nanocellulose. Nano cellulose can be used as bio medical products and nanocomposite materials.

Key words: Pine apple peel oil; nanocellulose; SEM studies.

Water & Wastewater Treatment (WWT)

Wastewater treatment technologies: Zero Discharge Liquid (ZLD), Ultrafiltration, Nanofiltration, UV; Arsenic removal; Reverse Osmosis; Ceramic & Polymeric Membranes; Solar powered micro filters; Safety and Quality of Underground Water; Industrial & agricultural Wastewater Treatment; Sedimentation, filtration and oxidation; Water reclamation; Water cycle

Abstract ID: WWT-OP1

Hydrogen Production from Wastewater by Photo-electrolysis using Ligand-free Semiconductor Nano-composite of TiO_2 modified by Au; A Brief Review

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Abstract
The global climate risks and energy requirement issues have forced the world to adopt renewable resources and reduce the over-dependence on fossil fuel. Hydrogen is found to be the best alternative in current decades, and most of the countries are trying to explore it into technology within 2025. Industrial sources of environmental pollution generate huge amounts of industrial wastewater containing various recalcitrant organic and inorganic pollutants that are hazardous to the environment. And industrial wastewater can be regarded as a prospective source of energy and valuable raw materials for hydrogen production. Conventional sewage treatment systems are often not efficient enough for the complete degradation of pollutants and they are characterised by high energy consumption. The chemical energy that is stored in the wastewater is unexploited. A solution to these problems is the photo-electrocatalytic depletion of waste water to produce hydrogen which leads to energy generation. TiO_2 has been used as a photocatalyst since the 1970s due to its low cost, earth abundance, and stability. There has been a wide range of research activities in order to enhance the use of TiO_2 as a photocatalyst using dopants, modifying the surface, or depositing noble metals. Ligand-free semiconductor nano-composite of TiO_2 modified by Au is one of the best routes of water depletion techniques. This paper presents a general brief overview of the semiconductor Au doped TiO_2 materials applied as photoelectrodes in the treatment of wastewater. It deals with the alternative/cost-effective synthesis process of ligand-free Au/TiO_2 nano-composite, fundamentals of photo-electrocatalytic reactions and the mechanism of waste water treatment as well as parameters affecting the treatment process.

Keywords: Nano-composite; Photo-electrocatalysis; Wastewater depletion; Green H_2 generation

Abstract ID: WWT-OP2

Waste to Wealth: Mechanistic insights into remediation of arsenic from groundwater using encapsulated red mud waste

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Abstract
Arsenic in groundwater has been deemed as the largest mass poisoning in the history of mankind. Over 5 billion people are affected worldwide by elevated level of arsenic. Conventional remediation includes adsorption, which is often limited by either capacity or cost. This study evaluates the efficacy of a waste material (red mud) for the remediation of the same. An activated red mud (AARM) -polyacrylonitrile (PAN) polymer matrix has been developed as polymeric beads. It is used as an adsorbent for removing arsenic from synthetic solution as well as real life groundwater. Batch adsorption experiments were performed to investigate the kinetics of the process, adsorbent dosage, and effect of initial concentration on arsenic removal. The study found that the maximum arsenic adsorption capacity is 9.27 mg/g. The beads were characterized in terms of surface characteristics and organic-inorganic interaction. A regeneration study was performed to understand the stability and potential for repeated use of the AARM-PAN polymeric beads for arsenic mitigation. Groundwater from real life source has also been taken into consideration to understand the efficacy of beads. The findings demonstrate the potential of red mud as a low-cost adsorbent for arsenic removal and provide valuable information for designing large-scale adsorption processes.

Keywords: Arsenic removal; Red Mud; Acid activation; Adsorption; Low-cost adsorbent; Polymeric beads; Kinetic study; Water treatment

Abstract ID: WWT-OP4

Experimental studies and kinetic modelling of simultaneous adsorption and photocatalytic reaction on synergistic removal of Methylene blue dye from waste water

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Abstract
The study investigates the effects of simultaneous adsorption and photocatalytic reaction for removal of dye from industrial effluents. Initially, the standalone reaction kinetic studies were carried out in an annular UV photoreactor by adding predetermined quantities of TiO_2 in Methylene blue solutions. The treated solutions were collected at regular time intervals and the samples were analyzed for dye content using UV-visible spectrophotometer. The experimental results were fitted to standard kinetic models, namely, Langmuir-Hinshelwood model for estimation of the model parameters. Further, calculated amounts of activated carbon were added to dye solutions and the samples collected at regular intervals were analyzed to establish the adsorption kinetics. For an understanding of the synergistic effects of simultaneous adsorption-reaction on removal of dye from wastewater, predetermined quantities of the photocatalyst and adsorbent were added to the dye solutions in a UV photoreactor and the treated samples collected at same intervals of time as the standalone processes were analyzed. The percentage removal of dye established synergistic effects of the integrated process. Suitable model equations were developed to establish the kinetics of the integrated process. Model predictions,showed reasonably good agreement with the experimental results (R^2=0.95).

Keywords: Dye removal; Simultaneous adsorption-photocatalysis; Kinetic modelling

Abstract ID: WWT-OP7

Enhanced electron trapping protocol of MIL-100(Fe) via different synthetic routes for the effective visible light degradation of Sulfamethazine

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Abstract
In this study, the comparative performance of MIL-100(Fe) prepared by two different methods as photocatalysts were evaluated for the effective visible light degradation of Sulfamethazine (SMT). MIL-100(Fe) has been synthesised via two different routes i.e., hydrothermal method (MIL_A) and room temperature conditions (MIL_B). Both MIL_A and MIL_B, two varieties of MIL-100(Fe), were characterised using FTIR, Raman, FESEM, EDX, XRD, Raman, BET, UV Vis-DRS, XPS, & PL to ascertain the morphology and optical characteristics. EIS, MS & photocurrent study were utilised for photoelectrochemical property. The band gap of MIL_A is higher than that of MIL_B. Photoluminescence (PL) analysis indicated MIL_A as a better photocatalyst. Both the photocatalysts showed comparable efficiency for the degradation of SMT with MIL_A showing better performance. A Box-Behnken experimental design is employed to optimise operating parameters such as initial concentration, pH and photocatalyst dosage. After three consecutive cycles, the performance of the photocatalyst has not deteriorated significantly. Intermediated products were identified using LC-MS and a degradation pathway is proposed.

Keywords: MIL-100(Fe); Sulfamethazine; Visible light degradation; Box-Behnken experimental design; Intermediate products

Abstract ID: WWT-OP8

Asphaltenes derived nanocomposites for the removal of emerging pollutants

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Abstract
Safe drinking water is the necessity of all living beings, which is often sourced from the same fresh water sources which provide water to industries. There have been many reported pollutants of the fresh water sources, but recently emerging

pollutants have been identified as the pollutant of concern. Hospital waste, pharma waste, expired drugs are classified as emerging pollutants and contribute to the health hazard and microbial immunity. On the other hand, petroleum industries produce asphaltenes in the range of tonnes/day, which is a waste, rich in carbon. These asphaltenes was used for preparation of activated carbon with BET surface area of 1850 m^2/g and pore volume 1.9 cm^3/g. The prepared activated carbon was used in the adsorption of Amoxicillin and Tetracycline and was with maximum monolayer adsorption capacity of 412 mg/g and 730 mg/g respectively. The adsorption processes were found to follow Freundlich isotherm. The adsorption kinetics were found to follow pseudo second order adsorption kinetics model.

Keywords: Emerging pollutants; Asphaltenes; Petroleum waste

Abstract ID: WWT-OP9

Mitigation of methylene blue from aqueous solution by hybrid process of coagulation-flocculation and adsorption

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Abstract
Textile industry wastewater is a major source of water pollution since it contains a large amount of dye and other harmful contaminants. Coagulation/flocculation and adsorption methods were considered mostly in textile wastewater treatment because of their excellent efficiency and simplicity. In this study, to observe the efficacy of colour and chemical oxygen demand (COD) reduction, from an aqueous solution of methylene blue, a hybrid process of coagulation-flocculation and adsorption was used. Among the several combinations of coagulant-flocculant, the supernatant of the best combination [PAC-SALG] was utilized for further adsorption process using granular activated carbon (GAC). Preliminary treatment included the determination of the best possible combination of coagulant-flocculant whereas the effect of adsorbent dose, contact time, and pH were observed in the secondary treatment. The experimental data obtained from these hybrid experiments revealed that the colour removal efficiency of overall studies was maximum (99.1%) and the reduction of COD in synthetic wastewater reached up to 66%. The maximum dye adsorption was observed at pH 4, after 40 minutes, with 0.9 g adsorbent dosage. Thus, the result shows that the hybrid process of coagulation-flocculation and adsorption can be a better approach to the mitigation of dye from textile wastewater.

Keywords: Textile Wastewater; Adsorption; Coagulation-flocculation; Dye; Methylene Blue (MB); GAC; COD

Abstract ID: WWT-OP11

Nano Adsorption Technology to help remove toxic metals from wastewater at Indian coal mine

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Abstract
With the growth in industrialization, pollution has been continuously risen. It is mainly because of pollutants and several other factors. Henceforth, to minimize such things in case of wastewater generated from coal mines, research has been carried out in this study. Toxic metals generally released from coal mines are mercury, lead, chromium, Arsenic, magnesium etc. The treatment of wastewater released from coal mining industries are done using efficient technique. One of the techniques that is addressed in our research is Nano-adsorption technology. It is quite helpful in complete treatment process of coal mine wastewater. However, to remove the pollutants and determine the toxic metals efficiency use of conventional method named Electro-coagulation is carried out in the study. It has helped in evaluating the % of toxic metal in the coal wastewater. The process is carried out in continuous manner with at least a capacity of 5 litres mining wastewater from which toxic metals are removed. Later on, the utilization of Nano Adsorption technology is done to ensure the sustainable growth in mining operations it is essential to effectively treat the coal mining wastewater. The project result of the research is to reduce the toxicity and approaching the treatment of coal mine wastewater to be Beneficial for environment. The sludge formation can also be used as the by-product for the automotive industry.

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Keywords: Mining; Toxic Metals; Nano-adsorption; Electro-coagulation; Coal wastewater

Abstract ID: WWT-OP12

Adsorptive removal of 2, 4- Dichlorophenoxyacetic acid using polypyrrole coated magnetic activated carbon derived from biomass

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Abstract
The water contamination due to excess herbicide usage has attained greater importance by treating in efficient, simple, and cost-effective techniques. In the current study, the research was carried out to determine the adsorption of 2, 4-Dichlorophenoxyacetic acid (2,4-D) from an aqueous solution using magnetic -activated carbon prepared from novel biomass using orthophosphoric acid as activating agent. As a part of the characterization technique, Brunauer-Emmett-Teller (BET) analysis was conducted to determine the surface area and pore volume. The polypyrrole coated magnetic activated carbon prepared using orthophosphoric acid resulted in surface area and pore volume having 745.41 (m^2/g) and 0.5287 (cm^3/gm), respectively. The preliminary experiments showed that polypyrrole-coated magnetic -activated carbon derived from biomass had a high adsorption capacity to remove 2,4-D from an aqueous solution.

Keywords: 2,4-D; Polypyrrole; Adsorption; Magnetic activated carbon

Abstract ID: WWT-OP13

Photocatalytic dye removal using P doped g-C_3N_4 nanosheet

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Abstract
As a result of global industrialization water pollution has become an obvious matter to look after. Organic dyes are one of the main pollutants and is used in many sectors like textile, painting, paper etc. In this work phosphorous doped graphitic carbon nitride (P doped g-C_3N_4 nanosheets) has been developed and used in the photocatalytic removal of methylene blue dye from synthetic wastewater. The prepared photocatalyst has been characterized through different techniques like, XRD, FTIR, UV-Vis, DRS, SEM, EDX, BET etc. Here, the dye removal efficiency of the prepared sample was evaluated under visible light source. The dye removal efficiency of the P doped g-C_3N_4 nanosheet has been obtained as nearly 85 %, which was much higher than bulk g-C_3N_4 (≈24%) and g-C_3N_4 nanosheets (≈37%). The reaction parameters like (solution pH, catalyst loading, and dye concentration) were optimized to enhance the dye removal efficiency by this heterostructure photocatalyst. The main limitation of using this catalyst in bulk solution is loss of catalyst with the dispose of treated water. This work addresses the limitation through the coating of the synthesized catalyst on the inert supported material which can enhance the recyclability of the catalyst. The results were observed and compared.

Keywords: P doped g-C_3N_4; Methylene Blue; Photocatalytic

Abstract ID: WWT-OP15

A Continuous Flow Packed Bed Photo Catalytic Reactor for Removal of Water Pollutants from Nag River: A Case Study

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Abstract
Rapid population growth and widespread industrialization are the main contributing factors to the increasing contamination of the world's diminishing freshwater resources. Photocatalytic water treatment using photo catalyst is a well-known advanced oxidation process (AOP) for environmental remediation and waste water treatment. This study is aimed to treat the polluted water of Nag River for domestic water supply purposes situated in Nagpur Maharashtra by continuous photocatalysis. The Tio_2 supported activated carbon packed bed continuous mode photocatalytic reactor was developed for reduction of its physiochemical parameters. Operating conditions of the photocatalytic process such as UV irradiation intensity, catalytic dosage, temperature, inlet flow rate affecting the pollutant treatment efficiency were evaluated and optimized. The results showed that TiO_2 activated carbon catalyst loaded photocatalytic reactor is able to treat organic contents at 83.33% removal efficiency and completely removed colour and enhanced dissolved oxygen level up to 35% at optimum operating conditions with significant reduction in treatment time. This further confirms the present method as a low-cost, highly efficient and sustainable oxidation technology for treatment of Nag River water.

Keywords: Photocatalytic Oxidation; Advanced Oxidation; Waste water Treatment; Environmentally Sustainable

Abstract ID: WWT-OP16

An Integrated Approach for treatment of Slaughterhouse Wastewater

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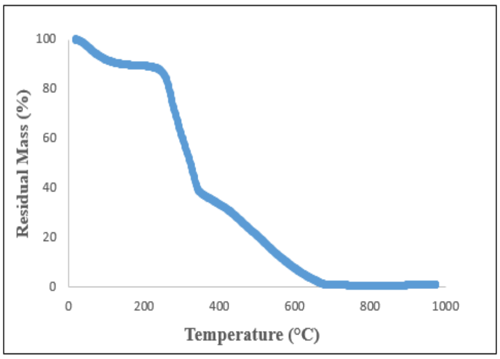
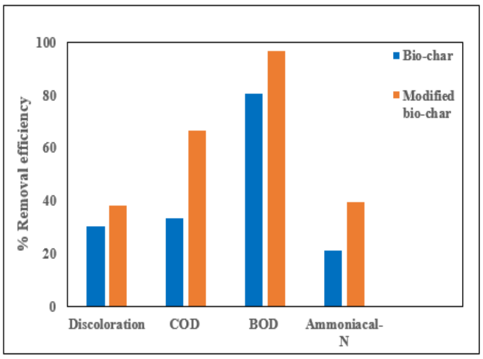
Abstract
Animal slaughtering in the slaughterhouse produces large amount of wastewater containing an array of organic pollutants including proteins, fats, lards and blood and thus, a thorough treatment of slaughterhouse wastewater (SW) is required for sustainable and environmentally friendly discharge. In this study, both physical and biological routes were adopted to treat chicken slaughterhouse wastewater which was characterized in terms of chemical oxygen demand (COD) (1308-4087 mg/L), biological oxygen demand (BOD)(1550-2800 mg/L), Oil and Fat (57700 mg/L), total organic carbon (TOC) (411.7 mg/L), and ammonical-N (32.2 mg/L). Both batch and continuous studies were done. Along with experiments, numerical simulations have been performed to investigate the hydrodynamics of the continuous flow treatment unit. Following figures have shown some typical results related to treatment of SW.



Residual Mass percentage of corn-cob dust with temperatures obtained from TGA



Removal study of Slaughterhouse wastewater

Keyword: Slaughterhouse wastewater; Bio-char; Bioremediation; Modelling and simulation

Abstract ID: WWE-OP17

Phycoremediation of Total Dissolved Solids from Highly Saline Water using Graesiella emersonii

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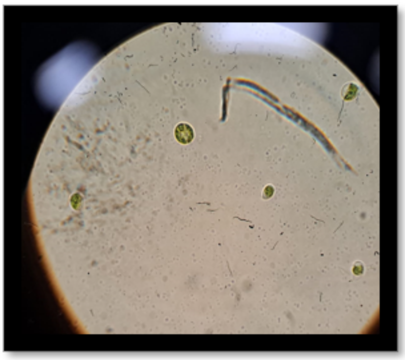
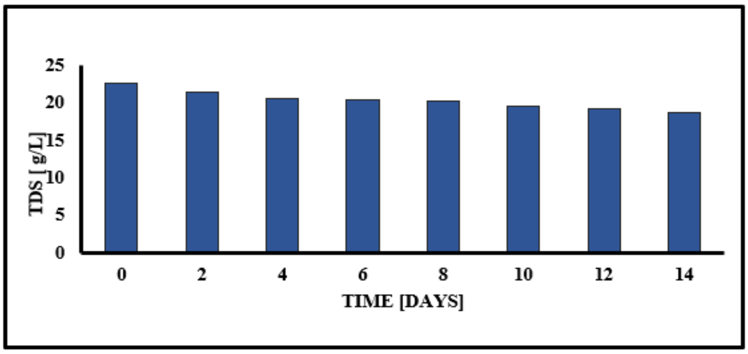
Abstract
Conventional desalination technologies are having some inherent problems like high energy requirement, high cost, etc. A green and economic route for desalination of saline water is in search. Phycoremediation technology, employing green algae/cyanobacteria, is an emerging low-cost, environmentally friendly technology. The present work aims at phycoremediation of TDS (total dissolved solids) from three types of saline water like, seawater (20-25g/L), industrial wastewater (13-14g/L) and groundwater (7-7.5g/L) using *Graesiella emersonii,* an indegenious algal strain, collected from Andaman and Nicobar Island. The strain was found efficient for removal of TDS. All the wastewater was characterised in terms of pH, TDS, salinity and conductivity before and after treatment and the algal biomass generated during treatment was analyzed in terms of its carbohydrate, protein and chlorophyll contents.



Microscopic view: *Graesiella emersonii* at 100X magnification



Removal of TDS using *Graesiella emersonii*

Keywords: Graesiella emersonii; Seawater; TDS; Phycoremediation

Abstract ID: WWT-OP19

Phycoremediation of Pollutants from Refinery Wastewater

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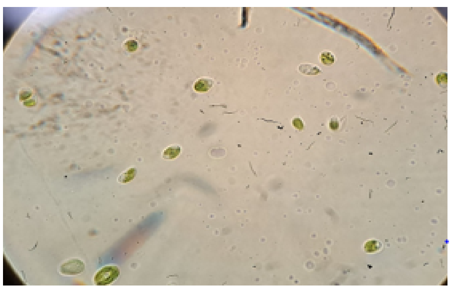
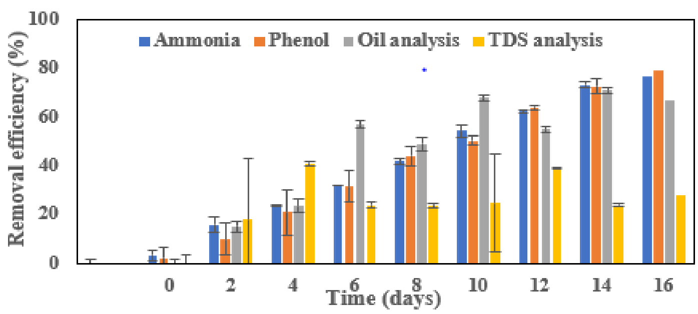
Abstract
The present study aims at phycoremediation of pollutants from secondary treated refinery wastewater. Initially, 15 algal stains, collected from different contaminated sites, were screened to examine their suitability to treat synthetic petroleum refinery wastewater at pH 8 with an inoculum size of 10%. The algal strain Scenedesmus vacuolatus was found most efficient for such purpose. The susceptibility of the selected strain was tested in the synthetic solutions of phenol (11-14 mg/L),



Microscopic view: ***Scenedesmus vacuolatus*** at 100x magnification



Removal of pollutants from refinery wastewater

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ammoniacal -N (10-300 mg/L), TDS (3800-6200 mg/L), and Oil & Grease (945-54000 mg/L) for 16 days. The maximum removal of pollutants has been found as phenol: 79.19±3.07%, ammoniacal-N:76.56±1.03%, TDS: 39.26±20.27%, and Oil & Grease: 68±2.82%. The biomass generated has been analyzed in terms of carbohydrate, protein and chlorophyll contents.

Keywords: Phycoremediation; Refinery wastewater; Phenol; TDS

Abstract ID: WWT-OP22

Chitosan Biochar Composite for Sustainable Zn(II) Removal: Synthesis, Parametric study, Equilibrium, Characterization, and Regeneration

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Abstract
This study focuses on the development of a sustainable and low-cost adsorbent for the removal of Zn(II) from an aqueous solution. Biochar was produced from cotton stalk residue biomass at (600°C and 2 h) of pyrolysis and combined with chitosan in different proportions (0:100%, 25-75%, 50-50%, 75-25%, 100:0%) to create a mechanically stable and mesoporous composite. The composite was tested under different experimental conditions, including initial concentrations (100 to 1000 mg/l), contact time (30 to 180 min), adsorbent dosage (1 to 10 g/l), temperature (30 to 60°C), pH values (2 to 10). Pseudo-Second order models (R^2=0.99) and Langmuir isotherm (R^2=0.99) and were applied to fit the adsorption data. The results showed that the composite had a high adsorption capacity for Zn(II), indicating well-developed monolayer adsorption driven by the chemisorption mechanism. The characterization methods were used to describe the microscopic view, BET surface area, elemental composition, thermogravimetric effects, and crystal structure of the best-resulted composite, which provided insights into its structural and chemical properties. The desorption and regeneration of the composite were also evaluated, demonstrating its potential for repeated use. Overall, the produced adsorbent offers a cost-effective and eco-friendly solution for the decontamination of industrial wastewater.

Keywords: Chitosan-biochar composite; Characterization; Equilibrium; Regeneration

Abstract ID: WWT-OP27

Removal of Methylene blue Dye from Wastewater using Keratin Nanoparticles Synthesized from Human hair

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Abstract
Heavy metals, dyes in waterbodies from dying, textile, and paper industries are one of the major environmental issues. Keratin is the principal component of wool, hairs, nails, and feathers. It consists of amino acids and can be used as biosorbent for the removal of dyes and heavy metals due to the presence of functional groups in the amino acid backbone and side chains. Nowadays nanoparticles have widely used because of their properties like high surface area, more active sites, and low diffusion resistance. Considering benefits of nanoparticles and the keratin biosorbent, keratin nanoparticles can be utilized for the water dye removal. Keratin was extracted using urea, thio-urea, 2-mercaptoethanol and tris-HCl. Nanoparticles formed from extracted keratin via sonication were used for the adsorption of methylene blue dye in the wastewater. A photocatalyst TiO_2 assisted keratin nanoparticle used for methylene blue dye adsorption in photoreactor was carried out to compare the adsorption in presence of UV-light. Work also demonstrates the optimization and kinetic study of methylene blue dye adsorption.

Keywords: Keratin; Nanoparticles; Biosorbent; Photocatalyst

Abstract ID: WWT-OP30

Development of multifunctional catalyst for removal of persistence compounds

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Abstract
Optical property of ZnO enhanced through Fe-doped ZnO nanoparticles synthesis through precipitation method using Zinc acetate dihydrate as a precursor and Oxalic acid as a bridging agent dissolved in alcohol. For optimum enhancement of catalyst, reflux method add-on with precipitation method. Optimization of amount of dopant by preparing Fe-doped ZnO in (0.5, 0.75, 1.0, 3.0, and 5.0 wt.%). Characterization of study of prepared Fe-doped ZnO nanoparticles reveals that, 5 wt.% Fe doped ZnO gave best result of bandgap reduction as compared to rest. The FT-IR and XRD data reveals that with 1:3 %wt. ratio of Zinc Acetate Dihydrate: Oxalic acid ratio gives the optimized result among various other ratio such as 1:1, 1:2, 2:1, 2:3, 1:3. FT-IR data reveals that ZnO nanoparticles prepared with 1:3 ratio shows peak at 637 nm^{-1}, While XRD data reveals that ZnO nanoparticles prepared with same ratio forms wurtzite structure nanoparticles. Photocatalytic degradation study of organic wastewater conducted between Bare ZnO and Fe-doped ZnO under the LED and Solar light source. Reduction in Bandgap from 3.17 eV of bare ZnO to 2.68 eV of Fe-doped ZnO reveals that Fe-doped ZnO has more tendency to work under visible light source.

Keywords: ZnO nanoparticles; Wastewater treatment; Persistent pollutants degradation

Abstract ID: WWT-OP31

Comparative study of RB5 and Congo Red removal from synthetic wastewater using Coagulation-Flocculation process

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Abstract
The textile industry is one of the most significant contributors to India's economic development and is also responsible for growing environmental concerns regarding water pollution. Coagulation-Flocculation has been proven as an efficient and convenient method of removing dye from wastewater. In this research, the maximum colour removal efficiency for Reactive Black 5 (RB5) and Congo Red (CR) from synthetic wastewater was observed by changing the dosages of coagulant-flocculant combinations and the pH. For this purpose, Ferrous Sulphate (FS) as coagulant, Sodium Aluminate (SA), and Sodium Alginate (SALG) as flocculants were used. The maximum colour removal efficiency was achieved at pH 7 with the coagulant-flocculant combination FS-SA providing better colour removal (98.44%) for CR than FS alone for RB5 (97.28%). It was also observed that the dosages of coagulant-flocculant required for RB5 dye removal was 1000 ppm, which was much higher than the dosage (200 ppm) required for CR removal. Comparing the above results, it can be concluded that the coagulant-flocculant combination (FS-SA) showed greater efficiency in removing CR dye than RB5.

Keywords: Textile industry; Wastewater; Reactive Black 5; Congo Red; Coagulation-Flocculation

Abstract ID: WWT-OP33

AOP Based degradation of organic dyes using a novel reactor

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Abstract

Rapid industrialization has changed the face of the world by maximizing production and minimize raw materials. To increase the production, industries release wastes into the water bodies directly without any proper treatment. This results in the presence of heavy metals, organic and inorganic compounds in the water. Traditional wastewater treatment technologies have proven to be marked ineffective for handling wastewater especially of synthetic dyes. Hence, a proper treatment method is required like AOP. Advanced Oxidation Processes (AOPs) are one of the leading processes to treat wastewater by generating hydroxyl radicals to oxidize and degrade the organic compounds. Cavitation, Photocatalysis, Ozonation and Fenton are some of the AOPs used to treat wastewater. The degradation factor of AOPs can increase ten folds if combined with a cleverly designed reactor. Hence, this paper focuses on the designing of a novel reactor based on combination of various AOPs to treat the wastewater efficiently. The paper focuses on the comparison study on degradation of organic dyes by an individual AOP and the combination of AOPs. An experimental study on the dosing of catalyst, energy consumption, effects of pH, by-product formed after degradation, efficiency to reduce COD, etc. will be contained in this paper.

Keywords: AOPs; Wastewater treatment; Reactor design; Hydroxyl radicals

Abstract ID: WWT-OP35

Preparation and Characterization of Activated Carbon Coated Magnetite or Oil-Water Separation

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Abstract

Water contamination is a severe issue that has an impact on people everywhere. Sewage discharges, industrial activities, agricultural activities, and urban runoff including storm water are the four main sources of contaminants. The purpose of the current work was to prepare and characterize activated carbon from neem leaf powder and activated carbon that had been coated with magnetite. (Fe_3O_4). The prepared adsorbents were characterized by Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FT-IR) and Vibrating Sample Magnetometer (VSM). When compared to the magnetization value of 4.4 emu/g, the saturation magnetization value of coated magnetite was 48.43 emu/g, which is more than sufficient for conventional magnetic separation. Adsorbent dosage, Initial concentration, and contact time were all examined and it was used for oil-water separation process for different samples in high viscous liquid (soy bean oil) and low viscous liquid (kerosene)at different pH levels. According to our results, low viscous liquid (kerosene) gives more removal efficiency for activated carbon coated with magnetite 75% and 85% removal respectively with pH=3 compared to high viscous liquid (soy bean oil). The reason for high removal at acidic condition for activated carbon coated magnetite was due to electrostatic attraction.

Keywords: Activated carbon; Magnetite nanoparticles; High and low viscous oil

Abstract ID: WWT-OP36

Colour Removal Studies on Methyl Orange using Iron Nanoparticles synthesized by Green Chemistry Approach

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Abstract

The higher concentrations of dye effluents discharged from the textile industries are considered as serious threat to the environment and are treated before being discharged to water bodies. With present methods being expensive, a strong need exists to look for alternative methods to decrease the concentration of colour in these effluents. In the present work, Green chemical engineering approach is being used to synthesize iron nanoparticles using insulin leaves as basic feed stock. The iron nanoparticles have been synthesized by using bottom-up methodology. The synthesized particles have been characterized using the FTIR, SEM, XRD and DLS techniques. The colour removal from synthetic waste water containing methyl orange has been studied using pure nanoparticles and nanoparticles embedded on alginate beads. The studies have been carried out using synthetic waste water to estimate the reduction in colour with adsorbent dosage, contact time and concentration of the dye. The colour removal has been found using the UV-Vis spectrophotometer and removal efficiency of colour has been estimated. The percentage of colour removal using nanoparticles and nanoparticles embedded on alginate beads is found to be 36%-56% and the adsorption phenomena has been found to obey Temkin isotherm.

Keywords: Methyl orange; Insulin leaves; Colour removal; Nanoparticles

Abstract ID: WWT-OP37

ADSORPTION OF CHROMIUM (Cr VI) FROM TANNERY WASTE WATER USING BIOADSORBENT: WINGED TERMITE

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Abstract
The chemical process of tanning, or treating animal skins and hides to prevent decay, results in leather, a strong, flexible, and long-lasting material. Over the centuries, leather; which is thought to have been the first fabric made by human hands has undergone significant development. The process of tanning leather uses a lot of water and produces a lot of wastewater. This waste water contains hazardous hexavalent chromium, or Cr (VI), as well as other heavy metals. In order to determine the winged termite's ability to remove Cr (VI) from tannery wastewater through bioadsorption, this study focused on the batch process results due to their simplicity. Adsorption experiments were carried out as batch studies with different contact times, pH and adsorbent dosage in order to find optimal conditions for the removal of hexavalent chromium, or Cr (VI) from tannery waste water. The functional groups on the adsorbent of the winged termite were identified using Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). The adsorption of Cr (VI) was found to be optimum pH 4.5 at 10RPM and 2 hours for dosage of 7g of winged termite. The experimental data closely fitted the plots of the adsorption isotherm.

Keywords: Hazardous hexavalent chromium or Cr (VI); Winged termite; Bio adsorbent; The effect of initial concentration, adsorbent dose, pH, contact time and temperature on the batch Adsorption/ desorption process were examined

Abstract ID: WWT-OP38

Characterization and adsorption performance evaluation of waste char

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Abstract
Environmental threats such as global warming, soil contamination, ground water pollution and air pollutions are the penalties of the huge generation of wastes from industries and urban areas. Therefore, waste management has become an important issue. An effective waste management includes prevention, reuse, recycling, recovery and disposal of waste. Several technological approaches have been explored to attain any one of the processes. Waste to energy (WTE) conversion is well accepted. Pyrolysis is one such promising technology which can produce three different types of fuel such as, pyro-oil, char and gases from solid or liquid wastes. This pyro char can be used as a good adsorbent. On the other hand, industrial effluent contains heavy metals like Lead (Pb), Arsenic (As), and Cadmium (Cd), as well as harmful anions like fluorides, nitrates, and sulphates, which cause extensive damage to our environment. Hence, treatment of industrial effluents is utmost important. In this present study, char material will be prepared from pyrolysis of waste materials and will be used for the liquid phase adsorption of Eosin y. Adsorption isotherm will be evaluated. Characterization of adsorbent will be done. The removal of pollutants from waste water solution using this adsorbent will be presented.

Keywords: Pyro char; Adsorption isotherm; Solid waste; Wastewater treatment; Industrial effluent treatment

Abstract ID: WWT-OP39

Modified Biopolymeric membrane for water treatment applications

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Abstract
Over the years, water has been contaminated by effluents from chemical industries, refineries, pharmaceuticals, agricultural wastes, and domestic waste. Membrane-based separation processes have become emergent technology for waste water treatment. Water recovered through the membrane process can be utilized for different applications. Currently, most membranes used for water treatment are derived from fossil fuels. In this study, bio-based polymeric material, cellulose acetate, obtained from renewable resources, was selected as the base polymer for waste water treatment. The cellulose acetate biopolymer matrix derived from natural resources is a lightweight, biodegradable and low cost polymeric matrix, which provides multiple active sites for linear and cross-linking polymerization depending upon the degree of acetylation. The greener solvent approach is followed in using DMSO as a solvent for membrane fabrication. In this study, the biopolymer is modified by incorporating SBA-15 nanomaterials into the polymer matrix to improve separation performance and strength. The membrane performance is evaluated by water flux determination with oil-water emulsion, and membrane efficacy is also studied for oil-water separation. SBA-15 filler concentration of 0.05, 0.1, 0.3 and 0.5 wt% of the polymer was loaded to attain maximum water flux (2120 L m^{-2} h^{-1}) with higher oil removal efficiency (99%). Filler loading was optimized to obtain a defect-free membrane and exhibit higher membrane performance. The fabricated membranes were tested multiple times to evaluate the consistency in membrane performance. The morphology characterization indicates uniform surface modifications when lower concentrations of fillers were used. The membrane has uniformly distributed pores and filler materials across the surface and exhibits higher separation efficiency and water flux. The developed membrane could be effectively used for waste water treatment.

Keywords: Biopolymer; Membrane separation; SBA-15 nanomaterials; Water flux; Oil removal efficiency; Waste water treatment; Oil-water emulsion

Abstract ID: WWT-OP40

High surface area biochar for the removal of naphthenic acids from environmental water and industrial wastewater

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Abstract
This study reports the production of biochar adsorbents from two major crop residues (i.e., rice and wheat straw) to remove naphthenic acids from water. The alkali treatment activated the biochars resulting in a tremendous increase in their surface area, i.e., up to 2252 m^2/g and 2314 m^2/g, respectively, for rice and wheat straw biochars. Benzoic acid was used as a model compound to optimize critical adsorption parameters. The maximum monolayer adsorption capacity of 459.55 mg/g and 357.64 mg/g was achieved for activated rice and wheat straw biochars. Remarkable recyclability of activated biochars as adsorbents was noticed, with no significant loss in their efficiency after ten successive regeneration cycles. The adsorption results were validated using commercial naphthenic acid mixture that was spiked in river water and paper/pulp industrial effluent. The activated rice and wheat straw biochars exhibited excellent adsorption efficiency of 130.3 mg/g and 74.6 mg/g, respectively. This study offers a cost-effective and eco-friendly approach to valorizing agricultural residues for pollutant removal from industrial wastewaters, including petroleum refineries.

Keywords: Biochar; Rice straw; Wheat straw; Alkali-treatment; Naphthenic acids.

Abstract ID: WWT-OP43

Effects of potential waveforms in Pulsating DC electroultrafiltration (EUF) of dairy wastewater

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Abstract
Ultrafiltration (UF) has been established as a promising technology in treatment of dairy wastewater. However, the expected growth of UF technology in dairy sector is partially impeded because of two well-known operational non-idealities, namely concentration polarization (CP) and membrane fouling. Several remedial methods were introduced over decades amongst which electrical field-enhanced UF, alternatively known as electroultrafiltration (EUF), came up as one of the techno-economically feasible options. Most of the initial studies on EUF were limited to the applications of constant DC field. Nevertheless, over the last two decades, pulsed electric field using sinusoidal function with non-zero mean value has been confirmed by several authors to yield superior performance characteristics relative to constant DC-based processes. Recently, we have deciphered the root cause behind such enhanced performance as the pulsating Maxwell stress-induced fatigue failure in the dielectric thin film of rejected proteins that has accumulated on the membrane surface. In this article, we have explored the effects of potential waveforms (e.g., sinusoidal, box, and saw tooth) on flux upscaling and overall performance upgradation of EUF. Transmembrane pressure (1-4 kg_f cm^{-2}), electric field strength (1000-15000 V m^{-1}), and pulsating frequency (1-100 Hz) were considered as three independent process parameters for each of the aforementioned waveforms. Outcomes of our study suggest nearly 50% flux enhancement in case of box wave operating with a mean potential of 15000 V m^{-1}.

Keywords: Electroultrafiltration; Permeate flux; Pulsating DC; Potential waveform; Box wave

Abstract ID: WWT-OP45

Sunlight promoted photodegradation of direct red-80 dye using a waste-derived catalyst

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Abstract
Water contamination due to the interference of dye molecules is a significant problem most of the population faces worldwide. Diverse treatment methods are adopted to treat the dye wastewater stream before its disposal in water resources. Apart from this, sunlight-promoted photodegradation has gained a prominent place in the field of dye removal. In the same string, the use of catalysts has become a new trend to be explored as the replacement for the current expensive catalysts for textile effluent. With the same perspective, jarosite - a hazardous solid waste generated from the zinc industry has been utilized as a catalyst for dye degradation from an aqueous solution. Primarily, the catalyst was prepared and characterized by X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Fourier Transform infrared spectroscopy (FTIR), and X-ray fluorescence spectroscopy (XRF) techniques. Furthermore, the degradation studies were conducted to determine the effects of various process variables inculcating time (15-180 min) and catalyst dose (0.1-0.8 mg/ml). The maximum direct-red 80 dye degradation of 99.56 % was observed at 90 min, 0.3 mg/ml catalyst dose, and an initial 60 mg/L dye concentration. Henceforth, jarosite as a catalyst can successfully be implemented to treat the waste effluent streams emerging from textile industries.

Keywords: Sunlight; Degradation; Jarosite; Direct red-80 dye

Abstract ID: WWT-OP47

The state of art on advancements in capacitive deionization

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Abstract
Pollution of fresh water bodies by various domestic and industrial sources creates a great demand for freshwater the 21st century, and a few parts of the world also marches towards DAY ZERO. Over the past ten years, capacitive deionization (CDI), a promising electrochemical water treatment technology, has drawn significant attention for its ability to effectively remove ions from water while being inexpensive and convenient for electrode regeneration for treating the polluted water and is highly effective for the treatment of brackish water. CDI cell is supplied with 1.2V to temporarily create an electric field that drives the ions to their different polarized poles and subsequently desorb these solvated ions when potential is switched off. Capacitive deionization is a good energy efficient operation since it targets/extracts the solutes instead of the solvent. This paper discusses the principle of CDI, compares various methodologies for improvised efficiency, its applications, and the impact of various operating parameters in the process. The synergic effect of CDI in combination with reverse osmosis (RO) and with zero liquid discharge were too discussed in this review. This review also opens up the scope of CDI in water treatment by optimising the operating parameters and energy efficiency of the process.

Keywords: Capactive deionization; Electrode potential; Energy efficiency

Abstract ID: WWT-OP48

Adsorption of Arsenic from Environmental Waters by Silica Gel Coated with Ceria Particles

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Abstract
Arsenic toxicity is severe environmental problem in ground water and drinking waters in several rural locations of India. WHO had limited drinking water limit of Arsenic to 10ppb. Long-term exposure to arsenic results in cancer, skin problems along with onset of cardiovascular disease and diabetes. Arsenic remediation of water is required in order to provide an Arsenic safe water supply.
Adsorption is the most popular method among the various techniques available for heavy metal remediation. Ceria based adsorbents have gained attention in the past few years owing to their stability and regeneration capabilities and high adsorption capacities. Silica gel beads of size 2-5mm are coated with ceria particles by precipitating the cerium hydroxide over washed silica gel beads followed by drying and calcination at 110 and 450^{o}C respectively. The synthesized adsorbent material was characterized by SEM-EDX shows the deposition of ceria over silica gel beads. The adsorption experiments were carried out that demonstrated the figures of merit of adsorbent material for arsenic adsorption in terms of adsorbent capacity, pH range and interferences from other species present in water. The XPS and theoretical studies were carried out in order to understand the mechanism and adsorption isotherms for adsorbent material.

Keywords: Environmental remediation, Adsorption, Arsenic, Ceria

Abstract ID: WWT-OP53

Influence of vegetation cover on hydraulic performance of a subsurface flow wastewater treatment constructed wetland

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Abstract
Engineered subsurface constructed wetlands (CWs) has been proven to be reliable, cost effective and long term solution for wastewater treatment. The optimal design and efficient operation of the CWs depends its hydraulic efficacy. Residence time distribution (RTD) measurement is an experimental tool to measure the hydraulic efficacy of CWs in terms of wastewater

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hydrodynamic parameters. For the measurement of the RTD of wastewater impulse of radiotracer was injected at feeding line of CW and monitored at different location of the CW using radiation detectors. From the measured experimental curves different parameters such as flow distribution, mean residence time, hydraulic efficiency index, effective volume fraction and short circuiting index of the wastewater in CW were estimated. Moreover, a flow model was developed to identify flow pattern and degree of mixing in the CWs. The model and hydrodynamic parameter were suggested that with development of roots due to maturity of the plants, the overall flow behavior of wastewater inside the plant was approches to the plug flow as desired and improve its hydraulic efficacy.

Keywords: Wastewater, Hydraulic Efficacy, Radiotracer

Abstract ID: WWT-OP57

Chemically crosslinked poly (vinyl alocohol) hydrogel for the sorption studies of reactive red 120 dye from aqueous solution

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Abstract
Reactive Red 120 (RR 120) dye widely used in textile industries is responsible for many fatal diseases such as allergy, dermatitis and skin irritation. This study is the investigation of the removal of Reactive Red 120 from aqueous solution using chemically cross-linked poly (vinyl alcohol) (CC-PVA) gel by sorption technique. The sorption experiments were optimized with different parameters such as pH, initial dye concentration, contact time, adsorbent dosage and solution temperature. Sorption kinetics was found to follow Ho's pseudo-second-order kinetic model. Sorption isotherm data was analyzed using four model equations: Langmuir, Freundlich, Temkin, Dubinin–Radushkevich isotherms and it was found that the Tempkin isotherm model was fitted the sorption data most with the highest correlation ($R^2 \geq 0.9521$) at higher temperature (46^{o}C). Thermodynamic parameters such as Gibbs free energy (ΔG), enthalpy (ΔH), entropy (ΔS) were also calculated. The positive value of enthalpy indicates that the uptake of RR-120 onto PVA gel is endothermic in nature. This study shows that the adsorption follows physisorption mechanism. The results thus obtained supported the use of PVA gel as an effective as well as favorable adsorbent in treating RR-120 dye.

Keywords: Hydrogel; Anionic dye; Remediation; Sorption; Endothermicity; Physisorption

Abstract ID: WWT-OP59

ARSENIC CONTAMINATION IN WATER – A REVIEW

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Abstract
Water, an essential component for the survival of living creatures on this earth. Due to increase in population, rapid growth in industrialization is finding its way is polluting water. Generally waste water discharged from chemical industries contain heavy metals like copper, zinc, arsenic, cadmium, lead, mercury, cyanides and many others. Out of these metals, Arsenic (As) is becoming one of the most dangerous chemical in the world. Arsenic is polluting ground water and drinking water over few decades causing serious health disorders to mankind such as skin diseases, lung cancer, reproductive disorders and many. According to Central Pollution Control Board (CPCB) of India, human body can tolerate arsenic concentration up to 0.05mg/l and according to WHO, the permissible limit is 0.01mg/l. This review article mainly focusses on the available forms of arsenic, sources of arsenic contamination and removal methods for arsenic suggesting the suitable. This review also focusses on the various human disorders caused by arsenic and places with higher arsenic contamination in India as well as world.

Key words: arsenic; contamination; removal; water; diseases.

Abstract ID: WWT-OP62

Water Quality Assessment of Surface Water at Basara Region

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Abstract
Surface water is a crucial resource that supports both ecological systems and human uses such as irrigation, drinking water, livestock, wastewater treatment, hydropower, industrial uses, and recreation. The River Godavari, the second largest river in India, is a holy river with significant religious importance since ancient times. However, due to the difficulty in interpreting spatial variations in water quality of such holy rivers, a monitoring program is essential to provide reliable estimates of river water quality. Therefore, a systematic study was conducted to assess the quality of water in the Godavari River at Basara, where water samples were collected from five sampling stations and analyzed using standard methods for twelve parameters, including pH, alkalinity, electrical conductivity, TSS, Hardness, TS, TDS, BOD, COD, DO, fluorides, and nitrates. The river was found to be polluted due to the discharge of pilgrimage articles, industrial, and other waste waters. The present study aimed to evaluate the impact of such contaminated water and assess the Godavari River water quality.

Keywords: Surface water; Godavari River; Water quality index; Basara; Kandakurthi; Tugini; Physico-chemical parameters

Abstract ID: WWT-OP60

Development of carbon-based membrane for oil-water separation

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Abstract
An enormous amount of emulsified wastewater is generated from crude oil processing units, petroleum refineries, and automobile industries. The separation of stable oil emulsion is a key challenge for petroleum refineries and other crude processing units. The present study envisages the development of an efficient, durable membrane and a filtration system for stable oil emulsion. The membrane will be developed by modification of ACF to produce a super-hydrophobic (water contact angle >150^{o}) and super-oleophilic (oil contact angle ~ 0^{o}) surface. The amendment will be done by dispersing transition metal nanoparticles (NPs) and growing carbon nanofiber (CNF) over activated carbon fiber (ACF). The Copper nitrate ($CuNO_3$) precursor will be dispersed over ACF substrate by continuous recycling. NPs of Cu will be developed *in-situ* within pores of ACF by carbonization and reduction of $CuNO_3$. The CNFs will be grown by decomposing acetylene at moderate temperature using chemical vapor deposition (CVD) technique. The integration of NPs and CNFs will produce a hydrophobic hierarchical web structure which will mask the macro-pores of ACF to give a screen size of membrane lower than oil droplets enabling the permeation of oil and the rejection of water. The study will include extensive characterization data of the developed material and the experimental results of separation of oil-water emulsion.

Keywords: Oil-water separation; Wastewater; Membrane; Carbon nanofiber

Abstract ID: WWT-OP66

Elimination of a Toxic Dye using *Avicennia Marina* Leaves: Optimization and Modelling

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Abstract
Toxic dyes found in industrial effluent must be treated before being disposed of due to their harmful impact on human health and aquatic life. Thus, Avicennia Marina Leaves was employed in the role of a biosorbent in this work to get rid of Methylene Blue derived from a synthetic solution. The effects of five process parameters such as temperature, pH, bio sorbent dosage, initial methylene blue concentration, using a central composite design, the percentage of dye clearance was investigated (CCD). The response was modelled using a quadratic model based on the CCD. The analysis of variance revealed the most influential element on experimental design response (ANOVA). Temperature of 44.3^{0}C, pH of 7.1, bio sorbent dose of 0.3 g, starting methylene blue concentration of 48.4 mg/L, and 84.26 percent dye removal were the best

conditions for Avicennia Marina Leaves powder. At these ideal conditions, the experimental percentage of biosorption was 76.93. The link between the estimated results of the developed ANN model and the experimental results defined the success of ANN modeling. As a result, the study's experimental results were found to be quite close to the model's predicted outcomes.

Keywords: Avicennia Marina; Central composite design; Methylene blue; Artificial neural network

Abstract ID: WWT-OP67

Phosphorus Removal and Recovery using Carbon Black Flow Electrode under Short-Circuited Closed Cycle (SCC) mode

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Abstract
Phosphorus (P) is an essential nutrient for fundamental life processes but also is a major pollutant leading to eutrophication in natural water at elevated concentrations. The efficacy of carbon black (CB) and activated carbon (AC) as flowable electrodes for phosphorus removal and recovery from synthetic wastewater using flow capacitive deionization (FCDI) technique operated under short-circuited closed cycle mode (SCC) was studied. Of all parameters studied phosphorus removal was significantly affected by the applied voltage and initial pH of the feed solution. The phosphorus removal efficiency, adsorption capacity, and average removal rate were 83.74 ± 1.30%, 8.76 mg/g, 0.025 mgmin-1cm-2, and 90.54 ± 1.12%, 9.26 mg/g, 0.0293 mgmin-1cm-2 for AC and CB electrode slurry respectively. Physisorption of phosphorus on carbon particles was insignificant compared to electrosorption. The electrodes were regenerated by short-circuiting to recover phosphorus and the highest phosphorus recovery efficiency of 68.06 ± 0.46%, and 85.46 ± 0.74% was obtained for AC and CB, respectively. Therefore, CB slurry as flow electrode under SCC mode showed better performance for both phosphorus removal and recovery efficiency compared to AC under the same mode of operation. The application of FCDI technique in the treatment of phosphorus-containing effluents has excellent prospects.

Keywords: Flow electrode capacitive deionization; Activated carbon; Carbon black; Phosphorus removal; Phosphorus recovery

Abstract ID: WWT-OP68

Effect of coagulation on microfibers in laundry wastewater

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Abstract
Microplastics pollution in the aquatic system has received significant attention due to their recalcitrant nature and ecotoxicological threat. In this study, the effect of coagulation on microfibers obtained from a lint screen of a domestic dryer and resuspended in pure water, and also in laundry wastewater was investigated using ferric chloride and polyaluminum chloride (PACl). The removal efficiency of the microfibers resuspended in pure water varied from 86%-96% depending on the fiber size ranges: < 90 µm, 90-125 µm, and > 125 µm with the smaller size microfibers showing a lower removal efficiency. Surfactant present in detergent in laundry wastewater reduced the microfibers removal efficiency to 0-37%, however, the addition of PACl increased microfibers removal to 90%. The optimal PACl concentrations for ≥ 90% removal were 1.75, 2, 4, and 6 mg/L for 0.5, 2, 4, 8 mg/L detergent, respectively. Zeta potential, FTIR, and SEM analysis were applied to observe the surface changes of microfibers during coagulation indicating possible mechanisms of coagulation. The dominant mechanisms for coagulation of microfibers by $FeCl_3$ and PACl seem to be charge neutralization and adsorption-bridging. This work provided some insights about the fate of laundry microfibers in primary treatment processes.

Keywords: Microplastics; Ferric chloride; Polyaluminum chloride; Charge neutralization; Surfactant; Laundry wastewater

Abstract ID: WWT-OP69

Fixed-bed column adsorption of tetracycline on effective mesoporous coconut shell adsorbent

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Abstract
This study investigates the use of a mesoporous coconut shell-activated carbon as an adsorbent for the removal of Tetracycline (TC) from aqueous solutions in a fixed-bed adsorption column. The surface area and porosity of activated coconut shells (ACS) were determined using the Brunauer–Emmett–Teller (BET) analysis. Effects of inlet TC concentration, feed flow rate, and the ACS bed height on the breakthrough characteristics of the adsorption system was examined. The dynamic response and operation of the adsorption column were determined using the breakthrough appearance time and the shape of the breakthrough curve. The BET analysis showed that the activation process successfully increased the surface area and pore volume of the coconut shell. Additionally, the experimental results showed that the most efficient bed capacity in the column study was achieved at an inlet TC concentration, feed flow rate, and ACS bed height of 100 mg/L, 8 mL/min, and 4 cm, respectively. Adams–Bohart and Yoon–Nelson models were used to validate the experimental data. The Yoon–Nelson model provided the best fit for the ACS column design under the various conditions studied, with R^2 of about 0.922. This research reveals that ACS is a promising adsorbent for the removal of TC.

Keywords: Tetracycline; Coconut shell; Activated carbon; Adsorption; Fixed-bed column

Abstract ID: WWT-OP73

Treatment of Sewage Effluent using Pomegranate Peel Waste Activated Carbon

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Abstract
Municipal wastewater treatment is to protect the health, safety, and welfare of the public. The objective of the study is to evaluate the performance of local agricultural waste such as pomegranate peels for treatment of wastewater from primary effluent taken from waste water treatment industry. Experimental work was carried out by preparing activated carbon by thermal and chemical activation of pomegranate peel powder. The various parameters such as pH, contact time, stirring speed, PPW (pomegranate peel waste) activated carbon dosage impact on waste water pollution treatment were investigated. It revealed that, the highest TDS and turbidity removal at optimum pH of 8 using 3 gm of PPW activated carbon and stirring speed of 100 rpm. It shows the equilibrium time was 40 minutes with the percentage removal of Turbidity, TDS and Salinity were 57, 98 and 47 respectively. From the results it was concluded that, PPW activated carbon will be one of the best green and ecofriendly coagulant for the wastewater treatment.

Keywords: Sewage effluent; Coagulant; Turbidity; Salinity; PPW

Abstract ID: WWT-OP74

Sorptive Eradication of Ciprofloxacin using Biomass-derived Cost-effective Activated Biochar: A Mechanistic Insight

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Abstract
The presence of fluoroquinolone-based veterinary antibacterial drug ciprofloxacin (CIP) in aqueous media is a major problem because of its ecotoxicity to aquatic life. Therefore, it is crucial to develop green, inexpensive, and effective adsorbents that will eliminate antibiotics from contaminated water. In the current study, activated biochar formed from coconut shells has been used as an efficacious sorbent for removing CIP efficiently. Thermal gravimetric (TGA) and proximate analysis are conducted to characterize raw coconut shells (RCS). Activated biochars are characterized by proximate analysis, FT-IR, SEM, and BET. The influence of adsorbate concentration (initial), adsorbent dose, pH, temperature, contact time, and agitation speed on the adsorption of CIP onto activated biochars are studied using batch experiments. The process of biosorptive removal is optimized and modeled using the Taguchi Orthogonal Array (TOA) approach. Langmuir isotherm and pseudo-second-order kinetic model best fit the experimental data with the maximum adsorption capacity of >90% and verify the chemisorption type of adsorption process. Thermodynamic analysis verified the spontaneous interaction between adsorbate and adsorbent. Cost analysis and reusability research confirm the cost-effectiveness and reusability of adsorbent. Therefore, activated carbon can be used effectively for the removal of CIP from wastewater.

Keywords: Biosorption; Activated biochar; Ciprofloxacin; Recyclability

Abstract ID: WWT-OP75

Design and Application of PSF membrane for the salt pre-concentration-cum-rejection from hydrometallurgical effluent of iron oxide plant

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Abstract
In hydro-metallurgical processing of ores and waste, water is predominantly used as medium to dissolve the metals, which are subsequently recovered as metal and compound. During purification and alkali neutralization step in a typical hydrometallurgical unit operation, effluent, containing soluble salts, is generated. Considering environmental implications, the treatment of effluent is essential for close loop recycling of water in the unit operation and for the recovery of soluble salts. Among advanced separation process membrane separation is one of the effective ways to treat effluents treatment amongst lime softening, crystallization, membrane separation, and adsorption. In this work, amide coated Polysulfone membranes were developed and used to treat effluent of iron oxide plant, containing $FeSO_4$ and Na_2SO_4 as soluble salts. These membranes were prepared using phase inversion technique, and were characterized in terms of permeability ($2*10^{-12}$), flux ($1.5*10^{-6} m^3/m^2s$), tensile strength(84N) and salt rejection (>50%). The synthesized membrane was further used to treat the real effluent having TDS (~50000ppm) and (Fe^{2+}~18.75g/l). The membrane (PSF-20 wt%, PVP-0.5wt %) rejects more than 80% of salts in a cross-filtration mode. Thus, the developed membrane shows the high efficacy towards salt rejection, substantiating economical applicability and high process efficiency.

Keywords: Membrane; Polysulfone; Hydrometallurgical effluent; Salt rejection

Abstract ID: WWT-OP76

Removal of Suspended Solids and COD from a Food Processing Industry Wastewater using Electrocoagulation and Advanced Oxidation Process

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Abstract
Electrocoagulation is a momentous technique in the field of wastewater treatment. The process is adopted by large scale industries as the consumption of chemicals becomes less and the amount of sludge produced gets reduced. The performance of the technique was already reviewed for the treatment of effluent from various industries like paper mills, textile, pharmaceutical etc. In the present study, the efficiency of the process has been investigated in the treatment of food processing wastewater using a set of iron (Fe) electrodes. The Electrocoagulation process is followed by Microfiltration and Advanced Oxidation process (UV). The experimental setup was fabricated for pilot study with a treatment capacity of 25 liters/hour. The working pH range was found to be 5.5 to 7.5. The effluent was directly treated without pH adjustment as initial pH was in effective range. In this research, TSS and COD were selected as the significant parameters to be removed to assess the efficacy of technique. Around 96% and 91% removal of TSS and COD were observed respectively. Effect of operational parameters like current density, time of electrolysis etc. has been observed to achieve optimum removal efficiency.

Keywords: Food processing wastewater; Electrocoagulation; Advanced oxidation; TSS; COD; Removal efficiency

Abstract ID: WWT-OP77

Targeting Zero Liquid Discharge (ZLD) for Resource Recovery: A Review

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Abstract
An emerging and tactical engineering approach to water treatment where complete water is recovered and contaminants are reduced to solid waste is Zero Liquid Discharge Technology. It is a strategic wastewater management system that ensures no discharge of industrial wastewater into the environment and focuses to economically treat wastewater through recycling and produce clean water suitable for reuse. ZLD systems employ advanced wastewater/desalination treatment technologies to purify and recycle virtually all of the wastewater produced. While many treatment processes attempt to maximize the recovery of freshwater and minimize waste, ZLD is the most demanding target because the cost and challenges of recovery increase as the wastewater gets more concentrated. The primary procedures to achieve ZLD systems is through employment of pre-treatment (Physicochemical and Biological), osmosis (Reverse and Forward), thermal processes (Evaporation, Crystallization, Distillation followed by Compression). The salt and other compounds generated as solid wastes from the highly concentrated disposed off brine solutions can be reused after proper treatments. Studies suggest above 95% of freshwater resource recovery from ZLD systems. Although it is a costly process, yet it significantly promotes sustainability and paves the way for circular economic goals. Hence ZLD is a cycle of closed loop with no discharge.

Keywords: Desalination; Brine; Membrane distillation

Abstract ID: WWT-OP80

Kinetic and Thermodynamic Studies of Cr (VI) Bio-sorption for Tannery Effluent Treatment

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Abstract
This research aimed to examine the adsorption capabilities of Shrimp Shell Activated Carbon as bio-sorbents for the removal of chromium ions from tannery effluent. The FT-IR analysis of the adsorbents revealed a change in the functional groups of the structure of both adsorbents before and after adsorption, which may be related to the adsorption processes occurring on the surface of the adsorbent. Experiments involving adsorption were conducted as batch investigations with varying contact periods, pH, adsorbent dose, initial metal ion concentration, and temperature. Maximum Cr(VI) removal efficiency was observed at 140 min contact time, 22 g/L adsorbent dosage, and pH 3. The percentage of Cr(VI) removal rose as the adsorbent dose (from 5 to 20 g/L) and contact time increased (from 60 to 160 min). The Freundlich isotherm model fits the equilibrium data better than the Langmuir model. The kinetics of chromium adsorption was accurately modeled by a pseudo-second-order kinetic model, and the calculated equilibrium sorption capacity of the model was in good agreement

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with the sorption capacity determined by the experiment. The thermodynamic characteristics indicated the feasibility of the adsorption technique. Positive entropy values show an increase in unpredictability at solid-liquid interfaces during adsorption. The efficiency of the adsorbents in removing chromium from wastewater was also investigated and found to be effective.

Keywords: Shrimp shell activated carbon; Biosorption; Kinetic and thermodynamic study

Abstract ID: WWT-OP81

Pilot-scale recovery of photocatalysts using ultrafiltration membrane

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Abstract
Despite the high efficacy of photocatalysts in wastewater treatment, their pilot plant and industrial-scale applications are scanty. The photocatalysts must be recovered for their reuse to minimize the treatment cost and also to avoid secondary water pollution due to the presence of catalysts particles. Further, it is highly desirable that the treated water should free from catalysts for its potential reusability for various applications. Herein, we have studied recovery of TiO_2 and Pt-doped TiO_2 (Pt/TiO_2) photocatalysts using a pilot scale cross-flow ultrafiltration (CF-UF) membrane system with a nominal area of 2 m^2 and pore size of 75 kDa. The photocatalysts recovery was conducted at a fixed flow rate of 22.5 L h^{-1} and transmembrane pressure drop of 0.45 kg cm^{-2}. The wettability studies confirmed slightly hydrophobic nature of CF-UF membrane (water contact angle: 97.5°). The effect of solution pH and photocatalysts concentration on catalysts recovery was also studied. The pure water flux was reduced from 11.12±0.15 to 10.28±0.15 and 9.51±0.03 L $m^{-2}.h^{-1}$ during the recovery of TiO_2 and Pt-doped TiO_2 (100 mg L^{-1}), respectively. The recovery of about 98.24±1.01% TiO_2 and 98.99±0.48% Pt-doped TiO_2 (dose of 100 mg L^{-1}) was achieved at the optimized pH 5. Both the flux and recovery (%) were decreased with an increase in the concentration of the photocatalysts. Therefore, the CF-UF membrane could be integrated with the photocatalytic water treatment system for the recovery of the photocatalysts.

Keywords: Pilot-scale; Photocatalysts recovery; Cross-flow ultrafiltration membrane

Abstract ID: WWT-OP82

Preparation, Characterization and Application of Mixed Clay Based Low-Cost Ceramic Membrane in Treatment of Oil-in-Water Emulsions

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Abstract
Coal fly ash (CFA) has emerged as a viable alternative material for ceramic membranes due to its cost-effectiveness. However, CFA-based ceramic membranes often lack the required mechanical strength for practical applications. It is crucial to understand the mechanisms by which different concentration of poly vinyl alcohol (PVA) affect the preparation of membranes, as this knowledge can help enhance mechanical strength while maintaining permeability. In this study employed three different concentrations of PVA to fabricate CFA membranes. Furthermore, it discussed the effects of the various concentration of PVA on the membrane characteristics, including permeability, pore size distribution, porosity, mechanical stability and chemical stability. Among the three different concentrations of PVA as binder solutions, the membrane prepared with 10 ppm PVA solution and sintered at 1100 °C exhibited the most favourable overall properties. It demonstrated a pore size of 1.59 μm, porosity of 39%, a flexural strength of 40 MPa, and a water permeability coefficient of 9.19×10^{-6} (m^3/m^2 s kPa). Additionally, when applied to the separation of oil-in-water emulsions, this membrane showcased an oil rejection rate exceeding 98%. This research provides valuable experimental evidence for enhancing the performance of low-cost CFA membranes, thus facilitating their practical utilization in engineering applications.

Keywords: Coal fly ash; Ceramic membrane; Pore-forming agent; Low-cost; Wastewater

Abstract ID: WWT-OP83

River Water Purification Using Indigenous Nano-Silica-Graphene Oxide (Nano-SGO) Based Gravity

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Abstract
Humanity has reached the water scarcity threshold due to pollution, urbanisation, rapid population growth, and increased demands. Lack of access to pure and clean water poses significant threat to public health. In this context, river water has been considered as an alternative water source. Desalination of river water and low-cost water purification methods must be used to clean up contaminated water to ensure public health and environmental sustainability. Present study deals with purification of river water using indigenous nano-silica-graphene oxide (Nano-SGO) based gravity filter which is low cost and less power consuming. Silica was synthesized from Barnyard grass and graphene oxide (GO) was synthesized by modified Hammers' method. Gravity filter was set up using Nano-SGO filtered medium. Water quality testing was done for both raw water and filtered water. Iron content was found to be 0.03 mg/l (0.58 mg/l for raw water). Sulphide and fluoride content were tested to be 16 mg/l (80 mg/l for raw water) and 0.45 mg/l (0.7 mg/l for raw water), respectively. Filtered water was having pH of 7.41 where as raw water was having pH of 8.47. Each measured parameter was compared with permissible limit as per World Health Organization WHO. From overall performance of the filter, it can be pointed out that Nano-SGO gravity filter may be good alternative of present commercial filter.

Keywords: Water purification; Gravity filter; Silica; Graphene oxide; Sulphide; Fluoride

Abstract ID: WWT-OP88

A Review on Nano Silica Based Gravity Filter for Water Purification

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Abstract
In the recent years water pollution is a global threat to the entire world. Quality of drinking water is significantly impacted by rapidly rising levels of pollutants in source water, including heavy metals, dissolved salt, bacteria, and disinfection by products. Many methods have been implemented for water treatment such as coagulation, sedimentation, sand filtering, chlorination, ion exchange, reverse osmosis and distillation. Broad use of these technologies is constrained because of self-contamination, enormous power requirements, and lack of economic viability. Recently, membrane-based Reverse osmosis (RO) desalination process is considered as more environmentally and energy-efficient method. But, polymeric membranes are prone to fouling, flux drop, degrade quickly, and have low tolerance to high temperatures. In this regard, currently nanofiltrationis widely employed in the treatment of drinking water, where polymeric nanofiltration membranes (NFMs) have some drawbacks including poor chemical resistance, short lifetimes, and membrane fouling. In this context, gravity filtration with various filter medium can be considered to purify waste water. In this review work, gravity filtration consisting of various types of filter medium including metal -oxide nanoparticles, carbon nanotubes, zeolite, graphene, biological activated carbon, mesoporous silica, has been discussed. Special focus has been made on nano-silica based filter medium towards the treatment of polluted water. This work also focuses on sources of silica and extraction of silica from various natural sources.

Keywords: Water pollutants; Desalination; Reverse osmosis; Gravity filter; Nano silica

Abstract ID: WWT-OP89

Removal of heavy metals zinc and copper from tannery wastewater using microalgae

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Abstract
Wastewater from leather and allied chemicals is known to contain high concentrations of organic and inorganic pollutants, making its treatment a challenging task. Conventional wastewater treatment methods are often inefficient in removing these

pollutant as they content traces of heavy metals, leading to environmental contamination and health risks. In recent years, the use of microalgae-based treatment systems has gained significant attention due to their ability to effectively remove various contaminants while offering potential for biomass and bioenergy production.
The study employs batch and continuous cultivation systems to evaluate the performance of microalgae. The effectiveness of microalgae in removing heavy metal, specifically zinc and copper is investigated here. Preliminary, experimental results indicate that microalgae can effectively remove a wide range of pollutants from tannery wastewater, including organic compounds and heavy metals. The growth of microalgae is influenced by various factors such as wastewater composition, photo/UV light availability, and nutrient concentrations.
The performance of bio degradation using algae has been tested under various conditions of their pH, residence time, intensity of light and feed compositions both by batch continuous systems in our laboratory, thereby optimizing the operating condition. it has been found that pH of 7.4, RTD of 57mins, UV of 26-400 μmol photons m^{-2} s^{-1}, heavy metal concentration of 8ppm are required for optimal operation.

Keywords: microalgae, wastewater, heavy metal

Abstract ID: WWT-OP90

Utilization of visible light active photo-catalyst TiO_2 for wastewater remediation

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Abstract
Photocatalysis has been considered a potentially promising approach for renewable energy and environmental remediation with abundant solar light. However, the currently available semiconductor materials such as zinc oxide (ZnO), Cerium dioxide (CeO_2), Selenium dioxide (SnO_2) etc. are generally limited either by the harvesting of solar energy or insufficient charge separation ability. To overcome the serious drawbacks of narrow light response range and low efficiency in most of these photo-catalysts, many strategies such as doping, bulk modification, composite photo-catalysts etc. have been developed in the past decades. Recently black TiO2 (Titanium dioxide) is extensively used as sunlight harvesters which facilitate the maximum solar energy absorption from ultraviolet (UV) to infrared (IR) region of the solar spectrum due to their improved optical absorption properties compared to the normal white TiO_2. The recent studies in black TiO_2 have also proved that the structural and morphological features along with the suitable electronic properties are responsible for their superior activity in many industrial applications. Looking into the minimal research on recycle photo-catalyst based on black TiO_2, in this review we have intend to explore various routes for synthesis of black TiO_2 and their performance in context with environmental remediation.

Keywords: Photo catalysis; Black TiO_2; Morphological features; Photo-degradation

Abstract ID: WWT-OP91

Polystyrene microplastics removal from aqueous solution using chitosan as a natural coagulant: Experimental investigations and numerical analysis using artificial intelligence

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Abstract
Microplastics (MPs) in wastewater have raised significant concerns due to their detrimental impact on the environment. The coagulation-flocculation-sedimentation (CFS) process has emerged as a fundamental approach for treating MPs due to its cost-effectiveness, high efficacy, and ease of implementation. In this study, batch coagulation experiments were conducted with 25 mg/L of 1 μm sized polystyrene (PS) MPs using varying dosages of chitosan (0.25-5 mg/L) to assess the impact of various operational parameters, such as pH (4-9), settling time (10-50 min), and stirring speed (50-200 rpm). Results revealed that around 41.39 % of PS removal was achieved by utilizing chitosan as a coagulant at the conducive conditions: chitosan: 0.5 mg/L, pH: 8, settling time: 40 min, and stirring speed: 200 rpm. During the coagulation process, charge neutralization was the governing factor, as ascertained by the zeta potential analysis. The scanning electron microscope (SEM) images

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revealed agglomeration adsorption within the CFS system. Fourier transform infrared spectroscope (FTIR) spectra indicate new bonds forming from the interaction between PS and the coagulant. Further, artificial intelligence (AI) modeling using artificial neural network (ANN), support vector machine (SVM), and Random Forest (RF) for validating the experimental results demonstrated an R 2 of 0.9992, 0.8927, and 0.9506, respectively.

Keywords: Polystyrene; Coagulation-flocculation-sedimentation; Charge neutralization; Artificial intelligence (AI) modelling

Abstract ID: WWT-OP92

Coke Oven Wastewater Treatment using Polymeric and Ceramic Membranes

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Abstract
This research aimed to investigate the efficacy of membrane separation technology in treating Coke Oven Wastewater (COW). A comparative study was conducted using three types of membranes: Commercial Polymeric Membrane (CP), Commercial Ceramic Membrane (CC), and Synthesized Ceramic Membrane (SC). The potential of the SC membrane in COW treatment was assessed in comparison to the CC membrane, which had a Molecular Weight Cut-Off (MWCO) of 1 Kilo-Dalton. The experiments were conducted under various Trans-Membrane Pressure (TMP) conditions ranging from 1 to 4 bars. Additionally, the effect of the PNF membrane on COW treatment was examined at TMP levels ranging from 5 to 25 bars. The research findings revealed that the SC membrane exhibited promising results in terms of permeability and flux when compared to the CC membrane. Moreover, the study considered the implementation of an anti-fouling mechanism to mitigate fouling effects on membrane performance.

Keywords: Coke Oven Wastewater; Polymeric membrane; Ceramic membrane

Abstract ID: WWT-OP93

Enhanced Oxidation of Emerging Organic Contaminants by Acid-activated Ferrate (VI)

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Abstract
Recently, the tetraoxy high-valent iron(VI), known as ferrate(VI) or Fe(VI, received great attention as a multi-purpose green water-treatment chemical, because of its unique oxidation, disinfection, and coagulation properties. Though Fe(VI) has shown remarkable efficiency in oxidizing several pollutants in water, it has sluggish reactivity with some emerging organic contaminants, especially at basic pH conditions. It was explored to activate (or catalyze) Fe(VI) oxidation reactions, at mild alkaline pH conditions, to enhance the oxidative transformation of organic pollutants and reduce the required dosage of Fe(VI) and contact time.
The activation of Fe(VI) by adding simple acids (HCl, HNO_3, and CH_3COOH) to the Fe(VI)- contaminant mixed solution in deionized water under slightly alkaline pH conditions was demonstrated for the first time. Acid activation of Fe(VI) resulted in increased oxidative transformation of caffeine (CAF), acesulfame potassium (artificial sweetener, ACE), and atenolol (β-blocker, ATL) by ~30% within seconds to minutes (versus minutes to hours with non-activated Fe(VI)). A possible reason for the augmentation of the oxidative transformation of organics may be the increasing formation of more reactive intermediate species, Fe(V) and Fe(IV), in the Fe(VI)-contaminant-acid mixture.
Further experiments demonstrated that acid-activated Fe(VI) oxidizes CAF in water at three times lower molar ratio of Fe(VI) to CAF than oxidative transformation observed by non-activated Fe(VI). CAF oxidation by acid-activated Fe(VI) was not negatively affected by presence of anions such as Cl^-, HCO_3^-, and SO_4^{2-}, and/or cations such as Na^+ and Mg^{2+}. Natural organic matter (NOM) and secondary effluent (SE) wastewater organics decreased the efficiency of CAF transformation. However, acid-activated Fe(VI) could mineralize other organics present in both NOM and SE as indicated

by the dissolved organic carbon removal. Comparatively, no mineralization was seen without activation of Fe(VI). Four oxidized products of CAF were identified by the liquid chromatography high resolution mass spectrometry technique. The reaction pathways of the oxidation of CAF by activated Fe(VI) have been proposed. It was also found that Fe(VI) and acid activated Fe(VI) can oxidize number of pharmaceuticals and pesticides present in real wastewater. The findings of this work may spur further research on the impact of different activation methods and solid materials on the oxidation of a range of pollutants by Fe(VI).

Abstract ID: WWT-OP94

Unleashing the Potential of Biochar Composites in Heavy Metal Removal from Industrial Effluent: Mechanism, Modification, and Application

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Abstract
This study introduces a cost-effective approach to fabricate a porous and ionically surface-modified biochar-based alginate polymer networks composite (BPC) through air drying. The BPC composite demonstrates the efficient removal of heavy metals from aqueous solutions and industrial effluents. The study also critically analyzes the role and concentrations of various components in the success of BPC. Characterization techniques were employed to evaluate the microstructure and adsorption mechanism, confirming the ability of the adsorbent's carboxyl, and hydroxyl groups to simultaneously remove various heavy metal ions in water. The BPC demonstrated high copper binding capacities (370 mg/g and 450 mg/g) through Response Surface Methodology (RSM) and column studies, respectively. It was also found to be effective in real and multiple systems, exhibiting competitive behavior and efficient removal of Cu (II). The adsorption process followed the Langmuir isotherm and pseudo-second-order kinetics, showing a good fit with experimental data. Stability studies and cost analysis indicate that the developed composite holds promise for addressing concerns related to contamination and its impact on human health and the environment.

Keywords: Biochar; Polymer; Column studies; Adsorption mechanism; Energy optimization; Regeneration

Abstract ID: WWT-OP95

Green synthesis of $NiWO_4/ZnO$ nanocomposite from *Azadiracta indica* leaf extract: Investigations on catalytic degradation of crystal violet dye and aqueous pharmaceutical waste solutions

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Abstract
Plant extract modified $NiWO_4/ZnO$ was green synthesised using *Azadiracta indica*. The as prepared nanocomposites were characterized using UV–vis-DRS, FT-IR, XRD, SEM, EDS and HR-TEM techniques. The surface area was measured by Brunauer, Emmett, Teller (B.E.T) analysis. SEM results showed that NNWZO nanoparticles composed of hexagonal with sponge live sphere with agglomeration. XRD results revealed that the standard crystallite size of ZnO (ZO), Plant extract modified ZnO (NZO), Plant extract modified $NiWO_4$ (NNW), Plant extract modified $NiWO_4/ZnO$ (NNWZO) nanoparticle was 31.11 nm, 30.21 nm, 20.31 nm and 12.12 nm for ZO, NZO, NNW and NNWZO respectively. The photocatalytic activities of NNWZO nanocomposite were investigated using crystal violet (CV) as a model organic pollutant and Ciprofloxacin as an aqueous pharmaceutical waste under visible light irradiation. The result revealed that NNWZO shows a superior photocatalytic activity due to the effective electron–hole separation by surface modification. The effects of operational parameters like pH, catalyst concentration and initial dye concentration have been investigated in detail.fromthe reaction parameters it shows pseudo first order kinetics.

Keywords: $NiWO_4/ZnO$; Azadirachta indica; Solar light; Crystal violet

Abstract ID: WWT-OP96

Decomposition of hydrazine in hydrazine carbonate waste stream generated during clean-up of degraded PUREX solvent

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Abstract
The aqueous waste generated during the treatment of PUREX lean organic phase with hydrazine carbonate (HC) contains the washable degradation product, hydrazine di-butyl phosphate (N_2H_5DBP) and actinides [U(VI) & Pu (IV)] in the form of carbonate complexes. After the separation of degradation product and recovery of actinides, the management of the aqueous waste demand complete destruction of hydrazine. Towards the destruction of hydrazine in HC based waste solution, experiments were carried out using ozone (O_3). For an initial concentration of 145 mM of N_2H_4, 98.5 % destruction could be achieved within 6 h of ozonolysis with a flow rate of O_3 at 70 $g.h^{-1}$. One set of experiment was also carried out with HC solution containing DBP. In that case ozonolysis was effective in hydrazine destruction but needs further addition of H_2O_2 for near complete destruction of DBP along with hydrazine. The hydrazine destruction in HC medium was also studied by chemical method using various concentrations of NO_2 (1% &10% in N_2). But the rate of destruction of hydrazine was found negligible. Further studies on electrochemical destruction of hydrazine are in progress.

Keywords: Di-butyl phosphate; Hydrazine carbonate; Ozonolysis

Abstract ID: WWT-OP98

Bioremediation of Chromium (VI) using microalgal species

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Abstract
Microalgae have been used widely for developing innovative and sustainable environmental processes. The current study presents a comprehensive study towards the potential of *Chlorella thermophilia* for the removal of hexavalent chromium (Cr(VI)) from BG-11 by re-modelling its biochemical compositions. The biochemical composition analysis of *Chlorella thermophilia* showed change in the carbohydrate, protein and chlorophyll content indicating alteration in its cellular composition to survive the stress triggered by the toxicity of Cr(VI). Carbohydrate content of *Chlorella thermophilia* exhibited bell shaped response while protein content has a declining trend with increasing initial (0-1 mg/L) Cr(VI) concentration and chlorophyll content was in the range of 6-7%. Growth kinetics showed exposure to Cr(VI) has a maximum decline of 10% growth as compared to control. Removal percentage of 65% (0.6 mg/L) was observed for detoxifying Cr(VI). Therefore, *Chlorella thermophilia* has a strong prospect as a sustainable source of treating heavy metal containing wastewater resulting in a socioeconomic welfare.

Keywords: Bioaccumulation; Biomolecule; Oxidative stress; Removal

Abstract ID: WWT-OP99

A waste-to-wealth strategy for removing Indigo Carmine dye from wastewater using Plastic Char produced from municipal solid wastes

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Abstract
In the age of civilization and technology, water is regarded as one of the most valuable resources, utilised for a variety of reasons in a range of businesses from household to large industries. The used water contaminated with various type of pollutants, when discharged into the environment without any proper treatment causes the ecosystem to suffer. Because of their high reactivity, toxicity, carcinogenic and mutagenic activities they can cause various problems to the human being as well as the rest of the environment. Though, the type of pollutant present in the water are highly dependent on the source, but dyes are very common among them. In this study we will concentrate on Indigo carmine, a dye that is utilised in a wide range of industries, including food, textiles, and medicines. Being resistant to conventional, biological, or physicochemical approaches due to their chemical composition and structural stability it is very difficult to remove. Beside water pollution,

another rising issue is solid waste management. With benefits such as durability, affordability, and mobility, modern life has become more reliant on plastic consumption, resulting in increased plastic waste over time. This study focuses on these two areas, Conversion of plastic waste to char and its' effect on indigo carmine removal from wastewater by adsorption. Various parameters were varied viz., Dosage, pH, Temperature, and Dye-Adsorbent to study their effect on adsorption. The highest removal of around 68% was achieved in this study after 180 minutes depending upon different dosages, pH and temperature.

Keywords: Indigo carmine; Plastic char; wastewater treatment; Adsorption

Abstract ID: WWT-OP100

Adsorptive removal of 2,4-Dichlorophenol using high surface area activated carbon derived from *Cassia Fistula*

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Abstract
Organic pollutants such as phenol and chlorophenols are considered hazardous due to the ill impact of pollutants on human beings at lowest concentration. Regulating bodies, namely WHO and USEPA have made stringent discharge limits for these organic pollutants. As per literature, adsorption is one of the common treatment processes carried out for abating organic pollutants. Herein, an attempt is made to obtain activated carbon using biomass (*Cassia Fistula*). Activated carbon was characterized by employing sophisticated techniques (BET, FTIR, XRD, SEM-EDS). Operational parameters (pH, temperature, speed, dosage) were optimized in batch study. Adsorption isotherms such as Langmuir, Freundlich, Temkin, and RP model and Sips model were fitted to the experimental data. From the results, it was concluded that, the data obeyed Langmuir model with the monolayer adsorption capacity of 370 mg of 2,4-dichlorophenol per gram of activated carbon for the concentrations varying from 25 to 600mg/L. This suggests that the *Cassia Fistula* derived activated carbon can be promising adsorbent for the removal of 2,4-dichlorophenol from aqueous solutions.

Keywords: Activated Carbon; *Cassia Fistula*; Isotherms; Organic pollutant

Abstract ID: WWT-OP101

Synthesis and evaluation of Boron, Cerium and Silver Ternary doped Titanium dioxide photocatalysts for Degradation of Ampicillin Antibiotic under sunlight

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Abstract
Nowadays, we can see that in the river water traces of antibiotics can be found, which has come up as an emerging problem, and also pharmaceutical companies waste water, contains antibiotic traces present in it, in the significant amount. Which makes it nice experimental domain to work upon. That waste water is very harmful if taken by the humans without its treatment so to treat it as early as possible is very necessary, else the bacteria emerging in that water will be converted to super bugs ,and then to cure disease from that bacteria's will be extremely difficult ,as they have resistive power to that antibiotic. For that we have prepared a ternary doped photocatalyst by doping boron, cerium and silver in titanium dioxide structure. Then the various characterization analysis was performed like Nano particle size, SEM, Raman spectroscopy, BET surface area, XRD, DRS. We got particle size in the range of 115 to 600 nanometer, XRD analysis band gap of 2.3 to 2.4 electron Volt. BET surface area analysis showed us surface area of about 25 m2/g.
Degradation analysis were performed under sunlight and the degradation was obtained approx. 68 percent which was better than previously performed research under UVA lights.
In this we can further change the dopants used which can make our degradation results better.

Abstract ID: WWT-OP102

Eco-Friendly Nanocellulose Synthesis for Efficient Chloramphenicol Removal from Pharmaceutical Effluent

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Abstract
Chloramphenicol is an antibiotic commonly used in both human and veterinary medicine, but its presence in the environment can pose risks to aquatic life and may contribute to the development of antibiotic-resistant bacteria. The increasing presence of pharmaceutical compounds, such as chloramphenicol, in aquatic environments has raised concerns about their potential negative impacts on aquatic ecosystems and human health. To address this issue, sustainable and eco-friendly methods for efficient removal of chloramphenicol from contaminated water sources are of paramount importance. Nanocellulose, derived from renewable resources, presents a promising adsorbent due to its unique physicochemical properties. In this study, we explore the green synthesis of nanocellulose as an effective adsorbent for the removal of chloramphenicol from aqueous solutions. The nanocellulose material was prepared using an eco-friendly and cost-effective approach, involving the acid hydrolysis of cellulose extracted from agricultural waste. The resulting nanocellulose displayed a high surface area and abundant functional groups, contributing to its enhanced adsorption capacity for chloramphenicol molecules. Scanning electron microscopy (SEM) and Fourier-transform infrared (FTIR) spectroscopy were employed to characterize the structural and morphological features of the synthesized nanocellulose. Adsorption studies were conducted to assess the efficiency of nanocellulose in chloramphenicol removal. The effects of different experimental variables, such as initial chloramphenicol concentration, pH, contact time and temperature, were investigated to optimize the removal technique. The adsorption isotherms and kinetics were analyzed to gain insight into the adsorption mechanism and feasibility of nanocellulose as an adsorbent. The exceptional adsorption capacity, combined with its eco-friendly nature, makes nanocellulose a compelling candidate for future applications in wastewater treatment and environmental remediation.

Keywords: Nanocellulose; Chloramphenicol removal; Green synthesis; Environmental remediation

Abstract ID: WWT-OP105

Synthesis of silane treated aerogel for the treatment of Naphthalene containing solution

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Abstract
With the development of human civilization, the demand and utilization of natural resources are increasing. Water, one of the main resources, has a very significant use in the day-to-day life of human beings. From daily household use viz., cooking, washing, and maintaining hygiene to the utilization by various large industries the water gets contaminated by mixing with different type of chemicals. Besides dye and heavy metals, Polycyclic aromatic hydrocarbons (PAHs) are playing an important role in water pollution. The simplest PAH, Naphthalene can cause liver and kidney damage, methemoglobinemia, digestive tract irritation, nausea, vomiting, diarrhoea, and death. This compound can contaminate water from landfill sites and petrochemical industries. To remove different types of pollutants from wastewater various research was conducted by using different physical, chemical, or biological methods. In this study we will focus on a relatively new approach to remove naphthalene from water by using aerogel. Aerogel is a solid substance with high porosity, extremely light weight, and contains 70% air on average. In this study aerogel was prepared and surface modification was performed by treating them with silane to study its' effect on naphthalene removal from water. Batch study was performed by varying different parameters viz., pollutant dose, weight of aerogel, temperature, pH and time. The highest removal achieved was 95% in 48 hours at pH 7, temperature 30^{o}C, pollutant dose 10 mg/ lit. by using 6 g of aerogel per 50 ml of solution.

Keywords: Aerogel; Naphthalene; Wastewater treatment; Silane treated aerogel

Abstract ID: WWT-OP107

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Competitive Adsorption of Arsenic and Fluoride from Aqueous Solutions on Synthesized Nanoparticles: Kinetics, Isotherms, and Competitive Effects

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Abstract
This research explores the competitive adsorption of arsenic and fluoride from aqueous solutions using synthesized superparamagnetic iron oxide nanoparticles (M_{IONP}). The behavior and efficiency of M_{IONP} were investigated through batch experiments. The influence of adsorbent dosage, contact time, and solution pH in binary component systems was performed. Under optimal conditions, the M_{IONP} demonstrated remarkable efficiency in adsorbing arsenic and fluoride, achieving maximum contaminant capacity. Similarly, the M_{IONP} effectively removed 90% of As(V) and fluoride in binary-component systems, showcasing its potential for simultaneous contaminant removal. Time-dependent studies revealed that the adsorption process in binary-component systems followed a pseudo-second-order kinetic model, indicating chemisorption as the dominant mechanism. The various models were utilized to analyze the competitive adsorption isotherm data, using Extended Langmuir and Extended Freundlich isotherm models. It was further highlighting the potential effectiveness of M_{IONP} as an adsorbent. The experiments were conducted by varying the concentration of arsenic while keeping fluoride constant and vice versa at different pH levels. Overall, this research yields valuable insights into the competitive adsorption of arsenic and fluoride using synthesized superparamagnetic iron oxide nanoparticles. The findings may contribute to developing innovative water treatment approaches, enhancing the purification of water resources for safer and cleaner usage.

Keywords: Simultaneous adsorption; Competitive adsorption; Arsenic; Fluoride; Binary adsorption; Kinetics; Competitive adsorption isotherms; Equilibrium isotherm modelling

Abstract ID: WWT-OP109

Operation aqua shield using indigenous membrane desalination technology: Delivering clean water to our border heroes

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Abstract
The border Area out posts in Kutch and Banas kantha borders are located at arid regions, do not have access to portable drinking water sources and hence mostly depend on either outside sources or they have to pull on with non-potable water. Chemical constituents that make water non-potable are high total dissolved solids (TDS), chloride, salinity, fluorides and nitrates and also bacterial impurities. In order to meet the drinking water needs of the BSF personnel one of the options can be reverse osmosis plant (R.O.), which includes the concentration of undesirable chemical constituents as well as bacterial and viral impurities in water and make water potable for drinking and cooking purpose. The availability of potable drinking water in adequate quantity at places in Rann of Kachchh is a challenging task. Rann of Kachchh is located in North of Bhuj, a district headquarters and assessed by Gujarat State Highway No.45. It is large salt marsh area occupying approximately 30,000 square kilometer area. At present the water requirement of various Border out Post (BOP) of Border Security Forces (BSF) are fulfilled by tanker from Dharmshala and at times from Khavda. The distance of Vigakot out post is 111 kilometer from Khavda. The BOPs are located at approximately 5km distance and spread throughout the border. The water samples taken from Shakoor lake (having TDS more than 17,000 mg/l), and from newly drilled tube well. The tube well drilled at BOP-1079 (Gainda Post). Our membrane modules give >90% salt separation and the permeate output is 300-400 litres per hour and 1200-1500 litres per hour for 4" and 8" diameter modules respectively, depending on feed water salinity and operating pressure employed. The constant improvements in permeation rate have enabled us to fabricate plants at lower cost than in the past.

Keywords: Membranes; Reverse osmosis; Total dissolved salts; Water treatment

Abstract ID: WWT-OP110

Technical feasibility of separating ^{90}Sr from acidic waste using TODGA-solvent impregnating resin

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Abstract
The crucial segment of our nuclear program is reprocessing of the spent fuel. The PUREX process used in the Indian nuclear fuel reprocessing plants to separate uranium and plutonium discharges acidic aqueous nuclear waste. The high-level liquid nuclear waste contains several useful elements which can be explored for various societal applications. Among the fission products, ^{90}Sr, a high cumulative yield fission product, is of great attention due to its societal applications. Studies were conducted to examine the feasibility of using solvent-impregnated resins (SIR) for the extraction of strontium. N, N, N', N'-Tetraoctyldiglycolamide (TODGA) impregnated on Amberlite XAD-7 was used as SIR for the separation of nitric acid solutions. The extraction of Sr(II) by SIR was studied as a function of nitric acid concentration in aqueous phase. The distribution coefficient for strontium extraction was maximum at 2 M nitric acid under experimental conditions. The dependence of strontium ion concentration in acid solutions was also studied. From these experiments, it was found that TODGA-SIR shows the potential for separation of Sr(II) from acidic solution. In this paper, details of experiments conducted and results obtained from those experiments are discussed.

Keywords: TODGA; solvent-impregnated resin; nuclear waste

Abstract ID: WWT-OP111

Selective separation of Zr(IV) from Ln(III)/An(III) using an Undiluted Phosphonium Ionic Liquid: A Sustainable Approach towards Spent Metallic Fuel Reprocessing

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Abstract
Selective separation of Zr(IV) from Ln(III) and An(III) using an undiluted sustainable ionic liquid has been investigated for the first time in the present study. Eu(III)/Am(III) were chosen as the representative Ln(III)/An(III). Tri(hexyl)tetradecylphosphonium nitrate (Cyphos nitrate: $[P_{66614}][NO_3]$) was chosen as IL phase and the feed phase was nitric acid containing the target metal ions. The extraction process was accomplished at different experimental parameters to explore the extractability of the proposed IL towards Zr(IV). The efficient extraction of Zr(IV) without any external ligand in IL phase and negligible extraction of Eu(III)/Am(III) was distinctly discerned leading to noteworthy separation factors for Zr(IV). The loading experiment revealed a noticeable growth of equilibrium concentrations of Zr(IV) in IL phase while that of Eu(III) was very less irrespective of the initial feed concentrations. Nitrate ion was found to be superior as IL anion in terms of metal loading in comparison to other anions conjuncted to $[P_{66614}]^+$ ion. Thermodynamics of extraction and the stripping of the loaded Zr(IV) from IL phase using a suitable stripping solution have also been investigated and the results would be discussed in conference.

Keywords: Ionic liquid; Separation; Zirconium(IV); Europium(III); Americium(III)

Abstract ID: WWT-OP112

Thiol-modified metal organic framework (Fe-TA) for aqueous phase immobilization of inorganic lead (Pb^{2+})

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Abstract
A facile one-pot synthesis route was successfully designed to produce a thiol-grafted iron-based MOF (Fe-TA). The co-precipitation process provided an affordable, scalable and commercial approach to manufacture the material in scale-up circumstances. The MOF demonstrated high adsorption capacity (> 600 mg/g) for inorganic lead (Pb) in aqueous medium which is regarded as an extremely toxic heavy metal with carcinogenic properties. A thorough characterization using FESEM, XRD, EDX, FTIR, BET, Zetasizer and XPS was performed and a detailed batch analysis was conducted to analyze the adsorption performance. Pb (II) uptake was quantified using Langmuir and Freundlich isotherm models. The effects of

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experimental parameters, such as, adsorbent dose, pH, time and temperature were explored to illustrate the adsorption kinetics as well as thermodynamic aspects. The high selectivity (K_d: 5.4×10^4 mL/g) and credible reusability of the material were also successfully investigated. Finally, the mechanism of Pb adsorption was explained employing XPS analysis confirming the effective role of thiol moieties to immobilize Pb in the form of stable chelated bond (Pb-S).

Keywords: Metal organic frameworks; Iron thiomalate; Adsorption; Lead; Chemisorption

Abstract ID: WWT-OP113

Water Quality and Treatments in Doaba Region of Punjab: Problem, Challenges & Solutions

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Abstract
The water quality is a topic of increasing concern due to its significant implications for public health and agricultural sustainability. The Doaba Region of Punjab faces numerous water quality issues, primarily arising from agricultural runoff, industrial discharge, and inadequate wastewater management. High levels of pollutants including nitrates, sulphates, pesticides, toxic chemicals and heavy metals, etc. have been detected in both surface and groundwater sources. This has led to adverse health effects on the population and compromised the region's agricultural productivity.
Challenges in addressing these issues are multifaceted. The region's heavy reliance on agriculture and industries exacerbates the pollution problem that further contaminates water sources. Additionally, the lack of effective wastewater treatment infrastructure and awareness among stakeholders further hinders progress. Solutions to these challenges require a holistic approach. Implementing and enforcing stringent regulations on agricultural practices and industrial discharges is crucial. In this paper, the current water quality status of Doaba Region of Punjab is presented. This work also outlines the problems and challenges in treating waste water in this region. Important research work carried out in last two decade related to this region is also discussed in this paper.

Keywords: Doaba region of Punjab; Heavy metal removal; Waste water treatment

Abstract ID: WWT-OP115

Removal of Dye from Waste Water using Sustainable Treatment Technology: A Review

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Abstract
Synthetic dye or colorant are water soluble compound which are produced from various industries like fabrics, foods, cosmetics, pharmaceutical, printer ink, paint, leather and plastics etc. Since the textile industries is major consumer of dyes and used about $7x10^7$metric ton of annual production on worldwide, it is estimated approximate 100 kg water is required to process of 1 kg of dye for coloring fabrics. So, the mass of dyes and quantity of waste water as effluent may estimate. Although the synthetic dye is relatively easy to detect due to its color on water surface but it is very difficult to eliminate it because of their aromatic structure, these dyes are toxic, mutagenic, carcinogenic for living organism in entire water eco system. because the nature of dyes leads to reduce photosynthesis process and dissolve oxygen level in waste water Currently, researchers and technologists applied various physical, chemical and biological treatments process to remove these contaminants from waste water. there are various techniques applied as flocculation, coagulation, precipitation, photo catalytic degradation., ion exchange, and membrane filtration. but most of the researchers have interest to remove this synthetic dye from bio adsorbent or bio waste material e.g., compound obtained from, bagasse, green algal biomass, and household vegetable and agricultural waste and newly discovered material as carbon nano material, zinc oxide, titanium die oxide, silica powder, carbon nano tube, well-structured bio composite materials due to low cost and effectiveness as environmental and quality point of view.

Keywords: Removal; Dye; Wastewater; Adsorbent

Abstract ID: WWT-OP117

Biomass Valorization as Bioadsorbent for the Removal of Cadmium from Wastewater

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Abstract
Toxic cadmium (Cd+2) is frequently reported above the permissible limit in aquatic ecosystems could be brought below safe limit sustainably and environmentally friendly manner by use of suitable bio-sorbent. Seed kernel (SK) and Fruit peel (FP) of Cascabela thevetia were applied to remove Cd+2 from synthetic wastewater after characterizing the biomass designing experiments by Design-software 6.0.8. Box-Behnken design used for optimizing process parameter showed optimum Cd+2 2 mg/L, pH 6, dose 60 mg and solution agitation at 400 rpm. The SK bio-sorbent removed 94% and FP removed 92% of Cd+2 from waste water. The adsorption of Cd+2 explained by the Temkin model (SK, R2=0.98; FP, R2=0.98). The bio-sorbents exhibited maximum monolayer sorption capacity 3.78 mg/g (FP) and 4.34 mg/g (SK) in 70 min.

Keywords: Cadmium; Bioadsorbent; Fruit; Seed; Adsorption; Removal

Abstract ID: WWT-OP119

Bioremediation of mixed dye water in aerobic sequential batch reactor

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Abstract
The effluents generated from textile and dye industries are very harmful due to presence of harmful chemicals on it. Therefore, its treatment is compulsory earlier to discharge. In present studies, degradation of mixed dye contained in water was carried out in a laboratory scale sequential batch reactor (SBR). The dyes selected were Acid Red 3BN, Malachite Green, Methylene Blue, and Metanil Yellow has total dye concentration of 500 mg/L. The reductions of colour and COD were recorded. To determine the optimum treatment condition, the experiments were performed at different hydraulic retention time (HRT), and fill time (t_F). The HRT 2.5 d was found to best with 88.4 % COD, and 93.5 % color reduction in 22 h operation. The first order bio reduction kinetics was tested to determine the kinetics constants at different HRTs. The process was found to suitable for treatment of mixed dye water MDW.

Keywords: Mixed dye water; Chemical oxygen demand; Colour; Aerobic SBR

Abstract ID: WWT-OP121

Surfactant modified coconut coir powder (SMCCP) as a low-cost adsorbent for the treatment of dye contaminated wastewater: Parameters optimization and adsorption mechanism

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Abstract
The dye contaminated wastewater discharged from various industries such as dye manufacturing, paint, textile, paper, cosmetic, etc. is a prime source of surface water pollution having serious detrimental effect on both environment and human beings. In this current study, modification of coconut coir powder (CCP) was carried out through cationic surfactant treatment and was successively utilized as the adsorbent for the discoloration of anionic dye (acid blue 185 (AB 185)) containing waste stream. Further, a comparative investigation of the dye removal efficiency of raw CCP and surfactant modified coconut coir powder (SMCCP) as the adsorbent was studied. Characterization of SMCCP adsorbent was done by Fourier transform infrared, thermogravimetric, and scanning electron microscope analyses. Furthermore, the optimization of critical operating parameters was investigated for the effective adsorption of AB 185 dye in batch mode. The adsorption of AB 185 onto SMCCP was a thermodynamically spontaneous endothermic process, following Langmuir isotherm and

pseudo-second-order kinetic model. Regeneration and reutilization of exhausted SMCCP adsorbent were successfully attained for five consecutive cycles with a minimal loss in the total adsorption capacity.

Keywords: Adsorption; Anionic Dye; Surfactant modification; Cationic surfactant

Abstract ID: WWT-OP122

Ultrasonic Degradation of Malachite Green dye in Aqueous Solution

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Abstract
Ultrasonic degradation is a promising process in wastewater treatment. It is an effective technique for a sustainable future because of its ability to break down persistent contaminants and improve the treatment process efficiently. The present study investigated the effect of operating parameters in the ultrasound process on the degradation of malachite green in an aqueous solution. A horn-type sonicator operating at 20 kHz and a maximum rated power dissipation of 700 W was used. The effect of operating parameters such as ultrasonic power (over the range of 70 W to 175 W) and initial solution pH (3, 5, and 6.6) on the degradation was studied, and the optimum conditions were determined. The degradation of malachite green increased with an increase in ultrasonic power from 70 W to 105 W, and degradation efficiency decreased beyond 105 W. The degradation of malachite green increased with an increase in solution pH with time. The cavitational yield and the ultrasonic degradation process cost are also calculated at the optimum conditions. For the present study, the cavitational yield and the estimated cost were 5.44×10^{-7} mg/ J and 8400 INR/m^3, respectively.

Keywords: Degradation; Malachite green; Ultrasound; Wastewater treatment

Abstract ID: WWT-OP123

Treatment of synthetic dye solution using punched holed aluminum electrodes: Parameters and economical study

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Abstract
Electrocoagulation is a promising technique that can be used to treat the effluent generated by textile industries. Textile industries are water intensive and effluent generated by them contains high biological oxygen demand, chemical oxygen demand, dyes (chemically stable and some are toxic) and heavy metals. The presence of color, toxic dyes, and heavy metals, even at lower concentration in the effluents lead to aesthetic and chemical pollution. Electrocoagulation uses in-situ generated coagulant to remove the pollutant from the wastewater. In the present study, synthetic reactive orange 4 dye solution was used as model pollutant and punched aluminum electrodes were used as anode and cathode. Anode and cathode have 4 holes and diameter of each hole are 4 mm. The effect of current density, inter electrode distance, and initial dye concentration on the performance of the electrocoagulation process have been studied. The color removal efficiency, electrical energy consumption, and operating cost of the process have been calculated. A color removal of 96.50% was obtained using current density of 1.39 mA/cm^2, inter electrode distance of 1.0 cm using initial dye concentration of 100 ppm. The electrical energy consumption of 2.058 kWh/m^3 and operating cost of 0.649 US$/$m^3$ was obtained.

Keywords: Electrocoagulation; Punched holed electrodes; Economical study

Abstract ID: WWT-OP124

Studies on Innovative Grey-water Treatment and Reuse for Villages using Reed Bed and Root Zone Treatment

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Abstract
Water, sanitation and hygiene are the three aspects under the purview of Sustainable Engineering & Technology for Rural Development and therefore needs special attention. The Reed Bed and Root Zone treatment, a natural process has proved to be very convenient as it encompasses the interactions of various process variables in synergistic manner.
In the present investigation, Chak Kolarkhal a model village, in the vicinity of Heritage Institute of Technology, is selected for conducting the feasibility of sullage/ grey water treatment and reuse by using reed bed and root zone treatment. The proximity of the village towards East Kolkata Wetland, the Ramsar Site of West Bengal justifies the need for undertaking the investigation. The influent quality of desirable parameters was determined. The investigation also included analysis of topography of the sites for selection/layout of the proposed plant. A combined flow system design was designed based on pilot study using floating macrophytes viz. Canna Indica, Typha elephantina. The HRT (5-6 days) and the area of the unit (0.7 acre) were calculated. The quality of the effluent conformed the CPCB standard of Type C water.

Keywords: Rural wastewater treatment; Root zone treatment; Natural treatment using macrophytes; Innovative engineering solution in village wastewater

Abstract ID: WWT-OP125

Feasibility of Production of Potable Water using Phytochemical Route

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Abstract
Access to safe drinking-water is important as a health and development issue at national, regional and local levels. The Central Pollution Control Board published Drinking Water Standard as Type A water which is comparable with WHO's standard. Ushira (roots of *Vetiveriazizanioides*) and Kataka (seeds of *Strychnospotatorum*) are two such medicinal plants capable for purification of water obtained from various sources. In the present investigation, the feasibility of using these phytochemicals for production of potable water (as per the standard prescribed by regulatory bodies) has been investigated. These plant species collected from the natural habitat were impregnated with a nanocrystalline membrane filter to identify the process variables and thereby to formulate the methodology of optimization of significant variables. The efficacy of removal of metal contaminations from water were also been studied. This investigation is an attempt to convert ancient Ayurvedic wisdom by the help of modern knowledge of nanotechnology for purification of water to overcome the public health hazards.

Keywords: Potable water; Ayurvedic phytochemicals; Water filter; Nano-filter

Abstract ID: WWT-OP128

Effect of silane-modified clays in ceramic supported hydrophobic composite membrane development and their performance in emulsified oil-water separation

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Abstract
Clays such as kaolin and bentonite are efficient membrane film formers in ceramic support and they are transformed into hydrophobic surfaces by fluoroalkyl silane or FAS for pure hexane and toluene separation from emulsified water in oil (hexane, toluene) solution. The fabricated membranes expressed distinct oil separation behavior due to their unique physicochemical properties. The membranes expressed superhydrophobicity (contact angle ~155^0), high flux (80-100LMH), and high porosity (38%) in kaolin-based membranes, whereas bentonite, exhibited comparatively lower hydrophobicity (contact angle ~140^0), low porosity (~17%), and low flux (25-40LMH) as high silica precursor content in bentonite clay produced highly dense and low-thickness membranes. This decline of flux and hydraulic permeability in the bentonite-based membranes was directly related to the critical and threshold radius of the membranes which also declined by silane coating. Interestingly the grafting impact or silane loading (%) was higher (20.12%) on the kaolin clay surface and lower (11.12%) in bentonite membranes due to the high compactness and low thickness of the membranes in the latter. This work reveals the role of silane-modified clays in constituting distinctive pore hierarchical structures, transient flux behavior, and surface roughness parameters for suitable optimization of water in oil emulsion separation processes.

Keywords: Fluoroalkyl silane; Superhydrophobicity; Silane grafting; Ceramic-based hydrophobic membranes

Abstract ID: WWT-OP129

BIOREMEDIATION OF WASTE FROM TANNERIES

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Abstract
Removal of heavy metals from wastewater has turned into a main pressing issue these days due to its capacity to taint water bodies. These heavy metals went into the water bodies through squander water from metal plating industries and industries of Cd-Ni batteries, mining, pigments and stabilizers combinations and so forth. Cd, Zn, Pb Ni, Cr, Cu, and Hg are the most significant toxic metals. In this review, removal of phenol and Cr (VI) was accomplished with the assistance of two native microorganisms *Syncephalastrum racemosum* and *Cunninghamella elegans*. At ideal conditions *S.racemosum* could eliminate limit of 200mg/L of Cr (VI) and 300mg/L of phenol. *C.elegans* was able to remove 200 mg/L of phenol and 175 mg/L of Cr (VI). *S.racemosum* outperformed *C.elegans* in terms of Cr(VI) removal, but both fungal strains performed best at 28.4° C for the percentage of Cr(VI) removal. The ideal pH for Cr (VI) evacuation was 7. *S.racemosum* gave a better Cr (VI) removal of 98.4% at pH 7 while *C.elegans* gave Cr (VI) removal of 94.7%. The hour of contact for the Cr (VI) evacuation in *S.racemosum* was inside a contact time of 30 minutes dissimilar to *C.elegans* which required a contact time of 40 minutes.

Keywords: Heavy metals; Wastewater; Phenol; Micro-organisms

Abstract ID: WWT OP 130

CHARACTERIZATION OF CHITOSAN-METAL OXIDE NANOCOMPOSITES USING HERBS

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Abstract
Metal Oxide nanoparticles specifically zinc oxide (Z), copper (I) oxide (C) and silver (I) oxide (A) were orchestrated and described by UV-Vis, FTIR, EDX, XRD and FESEM studies. FESEM studies affirmed the nano size of metal oxides. The nano metal oxide was effective against *S. aureus* and *E. coli*. Among eleven medicinal herbs, Naringi crenulata (H1), Cynodon dactylon (H2), and Cardiospermum halicababum (H3) were chosen for their ability to synthesize chitosan-metal oxide nanocomposites with herbs. The chose spices were portrayed by phytochemical tests, GC-MS examination and cancer

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prevention agent movement. Phytochemical screening tests showed the presence of restoratively dynamic parts in the leaves of the chose spices. GC-MS examination of methanolic concentrates of the spice leaves uncovered the presence of phytocomponents. The bioactive parts of the spices have high cell reinforcement property not entirely set in stone by DDPH technique. n creating novel bioactive spice consolidated chitosan-metal oxide nanocomposites. The properties and likely uses of the integrated nanocomposites have been entirely examined. Because of its antibacterial, antifungal, and antioxidant properties, chitosan can be used in a variety of biomedical applications on its own. Within the sight of metal oxide nanoparticles and spices, chitosan nanocomposites showed better than ever properties.

Keywords: Herbals; Nanoparticles; Bio nanocomposite; Phytochemical; Wastewater treatment

Abstract ID: WWT-OP131

Water quality assessment and treatment through Optimizing Phosphate Coagulation in Drinking Water near *Nagarjuna Agrichem Limited Industry in Srikakulam district*: A Response Surface Methodology Approach

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Abstract
The drinking water quality is highly affected by industrialization and by natural geographical features of the region. This work highlights on the quality survey and treatment of drinking water collected from four villages (Kalyanipeta, Kesavadasupuram, Arinam Akkivalasa, and Chilakapalem) near Nagarjuna Agrichem Limited in Srikakulam district, Andhra Pradesh. Physicochemical parameters of the samples were analyzed. The presence of phosphates in the samples (3.15 mg/L P) were found to be above the permissible limits (0.1 mg/L P) which required instant treatment by coagulation process. Various influencing factors like temperature, dosage, mixing speed, and mixing time were considered for optimization of the process. The statistical experimental design was done using central composite approach of response surface methodology to optimize phosphate removal via coagulation and flocculation technique. An optimized removal of phosphates was determined to be 79.5% and 76.06% at a temperature of 27ºC and 28ºC, dosage of 13.412 mg/L and 14.906 mg/L, mixing speed of 91 rpm and 78 rpm, and mixing time of 14.25 min and 11.62 min for coagulants ferric chloride and aluminium sulphate respectively. Ferric chloride was found to be a better coagulant will a removal efficiency of 79.5% and the treated water contained 0.645 mg/L of phosphate.

Keywords: Phosphates; Coagulation and flocculation; Response surface methodology; Optimization

Abstract ID: WWT-OP132

Advancements in Sulfate Radical-Based Activation for Efficient Degradation of Emerging Contaminants: A Comprehensive Review

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Abstract
In the last two decades, persulphate advanced oxidation processes (PS-AOPs) have been emerged as a significant advancement in wastewater treatment and addressing subsurface pollution. Although persulphate (PS) is a potent oxidizing agent, it reacts slowly with common pollutants. Therefore, activating PS to generate highly reactive radicals like sulfate and hydroxyl is crucial for efficient pollutant degradation.Sulfate radical-based advanced oxidation processes have gained attention recently for their effectiveness in breaking down emerging contaminants. Persulfate and peroxymonosulfate (PMS) can be activated through various means such as heat, alkalinity, UV light, activated carbon, transition metals, ultrasound and hydrogen peroxide. These activation methods produce potent sulfate radicals, strong oxidizers that efficiently degrade emerging pollutants.Sulfate radical-based AOPs offer advantages over hydroxyl radical-based methods, including superior oxidation potential, enhanced selectivity, higher efficiency for pollutants with unsaturated bonds or aromatic rings, and a broader operational pH range. Consequently, sulfate radicals are more efficient at removing emerging contaminants.This review offers a thorough examination of how activated persulfate and peroxymonosulfate are used to break down emerging

contaminants. It also investigates the factors affecting their effectiveness, provides concluding insights, and identifies future research possibilities regarding the activation of PS and PMS.

Keywords: Persulphate advanced oxidation processes; Sulfate radicals; Emerging contaminants; Wastewater treatment

Abstract ID: WWT-OP133

Studies on Synthesis of Nanocellulose from Plant Residues and its Evaluation as a Nanoadsorbent

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Abstract
Organic toxins, dyes, oils, pesticides, insecticides and heavy ionic metals emerging from diverse industries and human activities are perturbing both human well-being and ecosystems. To overcome these contaminants, nanocellulose-based materials have gained significant prominence as versatile biosorbents for treating water pollutants, primarily owing to their amenability to facile modification, high specific surface area and eco-friendly characteristics. With its abundant hydroxyl groups and porous structure, nanocellulose stands out as an excellent adsorbent for a wide range of contaminants. Surface functionalization with specific groups or the incorporation of other materials can tailor its adsorption properties to target contaminants. The diverse structures of multifunctional nanocellulose have consistently demonstrated their excellence in water purification, emerging as a favourable alternative to contribute to a cleaner environment. This work presents a comprehensive synthesis of nanocellulose and underscores the evolution of nanocellulosic adsorbents, progressing from suspensions to hydrogels and aerogels.

Keywords: Adsorbent; Nanocellulose; Synthesis; Water treatment

Abstract ID: WWT-OP134

Iron Nanoparticles Derived from Plants Extracts for the Removal of Heavy Metals

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Abstract
Recent years have seen an exponential growth in nanoparticle synthesis due to the exploitation of its high adsorption rate, high surface area, simple and affordable synthesis for water purification by removing microbes, compounds (organic and inorganic), as well as, heavy metals. The green synthesis of Zero-Valent Iron Nanoparticles (ZVI NPs) has proven to be environmentally beneficial in many ways due to the usage of naturally occurring plant extracts. Fe^0 makes up the core of the synthesized core-shell like iron nanoparticles, with iron coordination compounds, iron oxides, iron-carbon alloys, and layers of biomolecules as the shell's outer layer. These ZVI NPs can reduce heavy metal compounds found in wastewater, including cadmium, lead, zinc, copper, and arsenic. Antimicrobial resistance and adsorption have also been seen in irradiated nanoparticles. When present in significant concentrations, the adsorbent—ZVI NPs—rapidly and efficiently lowers heavy metal complexes. This study focuses on the contamination and harmful effects of heavy metals on human health, conventional methods for heavy metals removal, and a potential mechanism for the synthesis of ZVI- NPs using the plant extracts and the structural features of the synthesized ZVI- NPs.

Keywords: Adsorption; Green Synthesis; Zero-Valent Iron

Abstract ID: WWT-OP135

Enzyme-Driven Textile Dye Bioremediation: Molecular Docking and Environmental Impact Assessment

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Abstract
Chemically stable and easy-to-manufacture dyes are widely available due to the textile industry's rapid expansion. Due to their poor biodegradability in aquatic habitats, these dyes pose an environmental risk. Enzyme-linked bioremediation is being tested to reduce textile dyes' environmental impact. We assessed the susceptibility of 10 dyes (Reactive Black 5, Reactive Red 22, Reactive Red 198, Acid Yellow 42, Reactive Blue 19, Direct Blue 15, Direct Red 28, Basic Green 4, Basic Violet 3, and Acid Orange 7) from various chemical classes using bioinformatics and molecular docking. We tested these dyes for degradation by laccase, azoreductase, peroxidase, nitroreductase, and hydrolase. The enzymes described here are from *Pseudomonas putida, Bacillus subtilis, Aeromonas hydrophila, Lysinibacillus sphaericus,* and *Staphylococcus aureus*. *In silico* docking investigation using AutoDock Vina software reveals enzyme-dye interaction mechanisms, stability, catalytic activity, and selectivity. The interactions between amino acids and selected dyes emphasize the importance of enzyme-driven bioremediation processes and the role each enzyme plays in decolorizing and degrading textile dyes.

Keywords: Textile dyes; Enzyme-driven bioremediation; Docking analysis

Abstract ID: WWT-OP136

Rice Straw derived Biochar as an Adsorbent for Removal of Phenol from Water

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Abstract
Stubble burning of rice straw is one of the major causes of air pollution in Northern India during the rice harvest season, leading to an increase in Air Quality Index. Apart from air pollution, stubble burning also causes harm to the health of living organisms, loss of soil nutrients and damage to soil biodiversity. Stubble burning can be prevented by utilizing rice straw either directly or indirectly. In the present study, the use of biochar obtained from pyrolysis of rice straw as an adsorbent for removal of phenol from water was explored. The rice straw was pyrolyzed at different temperatures (300 - 800℃) in inert environment and the surface area of biochar was determined. It was observed that the surface area of biochar increased with an increase in pyrolysis temperature. The biochar obtained from pyrolysis at 800℃ had the maximum surface area of 53 m2 /g. The biochar (800℃) was then used as an adsorbent for removal of phenol from water. The phenol removal efficiency of 95% was achieved after 24 h with an adsorbent dosage of 20 g/L. The kinetics and isotherm of the adsorption was studied, and the data was best fitted using pseudo second order kinetic and Langmuir isotherm model. The results from the present study demonstrate that biochar can be used as an effective adsorbent for removal of phenol from water.

Keywords: Rice straw; Pyrolysis; Biochar; Surface area; Phenol; Adsorption

Abstract ID: WWT-OP137

Bio-waste adsorbent for removal of Heavy metal from Wastewater

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Abstract
Water pollution, which has become a severe worry due to the rapid growth in industrialisation, urbanisation, and population over the past several decades, is a big worldwide nightmare. Various contaminants from industries, including dyes, heavy metals, pesticides, and pharmaceutical effluents, are released directly into water bodies. Heavy metals are the principal pollutants in wastewater among these contaminants since they can annoy living things and persist in the environment. Heavy metal contamination in lakes, rivers, and other aquatic sources has increased in several nations as a result of inadequate aquatic system treatments coupled with increased industrial activity. There are several techniques for eliminating these heavy metals from aquatic sources including membrane filtration, electrocoagulation, chemical precipitation, electrolysis, coagulation, ion exchange and adsorption. Adsorption is a simple, sustainable, cost-effective, and environmentally friendly technique for wastewater treatment, among all other existing technologies. Accordingly, this article highlights the effective removal of heavy metals using a biowaste adsorbent Watermelon leaf (WML). The results revealed high efficiency for removing heavy metals (HMs), especially when using WML. The WML adsorbents achieved more than 90% removal percentage in synthetic wastewater especially Cr (VI) at pH 2 ± 0.5 with a chromium metal content of 15 mg/L.

Keywords: Adsorption; Biowaste adsorbent; Contamination; Environment; Wastewater

Abstract ID: WWT-OP138

Utilization of chemically synthesized activated carbon from Watermelon rinds based agro waste for removal of synthetic dye

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Abstract

Chemically synthesized activated carbon from watermelon rind (WRAC) was implemented in the adsorption of the Remazol Brilliant Blue Reactive (RBBR) dye in this paper. Several characterization techniques were used to identify the improvement in adsorbent surface chemistry after treatment. Such as the BET surface area, FTIR, SEM, and proximate analysis techniques were used to characterize WRAC. Watermelon rind-derived Activated carbon were prepared as follows: activation temperature of 820 °C, activation time of 2.05 h and IR of 2.85. Adsorption results were analyzed by Kinetics and Isotherms models. This study revealed that potential of adsorbent was derived for Remazol Brilliant Blue Reactive (RBBR) dye removal from waste water.

Keywords: Biosorbent; (RBBR) Dyes; Wastewater treatment; Watermelon rind

Abstract ID: WWT-OP139

Removal of Fluoride from Groundwater using Rice husk ash & Silica Synthesized from Rice hulls

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Abstract

Many pollutants pollute groundwater, with fluoride being one of the most hazardous elements in the global scenario. According to WHO recommendations, the fluoride limit in drinking water is 1.5 mg/L. Fluoride high concentration in drinking water cause dental and skeletal fluorosis in millions of people worldwide. As the people and their needs increased, so did the number of dangers to groundwater. With an increasing demand for groundwater for domestic, industrial, and agricultural purposes, the strain on this assistance must be great. The current study focuses on the percentage of fluoride removed from water using low-cost materials, rice husk ash and silica from agricultural biomass waste, at various concentrations, contact time, adsorbent dosage, coexisting anions, and pH of the solution. Fourier-transform infrared spectroscopy, X-ray powder diffraction, a scanning electron microscope, and the Brunauer-Emmett-Teller method were used to characterize the adsorbent. Maximum fluoride removal is observed in batch research studies at low concentrations of 1 g/L adsorbent dosage. The results showed that rice husk ash had a higher surface area than silica, with 75.32 m^2/g and 35.81 m^2/g, respectively.

Keywords: Groundwater; Fluoride removal; Rice husk ash; Silica

Abstract ID: WWT-OP140

Mycoremediation of refinery wastewater and simultaneous removal of heavy metals

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Abstract

This study deals with the degradation of refinery wastewater and simultaneous removal of heavy metals using fungal strains: *Aspergillus niger*, *Phanerochaete chrysosporium*, and *Coriolus versicolor*. Different parameters, viz. pH, temperature and mineral salt medium concentrations were optimised. The *P. chrysosoporium* achieved 90.7% COD removal at pH 4.5 at 30°C within 7 days, higher than the *A. niger* 63% and *C. versicolor* 86%. The *P. chrysosoporium* strain was further assessed for heavy metal removal. Wastewater was mixed with varying concentrations of Fe, Cu, Zn, Ni, Cd, and Pb, to evaluate their influence on COD and heavy metal removal. A separate experimental setup was introduced where refinery wastewater mixed with heavy metals was spiked with selenite ($SeO3^{2-}$) to enhance heavy metal removal; the reduction of selenite results in biogenic selenium nanoparticles (SeNPS). These SeNPs increased the adsorption capacity of fungal cells due to their enlarged surface area and charge. Such operations can potentially treat mixed inorganic and organic wastewater, which requires a separate carbon source, thus reducing treatment costs.

Keywords: Mycoremediation; Refinery wastewater; Heavy metal

Abstract ID: WWT-OP141

Influence Of MFLP on The Removal of Divalent Zinc from Aqueous Solution

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Abstract
The biodegradable nature of heavy metals leads to their accumulation in living organisms causing various diseases. Adsorption is found to be superior due to its low cost, consumption of less reagents and possibility of recovery of valuable materials. The objective of this work is to exploit the use of low-cost Mallet flower leaves powder (MFLP) for the removal of divalent Zinc from aqueous solutions. Experiment s are performed for understanding the effect of agitation time, PH and concentration of the adsorbate, Temperature, adsorbent size.Atomic Absorption Spectroscopy is used for carrying out the analysis of divalent Zinc. Scanning Electron Microscopy is used for understanding morphology of MFLP before and after adsorption, while FTIR is used for identifying the functional groups. With an increase in particle size of adsorbent from 100 to 200 mesh size in 50ml of solution with concentration of 60 mg/L, the percentage adsorption of divalent Zinc 45.67%to72.8% and for 100mg/L in 50 ml of solution, the percentage adsorption divalent Zinc is increased from 43.2% to 77.4%. The Freundlich model for divalent Zinc adsorption onto mallet flower leaf powder proved to be the best fit followed by Temkin model for the experimental data. The thermodynamics of adsorption of divalent Zinc on mallet flower leaf powder is spontaneous and feasible.

Keywords: Divalent Zinc; FTIR; Heavy metals; Mallet flower leaves powder (MFLP)

Abstract ID: WWT-OP142

Wastewater Management: Sensor integration with manual filtration and multi-parameter monitoring for testing water quality

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Abstract
Water is vital for survival. Presently, it is getting contaminated due to industrial effluents, domestic wastes, pollutants, etc. This pollution has wiped out many exotic fish species, coral reefs, plants, zooplankton, and other organisms.
So, effective wastewater management is essential for safeguarding water resources and minimizing environmental impacts. This study presents an innovative approach that combines sensor integration with manual filtration techniques and multi-parameter monitoring to enhance water quality assessment in wastewater treatment processes. Key water quality indicators like pH, turbidity, and dissolved oxygen, are all continuously recorded by these sensors in real-time. It contributes to the advancement of wastewater management practices by integrating state-of-the-art sensor technology with traditional filtration methods.
The manual filtering stage serves as a fail-safe mechanism, assuring the effective removal of bigger particles and potential contaminants. It enables operators to notice deviations from intended water quality parameters, allowing for the taking of prompt actions.
This study is expected to have a significant impact on the field of wastewater management, promoting sustainability, efficiency, and environmental protection.

Keywords: Wastewater management; Sensor integration; Filtration; Sustainability; Efficiency; Environmental protection; Water quality indicators

Abstract ID: WWT-OP143

Fabrication of novel tubular ceramic membrane using pyrophylite and activated carbon by extrusion method and its performance in ultrafiltration of treated oily wastewater

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Abstract
Extrusion method was applied to fabricate the tubular ceramic ultrafiltration membrane using cost - efficient clay mixtures, namely pyrophyllite, kaolin, feldspar, and activated carbon (AC) followed by sintering. The mixture of clay powders with the addition of carboxymethylcellulose sodium salt as binder extruded to form a porous tubular membrane. Addition of AC indented to control membrane fouling and increase organic removal efficiency. The sintered membrane featured a uniform surface without any cracks and very good corrosion resistance in both acidic and basic conditions. From FESEM analysis, it was observed that the number of pore and size of pores got reduced by increasing the sintering temperature. The observed pore size range of 0.15 to 0.5 μm (average) confirms the ultrafiltration type of the membrane. However, with the increase in temperature from 850 °C to 1100 °C, the flexural strength is increased from 6 MPa to 21 MPa. The fabricated membrane showed potential applications in the filtration of treated oily wastewater and can be used as ultrafiltration membranes in wastewater treatment.

Keywords: Activated Carbon; Ceramic membrane; Oily wastewater; Pyrophylite; Tubular membrane

Abstract ID: WWT-OP146

Down Regulating Colour and Toxicity of Effluent using Microaerophilic Bioreactor

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Abstract
Synthetic dye effluent is a major hazard to the surrounding environment. This hazardous condition is inevitable but the regulation of decolourizing and detoxifying could be done using reactors. In this study we have designed a microaerophilic bioreactor which incorporates a microbial consortium of Pseudomonas stutzeri and Alcaligenes faecalis. We had used the effluent from microbiological labs from our university and we treated them at the range from 20ppm to 60ppm of Crystal Violet dye. Standardization of dye removal was done primarily in small scale and later implemented in a large-scale setup. Characterization studies for adsorbent was done using SEM analysis to get the nature of the pore size. In this study we chose 40ppm and 60ppm of dye effluent to be treated in lab scale setup with adsorbent and adsorbent along with microbial consortium and the treated effluent was analysed using UV- Visible spectrophotometry at 579nm and the efficiency of the percentage of removal was observed to be 99.7% and 99.1% for 40ppm with adsorbent and adsorbent with consortium respectively. Similarly, for 60ppm it shows 99.8% and 99.4% removal respectively. The experiment done in small scale bioreactor with 60ppm shows 99.8% and 99.6% removal with adsorbent and adsorbent along with consortium and also the highest removal is achieved at 8pH. The adsorption isotherm was also studied.

Keywords: Crystal violet; Decolourization; Bacterial consortium; SEM analysis; UV-Visible spectrophotometry

Abstract ID: WWT-OP147

Low-Cost Adsorbents for Single and Multi-Component Systems: Remediation of Textile and Pharmaceutical Wastewater Treatment

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Abstract
This review paper critically examines the utilization of low-cost adsorbents in the context of single and multi-component systems for the remediation of wastewater generated by the textile and pharmaceutical industries. The treatment of such complex effluents poses a significant challenge to environmental engineers and researchers, demanding cost-effective and sustainable solutions. In response, this review synthesizes the latest advancements and insights in this crucial field. The paper commences by offering an overview of the escalating concerns associated with textile and pharmaceutical wastewater, including the discharge of recalcitrant organic compounds, heavy metals, and other hazardous substances into natural water bodies. It underscores the imperative need for innovative and affordable wastewater treatment strategies. A comprehensive analysis of low-cost adsorbents is presented, encompassing a broad spectrum of materials such as agricultural residues, industrial by-products, and naturally occurring substances. Each category of adsorbent is meticulously scrutinized for its composition, surface characteristics, and adsorption capacity, with a focus on its suitability for addressing the specific contaminants prevalent in textile and pharmaceutical effluents. The review proceeds to delve into the adsorption processes' intricate dynamics within single and multi-component systems. It dissects the adsorption isotherms, kinetics, and thermodynamics governing these systems, offering valuable insights into the mechanisms driving adsorption phenomena. By synthesizing this knowledge, the paper provides a foundation for optimizing operational conditions and enhancing the efficiency of low-cost adsorbents in diverse wastewater treatment scenarios. Furthermore, the review underscores the sustainability aspects of employing low-cost adsorbents, including their potential for regeneration and reusability. By adopting these materials, the environmental footprint of wastewater treatment processes can be significantly reduced, aligning with global sustainability objectives.

Keywords: Adsorption; Low-cost adsorbents; Textile wastewater; Pharmaceutical wastewater; Remediation

Abstract ID: WWT-OP148

Intelligent techniques for wastewater treatment: A technical review

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Abstract
Industrial wastewater treatment is a crucial but challenging task. The perpetual chemical and bio-chemical reactions impart a great deal of complexity to the composition of industrial wastewaters. While conventional modeling approaches can handle linear processes, complex systems exhibiting non-stationary behavior can prove challenging. Machine learning techniques based on variants of Artificial Neural Networks, Bayesian approaches and Genetic Algorithms have proven promising for outlier detection, model generation and prediction in the field of wastewater treatment. In this context, intelligent techniques enable both feature extraction and application of suitable algorithms to datasets to obtain precise results. Inference mechanisms that support decision-making combined with visualization render machine learning algorithms as the most dependable techniques for analyzing various factors affecting wastewater treatment systems. Machine learning approaches are useful for data processing, real-time modeling and actionable inference for compliance with government norms for wastewater treatment. Moreover, machine learning algorithms have also been applied in wastewater treatment to optimize efficiency parameters.
This paper reviews the application of machine learning algorithms for data processing, modeling, parameter optimization, prediction, and decision-making for efficient management of wastewater treatment processes. The challenges, limitations and future prospects of these approaches are also discussed.

Keywords: Wastewater treatment; Machine learning; Algorithm; Modeling; Optimization

Abstract ID: WWT-OP151

Integrated Design Parameter Analysis for Enhanced Wastewater Treatment

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Abstract
Diversified research attempts has been undertaken as of now to understand inter-relation of different process design parameters through laboratory scale or pilot plant scale observation interpreted with statistical and artificial neural networking tools. The prime objective of those research are enhancement of process and operation yield, reduction of retention time, less area demand, firm dynamic hydraulic movement, and development of robust integrated system for different generation of wastewater treatment technology. The present research article is focused at assessment of different independent design parameters observed in operating condition of a running waste water treatment plant. Fixed design parameters like length and width of process tanks of wastewater treatment facilities like anoxic tank, aeration tank, anaerobic system along with variable design parameters like Inlet and Outlet Flow, Volumetric Sludge Generation, Water column depth in suspended or attached growth system Characteristics parameters of inlet and outlet water like Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solid, Ammoniacal Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus and intrinsic parameters in running condition like Mixed Liquor Suspended Solid, Volatile Suspended Solid, Activated Sludge Recirculation Ratio, Mixed Liquor Recirculation Ratio to Anoxic Tank will be considered as the input to the research. The outcome of this research will be development a problem statement and algorithm using statistical and machine learning tools like logistics regression, particle swarm optimization, support vector machine etc. tools which may be based on future availability of above-mentioned operating data can project input intrinsic independent design parameters pertinent to the operating conditions like F/M Ratio, Yield Coefficient, Substrate Utilization Rate etc.

Keywords: Wastewater treatment; Design parameters; Integrated analysis

Abstract ID: WWT-OP152

DEVELOPMENT OF BIOWASTE DERIVED POLYMER NANOCOMPOSITES FOR WASTE WATER TREATMENT

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Abstract
Water contamination and its adverse effect have become a serious cause of concern for the existence of human. With progressive industrialization, variety of contaminants has been thrown into the environment without any treatment which in turn becomes cause of concern to the human being. These industrial effluents mainly contain water pollutants such as dyes, heavy metals, phenolic compounds and medicines that have been discharged as effluents from various industries such as petroleum, paper, pulp, paints, textiles, food, etc. Among existing processing techniques for removal of these pollutants, adsorption remains a well-developed strategy due to low cost and easy process methodology as compared to others. Nanocomposites, composites, non-absorbents, layered silicates, activated carbon, biosorbents, biochar, etc. are extensively explored for efficient removal of dye from waste water. Adsorbents consisting of two or more materials or subcategories of other adsorbents are known as composite adsorbents. Development of polymeric nanocomposites-based adsorbents would offer enhanced adsorption efficiency due to the presence of functional groups on the surface of the polymer, ensuring the adsorption of metal ions and dyes and hence synergistically enhancing the overall removal efficiency. In this work, our objective is to develop a novel, efficient polymeric nanocomposite based adsorbent capable to remove multiple pollutants.

Keywords: Wastewater; Adsorption; Polymeric nanocomposites; Adsorbent

Abstract ID: WWT-OP153

Advanced Monolithic Metal Oxide/Sulfide Structures for Efficient Photocatalytic Decomposition of Organic Contaminants

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Abstract
The environmental pollution caused by anthropogenic activities has grievous consequences as these pollutants have a detrimental effect on living beings. Of the numerous techniques to treat water pollution, photocatalysis has come across as the most promising route. However, the employment of powdered photocatalysts restrains the large-scale use of this method. Monolithic photocatalysts come as a savior in this situation which have better transport kinetics and easy recovery due to single rock like structure. We have constructed the visible-light-driven monoliths by the wet impregnation of aqueous solution of suitable precursor metal salt into silica monoliths. In this context, four different monolithic photocatalysts in centimeter length scale (~0.7 cm in length and 0.5 in diameter) were synthesized i.e., WO_3/SiO_2, Sb_2S_3/SiO_2, MoO_3/SiO_2, and CuO/SiO_2 monoliths. The easy recovery after the photocatalytic treatment and high reusability is their most important attribute. All the monoliths had high surface area, porous morphology (multimodal porosity), and favorable optical properties. The performance evaluation and kinetic studies were conducted for the photocatalytic treatment of various organic pollutants like dyes, pesticides, and pharmaceutical contaminants. The influence of solution pH, concentration of catalyst, light source, and illumination area on the photodegradation was studied. The trapping experiments were also performed to know the photodegradation mechanism. The catalysts exhibited good efficiency compared to corresponding powdered materials ascribing to high surface area and increased number of active sites. Consequently, the increased light-harvesting ability facilitates the speeding up of the reaction kinetics on surface and transport kinetics.

Keywords: Monoliths; Nanocomposites; Metal oxides; Photocatalysis; Wastewater treatment; Pollutants

Abstract ID: WWT-OP154

Bioremediation of arsenic using bacteria immobilized on low density polyethylene in a packed bed bioreactor

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Abstract
This paper explores the possibility of bacteria immobilized on Polyurethane foam (PUF) for bioremediation of arsenic in a column study. The bacteria *Proteus alimentorum* strain TY6 and *Pseudomonas aeruginosa* strain K7Pb were effective in remediation of As(III) and As(V). The concentration of As(V) and As(V) was varied from 250 to 5000 ppb at two different flow rates, 50 mL/min and 100 mL/min each. Efficiency of TY6 varied from 7.54 to 99.5% for As(III) and from 8.26 to 99.62% for As(V). For K7Pb it varied from 3.48 to 98.4% for As(III) and 4.22 to 99.4% for As(V). Both isolated also showed potential for biotransformation of arsenic. TY6 was able to oxidize As(III) to As(V) and % oxidation ranged from 1.218 to 18.34% whereas reduction capacity of K7Pb from As(V) to As(III) ranged from 2.256 to 15.76%. The experiments were run until either the arsenic concentration was reduced to below the permissible limit (10 μg/L) or there was no significant change in the concentration. The results revealed that both the bacteria have very high potential for arsenic remediation.

Keywords: Arsenic; *Proteus alimentorum* strain TY6; *Pseudomonas aeruginosa* strain K7Pb; Bioremediation

Abstract ID: WWT-OP155

Utilizing Banana Pseudo-stem for Efficient Crystal Violet Removal via Capacitive Deionization

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Abstract
This study investigated the removal of crystal violet (CV) dye from wastewater using banana pseudo stem biochar in a capacitive deionization (CDI) method. CV is a common synthetic dye used in various industries, and the presence of this dye in water bodies has an adverse effect on aquatic life, the ecosystem, and human health. Compared to conventional methods, CDI, an electrochemical desalination technology, has been developed as a novel water treatment approach with great potential. The choice of electrode material is a key factor that promotes the development of CDI technology and expands its applications. The use of banana pseudo stem biochar is an attractive option due to its environmentally friendly,

cost-effective, and renewable properties. To better understand the behavior of the prepared biochar towards the selected pollutant, various characterization techniques were employed to investigate the effects of parameters such as concentrations and pH on the removal of crystal violet. The findings indicate the potential and suitability of biochar derived from banana pseudo stem as a promising electrode material for the removal of crystal violet through CDI.

Keywords: Crystal violet; Capacitive deionization; Banana pseudo stem biochar; Environmentally friendly

Abstract ID: WWT-OP156

Plasma-treated zinc titanate with improved photocatalytic degradation of methylene blue under light-emitting diodes(LEDs)

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Abstract
Sunlight is a widely available, renewable, clean, and green energy source. Photocatalytic activity of oxide-based semiconductor particles has been demonstrated in lots of environmental applications. In particular, zinc titanate (ZTO) nanoparticles prepared by the electrospinning route have shown potential for harvesting visible light toward photocatalytic degradation of phenol(Perween et.al). Nitrogen plasma treatment technologies have been used alternatively for the generation of oxygen vacancies for metal oxide-based catalysts. The synergetic effect of nitrogen plasma-treated nanoparticles produced the highest concentration of OH radicals(Pandiyaraj et al). Therefore, in this paper, we explore the possibility of plasma in ZTO particles to further improve its photocatalytic activity and utilize it for methylene blue degradation under LEDs. We observe ~10% higher degradation in plasma-treated ZTO.
This work compared the performance of ZTO and plasma-treated ZTO. The rheometer confirmed the high viscosity of plasma-treated ZTO. Dynamic light scattering (DLS) shows better suspension of plasma-treated ZTO. Other characterizations of plasma-treated ZTO are in process. Photocatalytic degradation of methylene blue under LEDs carried out in a custom-made set-up and absorbance curve is from UV-vis spectroscopy.

Keywords: ZTO; Plasma; Methylene blue; LEDs

Abstract ID: WWT-OP157

Intensification of biological oxidation of real pharmaceutical effluent using ultrasound based advanced oxidation

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Abstract
The present work demonstrates the significant role of ultrasound (US) based advanced oxidation for intensification of biological oxidation applied for the treatment of real pharmaceutical industrial effluent procured from the local industry. The initial part of the work presents an experimental study into combined approaches of ultrasound with ozone (O_3), H_2O_2 and Fenton's reagent for treatment of real effluent. Under optimized conditions (120 W, 20 kHz and duty cycle of 70%), maximum COD reduction of 42.31% was observed using a combined approach of US + H_2O_2 + O_3 at H_2O_2 loading of 1000 ppm, O_3 loading of 2 l/min, pH of 6 and an overall treatment time of 60 min. Individual approaches were also studied which showed lower degradation as compared to combined approach at the same operating conditions. After the toxicity analysis of untreated and pretreated samples, the pretreated effluents were subjected to actual biological oxidation. A maximum reduction of 86.7% in COD was obtained for US + H_2O_2 + O_3 pretreated effluent. Overall, it has been concluded that the hybrid oxidative processes as US + H_2O_2 + O_3 followed by biological oxidation is established as the best approach ensuring effective COD reduction and obtaining final colourless/reusable effluent.

Keywords: Process intensification; Acoustic cavitation; Biological Oxidation; Toxicity

Abstract ID: WWT-OP158

Green water footprint for oleaginous fermentation

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Abstract
Yeast single cell oil (YSCO) fermentation is a promising technology for producing sustainable and renewable oils. The water footprint of YSCO fermentation is a measure of the total volume of water used to produce a given amount of YSCO. We estimated the blue and grey water footprint for YSCO fermentation to be 3.87 and 23.66 m3 water/kg of lipid, respectively, and envisaged that the freshwater requirement can be fulfilled by adopting a rainwater harvesting process. The incorporation of rainwater for YSCO fermentation included the water footprint of the feedstock production, the fermentation process, and the transportation and use of the YSCO. The total (direct and indirect) rainwater consumption for the fermentation process will result in a green water footprint. We collected the rainwater during the monsoon season (June to August 2023 at Dehradun, Uttarakhand, India) and subjected it to operate the entire fermentation plant (500L tank). Detailed characterization was done to assess the water quality during various stages (Gate-to-gate) to estimate the direct and indirect green water footprint physicochemical characterization to understand the water quality. Our results suggested that a sustainable oleaginous fermentation process could be developed using green water.

Keywords: Rainwater harvesting; Lipid fermentation; Spent broth characterization

Abstract ID: WWT-OP159

Study of Biosorbtion of Chromium(VI) using Moringa leaves

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Abstract
A well-known, extremely poisonous metal that is also regarded as a priority pollution is Hexavalent chromium (Cr (VI)), which is hazardous to the environment and carcinogenic, is released into the environment more frequently as a result of rapid industrialization. Moringa (Moringa Oleifera) leaf powder is used to study the bio sorption of chromium (Cr (VI)). The source for the biosorption of Cr (VI) in the Moringa leaf powder is the presence of a sizable amount of organic acids. The feed solution contains varying amounts of Cr (VI), and the suggested biosorbent's effectiveness in removing Cr (VI) is studied using various dosages of the biosorbent. The Moringa leaves powder was characterized using XRD, FTIR, and SEM. The carboxylate and hydroxyl groups found in moringa leaves are thought to have a chelating action, which has been confirmed by the FTIR study. The aim of this work was to use economical and environmentally friendly bio-sorbents to remove chromium ions from wastewater. The adsorption experiments were carried out by batch studies with varying the conditions such as dosage, time and concentration were optimized to 0.15 g, 30 min and 100ppm, respectively. The results of this study indicate that bio adsorbents that are safe for the environment can be used as multipurpose materials for the treatment of water.

Keywords: Biosorption; Chromium (VI); Moringa leaves

Abstract ID: WWT-OP165

Remediation of acidic mining drainage using novel ceramic supported polymer composite membrane

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Abstract
Mining industries contribute an essential role to progress in economy. A massive quantity of mining waste effluents [acid mine drainage (AMD)] which causes water, air/soil contamination and disturb ecological balance. AMD predominantly contains a mixture of heavier toxic metal ions like SO_4^{2-} , Al^{3+}, Co^{2+} , Fe^{2+},Mn^{2+}, Ni^{2+}, Cr^{3+},Cletc., along with chemical contaminants (COD) and TSS. To treat such complex waste streams, ceramic supported polymer composite membrane using layer by layer approach is proposed to overcome the limitations of existing processes. Herein, support was dip coated with polyamide 6 (20 wt/vol %) and formic acid combination to form single layer, after that, top second layer is developed by coating with 10 wt/vol % of same polymer/acetic acid combination. The study reveals the incorporation of

polymer over substrate can reduce the pore size (~3.57nm) and also can enhance the performance in terms removal like TSS~95.23%, turbidity~99.9% as well as removal of heavy metal ions like Co^{2+} ~ 73%, Fe^{2+}~ 71.5%, Cr^{3+}~ 73.6%, Ca^{2+}~ 72.8%, Ni^{2+}~ 70 %, Na^{+}~72.3% Mn^{2+}~71.2% ,Al^{3+}~68.9% and Cu^{2+}~ 70.5% along with anions like Cl^{-} ~ 74.3% and SO_4^{2-}~74% .

Keywords: Ceramic supported polymer composite membrane; Metal removal; Water recycling

Abstract ID: WWT-OP166

Comparative study of harvesting of different microalgal strains from wastewater using chemically synthesized ferromagnetic nanoparticles for downstream processing

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Abstract
The current work is a proof-of-concept study of four microalgal species harvested from wastewater bodies for downstream processing, using synthesized magnetic nanoparticles. Four algal strains were used in the project viz., *Chlorella vulgaris*, *Synechococcus elongatus*, *Spirulina platensis*, and *Scenedesmus obliquus* first cultured in Asn III media and then in wastewater. Magnetic nanoparticles were used for harvesting the fully grown algal species, based on opposite charge attraction between the algal species and nanoparticles. Nanoparticles showed clustering around the algae in a matter of few hours, post which the cluster of algae-NPs were removed from the wastewater using a strong magnet. The algae-NPs cluster was then separated using centrifugation and altering the pH. The algal species *Scenedesmus obliquus*, *Chlorella vulgaris*, and *Spirulina platensis* showed promising results when combined with magnetite nanoparticles and were successful in getting harvested from the formulated artificial wastewater. All the values simultaneously depicted a higher performance of microalgal harvesting by PEG coated MNPs as compared to simply Bare-MNPs**.** In conclusion, magnetic nanoparticles can be considered an efficient approach for harvesting microalgal species for obtaining useful products as well as cleaning the wastewater bodies to turn them into clean water.

Keywords: Waste water recycling; Algae-nanoparticle complex; Magnetic nanoparticles; Algal technology

Abstract ID: WWT-OP168

Preparation of Photocatalyst for Degradation of Rhodamine B from Wastewater

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Abstract
Rhodamine B dye is applied in the textile industries but it leads to various neurotoxic problems. Moreover, textile effluent has become the major cause for water pollution. Photocatalytic treatment for dye removal is amongst the effective and economic method. In this work, the photocatalyst $LiCo_2O_4$ was prepared by citrate complexation (CT) method and was applied for the removal of rhodamine B dye at various concentrations. The characterization of the photocatalyst was done by Scanning Electron Microscopy and X-ray diffraction analysis. Experiments were carried out at different initial dye concentrations, adsorbent dose and contact time. The photocatalyst exhibited desirable photocatalytic performance for the degradation of rhodamine B under ultraviolet - light radiation.

Keywords: $LiCo_2O_4$; Degradation of dye; Waste water

Abstract ID: WWT-OP169

Simulation and Techno economic analysis of an Integrated process for Sequential Salt Recovery from sea water Ro reject brine solution

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Abstract
Water scarcity is a serious issue in the global scale. Desalination is a one of the promising methods employed to augment the water crisis. However, reject brine solution from seawater desalination plants cannot be discharged out due to environmental concerns. This could be addressed by employing Zero Liquid Discharge (ZLD) technology to treat seawater RO reject brine solution and to recover economically valuable salts as well. ZLD is achieved by integrating membrane and thermal based separation techniques on RO reject brine solution. In this configuration, the membrane module will be used a preconcentration step to reduce the heat load on the subsequent thermal based methods by a significant amount. The output from the membrane module is then sent as an input to the thermal based separation technique simulated through Aspen Plus simulation software. Thermal based separation techniques will be implemented through a series of multi-effect evaporators and sequential crystallizers to recover salts such as NaCl, $CaCO_3$, KCl, $MgSO_4.7H_2O$ etc. Feasibility of the integrated configuration and its techno-economic analysis is studied using simulation.

Keywords: Zero liquid discharge; Reverse osmosis; Seawater reject brine

Abstract ID: WWT-OP170

Perspectives of Biochar-Aided Advanced Oxidation Processes for the Remediation of Emerging Dyeing Contaminants

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Abstract
Biochar-aided Advanced Oxidation Processes (BC-AOPs) have emerged as a novel and promising method for degrading wide organic contaminants in water and wastewater treatment. In this investigation, the principles, processes, and possible applications of BC-AOPs are highlighted. AOPs produce highly reactive oxygen species (ROS), such as hydroxyl radicals (•OH), to oxidize and mineralize organic contaminants. Biochar, a carbonaceous material derived from biomass pyrolysis, serves as a catalyst or support in AOPs, enhancing their efficiency and stability. Biochar's distinctive physicochemical features, such as large pore volumes, functional groups, and high surface area, contribute to its catalytic role in enhancing OH production. The combination of biochar and AOPs creates synergistic effects, enabling the degradation of a wide range of recalcitrant dyeing contaminants, inclusive of many industries. BC-AOPs offer several advantages, including low-cost materials, versatility, and the potential for sustainable synthesis through the utilization of various biomass residues. However, challenges remain in optimizing biochar characteristics, understanding reaction kinetics, and evaluating the long-term stability and reusability of biochar in AOPs. BC-AOPs hold significant promise as an effective and environmentally friendly technology for water and wastewater treatment, contributing to the mitigation of water pollution and ensuring water resource sustainability.

Keywords: Biochar; Wastewater; Dyes; Remediation; AOPs

Abstract ID: WWT-PP1

Zero Liquid Discharge Treatment of wastewater in Lignocellulosic Biorefineries

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Abstract
The growing concern about the scarcity of fresh water resources, stringent environmental regulations and increased economic considerations has focused the importance of efficient wastewater treatment (WWT) and water reuse. The main aim of WWT is to remove contaminants from wastewater using a series of physic-chemical, biological and integrated

treatment process. The scientific studies show that most of this process alone cannot remove the pollutants effectively either they are expensive or inefficient to remove trace pollutants. The application of hybrid process also known as integrated system has gained attention in an effort to increase the efficiency of wastewater treatment and improve the quality of effluent. In recent years, zero liquid discharge (ZLD) gain attention to reduce liquid waste generation while increasing water supply, and this industrial wastewater management strategy has sparked renewed interest around the world. Despite the benefits of reduced water pollution and resource recovery from waste, there are several obstacles to overcome before ZLD can be widely used. These processes achieve higher efficiencies than individual process. In the present study it is proposed to design a wastewater treatment system to provide robust treatment of lignin containing wastewater stream allowing for direct reuse of treated water in upstream processes.

Keywords: Zero liquid discharge; Advanced oxidation process; Microbial fuel cell

Abstract ID: WWT-PP2

Hydrodynamic cavitation aided advanced oxidation process for remediation of pharmaceutical effluent from wastewater

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Abstract
The aquatic ecosystem is in grave danger due to the recalcitrant pharmaceutical effluents. Sulfonamide is an antibiotic often found in the effluent streams causing hostile effects on the environment as well as proliferating the resistance to the antibiotics. This is serious concern and needs to be neutralized with aid of special treatment strategies. Advanced oxidation processes are a promising remedy for this concern. However, hydrodynamic cavitation (HC) is still dormant despite of its latent potential. This current work studies the degradation kinetics of the sulfonamide antibiotic in the wastewater using hydrodynamic cavitation in synergism with the advanced oxidation processes. Using standalone HC setup, the pH (2) and inlet pressure (4 bar) was optimized achieving degradation of 16.4 % within an hour. The synergistic approaches with hydrogen peroxide (HC+H_2O_2), ozone (HC+O_3) as well as Fenton's reagent (1:3) resulted in 83.2%, 92.2%, and 82.4 % degradation with just half an hour. For the evaluation of the degradation mechanism Liquid Chromatography- Mass Spectroscopy (LC-MS) was used. Kinetic studies showed that the degradation of sulfonamide follows the first order kinetic behaviour for all the synergistic approaches. From economic and technological point of view the HC+H_2O_2 (0.3 g/L) excels from rest of the combinations.

Keywords: Sulfonamide; Pharmaceutical effluent; Advanced oxidation process; Hydrodynamic cavitation; Optimization

Abstract ID: WWT-PP3

Comparative Study on the Biosorption of Cr (VI) Using Raw Pomegranate Peel and Green Coconut Shell

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Abstract
It has been observed that both raw pomegranate peel (RPP) and green coconut shell (GCS) can be used as bio-adsorbents to remove heavy metal ions from contaminated water. RPP contains ellagitannins, flavonoids, and lignin that have been demonstrated to have high metal-binding abilities. GCS, on the other hand contains cellulose, hemicellulose, and lignin, which are known to have a high affinity for heavy metals. RPP and GCS also have high surface area and is abundant in functional groups including carboxylic, hydroxyl, and phenolic groups that help the formation of complexes that aids the adsorption of metals. Chromium is known to be carcinogenic and has also been reported to cause epigastric pain, nausea, vomiting, severe diarrhoea, and haemorrhage. Chromium, in particular, is present in mining, metal-finishing and electroplating operations, and is also used in the manufacturing of pigments, leather, print films, and catalysts. A glass column packed with adsorbents such as RPP and GCS may be used to remove Cr (VI) by passing contaminated water through the bed and continuously monitoring the outlet concentration. A comparative study can be done by using these adsorbents individually at various bed heights and flow rates of the water.

Keywords: Biosorption; RPP; GCS; Chromium; Adsorbent

Abstract ID: WWT-PP4

ARSENIC REMOVAL TECHNIQUES IN TREATING WASTE WATER

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Abstract
Arsenic is the 20th among the elements in abundance by (1.5-2.2ppm). high concentrations of sulfide ore comprise of (As), native element(4minerals), Arsenides (27minerals) and sulfides of (As) with metals (Pb, Cu, Th, 65minerals) oxidation products of foregoing (2- oxides, arsenites, 116 arsenates, & 7 silicates). A high concentration of (AS) is 2,100ppm and an average of 115ppm, mostly found in sediments depositions and areas of hot brines. Arsenic is a ubiquitous, risky naturally occurring metalloid that may be a risk factor for cancer after exposure to contaminated drinking water, cigarettes, foods, occupational environment &air. Drinking water is largest source of (As) poisoning. Where Arsenic in its ion form As (+3) is 50>>> As (+5) in toxicity causes chronic diseases which leads to psychological effects, decreased mental performance, hypertension & increased risks of cardiovascular disorders, diabetes too. Inorganic (As) compounds are more highly reactive than organic species in getting absorbed into human cells. Arsenic Removal & concentration reduction techniques, physical treatment, and biological treatments are Lime precipitation, oxidation, coagulation followed by precipitation (or) filtration , Adsorptive Media, Ion exchanger .Current industrial process in treating wastewater and sludge treatment for arsenic concentrations reduction involves cost-efficient, suitable technique, minimal (As) concentration, non-toxic, and unharmed. It's applications in various sectors are Pharmaceuticals, agricultural chemicals, & semiconductor industries. Its usage isn't deployed anywhere in the world, also it's deposited at higher concentrations in resources that are harmful, using these technologies in treating Wastewater for removal of Arsenic.

Abstract ID: WWT-PP12

Removal of Toxic Organic Pollutants in Industrial Effluent by Catalytic Wet Air Oxidation over γ-Al_2O_3 supported TiO_2 catalyst

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Abstract
Catalytic wet air oxidation (CWAO) is now a most economical and time saving process for toxic organic pollutants in industrial effluents. According to toxicity of different pollutants, preparation of supported metal catalyst are the present need of research. The present study focuses on the preparation of γ-Al_2O_3 supported TiO_2 catalyst by excess solution impregnation (ESI) method with Ti metal loading from 0.1 to 1 wt. % TiO_2, and γ-Al_2O_3 support from 5 to 10 gm. The CWAO was carried out in a 1 lit volume 3 necks glass batch reactor at atmospheric pressure. Optimization of catalyst loading, air flow rate, temperature, initial concentration of model pollutant acetic acid and stirring speed (rpm) are studied to remove the acetic acid from industrial effluent by CWAO method. The catalyst and supports are thoroughly characterized by physicochemical techniques such as BET, SEM, XRD, TEM. It is noticed that the TiO_2/γ-Al_2O_3 is a good metal oxide catalyst due to its strong acid-base property, stability and reactivity. Besides, it is found from the literature that, Ceria promoted Pt/γ-Al_2O_3, Ce–Co/γ-Al_2O_3, Ag/γ-Al_2O_3-ZrO_2, Fe_2O_3-CeO_2-Bi_2O_3/γ-Al_2O_3, 10%CuO/γ-Al_2O_3 etc. are used to remove pyridine, β-picoline, 3-cyanopyridine and ammoniacal nitrogen, formaldehyde, phenol, azo-dyes, pulp and paper waste-water etc. with positive results.

Key words: Catalytic wet air oxidation (CWAO); TiO_2/γ-Al_2O_3 catalyst; Acetic acid pollutant

Abstract ID: WWT-PP13

Assessing the effect of different drying conditions on struvite quality and kinetic modelling for easier and cost-effective downstream processing

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Abstract
Increasing agricultural demand and depletion of phosphorus rocks has made transition in research from contamination removal to nutrient recovery from wastewater. Precipitation of struvite or magnesium ammonium phosphate is an effective way of sustainable management and recycling of nutrients (N&P) from wastewater. However, conventional drying of struvite in hot air oven makes the process time consuming and cost ineffective. Our study focuses on evaluation of performance of conventional (20-100°C), microwave (180-720 W), sun and room temperature drying on the quality of struvite produced from source separated urine by electrocoagulation using Mg-Mg electrodes. The effective diffusivity is reported to be $1.01402e^{-08}$- $2.15936e^{-07}$; $2.30599e^{-07}$- $1.74507e^{-06}$; $5.43852e^{-08}$; $8.64472e^{-09}$ for conventional oven, microwave, sun and room temperature drying respectively. The falling rate period was observed to fit on Page, Newton and Handerson-Pabis model for most of the conditions with the correlation co-efficient value of >95%. The dried struvite was subjected to XRD analysis to determine the effect on the quality revealed the disintegration of struvite crystals with the increase of temperature above 60°C in conventional oven and 180 W in microwave oven into other forms. The sun drying is concluded to be a cheaper alternative which is less time consuming and retains struvite quality.

Keywords: Drying; Struvite; Kinetic modelling; Cost-effective; Downstream processing

Abstract ID: WWT-PP14

Preparation and Characterization of Mesoporous Material Supported Titanium Oxide NPs for Efficient Removal of Toxic Organic Pollutants from Industrial Effluent

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Abstract
The removal of toxic organic pollutants from industrial effluents is a critical environmental concern. Propionic acid is one of the most toxic and hazardous pollutants present in industrial effluents. It can create severe health issues in humans including, skin, eyes, lungs, and other major physical troubles. In this study, a novel mesoporous material was synthesized via excess solution impregnation (ESI) of Ti nanoparticles (NPs) on mesoporous Al_2O_3. Degradation of propionic acid pollutants is performed in a 3-neck glass reactor over synthesized composite materials and air as the oxygen source. The efficiency of the synthesized composite material in removing toxic pollutants such as propionic acid from industrial effluent is evaluated by optimizing key parameters such as temperature, pressure, reaction duration, etc. Characterization techniques, including XRD, XPS, SEM, TEM, EDX, TPD, TPR, HRTEM, and BET surface area analysis are employed to evaluate the composite's crystal structure, morphology, surface area, and porosity. Material characterization results reveal a well-defined crystal structure and uniform particle size distribution of the mesoporous Ti/Al_2O_3 material, along with a high surface area and porosity. This research contributes to an efficient and sustainable option for industrial wastewater treatment, addressing environmental concerns and ensuring human health and well-being.

Keywords: Mesoporous materials; Ti NPs; ESI method; Characterization

Abstract ID: WWT-PP15

Food waste-derived hydrochar modified with Zn-Al as photocatalyst (Zn-Al@HC) for tertiary abatement of salicylic acid from wastewater

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Abstract

Waste-derived catalysts are of utmost interest in the research area of advanced wastewater treatment. The present investigation illustrates the transformation of food-waste digestate-derived hydrochar (HC) to a highly efficient photocatalyst

(Zn-Al@HC). Further its application in persulfate (PS) activation and remediation of salicylic acid (SA), an emerging contaminant, from wastewater/ industrial effluent under UV/PS/Zn-Al@HC system was evaluated. The morphological and photoelectrochemical characterizations confirm the formation of photocatalytic $ZnAl_2O_4$ composited on the HC surface and the high photocurrent response of Zn-Al@HC under UV exposure. The as-synthesized photocatalyst showed outstanding performance with the SA degradation efficiency more than 90%. On conducting the radical scavenging evaluation, the dominance of hydroxyl radical (•OH) and the potential mechanism was deduced. Moreover, the cyclic voltammetry for 20 repetitive cycles under harsh environment affirms the photostability of the Zn-Al@HC, even in real environmental conditions. Further, the techno-economic assessment of UV/PS/Zn-Al@HC treatment revealed the total operating cost of 0.15 \$ m^{-3} $order^{-1}$ and electrical energy per order of 0.013 kWh m^{-3} $order^{-1}$, respectively, at optimum condition. Thus, the as-synthesized photocatalyst proved to be a sustainable and economical option for digestate valorization, and remediation of emerging contaminants-laden wastewater and can be scaled up.

Keywords: Hydrochar; Photocatalyst; Persulphate activation; Advanced oxidation process; Salicylic acid

Abstract ID: WWT-PP16

Enhanced Degradation of Formic Acid by Catalytic Wet Air Oxidation on γ-Al_2O_3 Supported Titanium Oxide NPs

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Abstract
The Environmental Protection Agency (USA) declares the formic acid is one of the most hazardous and toxic chemicals. Ingestion of formic acid can result in burns to mouth, throat and stomach, difficulty to swallowing and blood vomiting. Breathing in formic acid may cause irritation of eyes and nose, sore throat, cough, chest tightness, headache and confusion. Catalytic wet air oxidation (CWAO) is one of the most promising and environmental friendly advanced oxidation process for high strength, toxic, harmful and non-biodegradable contaminants under milder conditions. The present study focuses on the enhanced degradation of toxic formic acid using γ-Al_2O_3 supported titanium oxide nanoparticles (NPs) in a batch reactor at atmospheric pressure using air as the oxygen source. The catalyst was prepared via excess solution impregnation (ESI) of Ti nanoparticles (NPs). The reaction was performed with varying the catalyst dosage, temperature, initial concentration of formic acid, and metal content (0.1 to 1 wt. % Ti) in the support. The catalyst and support are characterized using SEM, BET, TPR, TPD, XRD and HRTEM techniques. Further, CWAO of formic acid is performed to study the reaction mechanism and reaction kinetics, to develop more active and stable catalyst to utilize on industrial scale operation.

Keywords: TiO_2/Al_2O_3 catalysts; CWAO; Formic acid pollutant; Reaction kinetics and mechanism
Abstract ID: WWT-PP17

Magnetic catalyst nanoparticles-coated Ozone microbubbles for effective removal of trace pharmaceutical pollutants from wastewater

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Abstract
Pharmaceutical pollutants in municipal water are pharmaceutical chemicals and their metabolites found in the water supply that is meant for human consumption. Due to disposal of un used medicines, excretion of pharmaceuticals and their metabolites after administration by humans results in entry of contaminants into the municipal water bodies. Presence of these pharmaceutical pollutants in the water bodies raises concern due to their potential adverse effects on environment and human health. In order to effectively remove the traces of pharmaceutical pollutants, various advanced methodologies like oxidation processes that involve ozonation and photocatalysis, membrane filtrations, and activated carbon adsorption techniques have been employed. However, these techniques are not completely effective in the removal of traces of pharmaceutical pollutants from water. In the current work, we have synthesized magnetic catalyst nanoparticles-coated ozone microbubbles for the efficient degradation of trace quantities of pharmaceutical pollutants in wastewater. Ozone microbubbles, typically smaller than 100μm, were synthesized by using a sonication process. These microbubbles offer large interfacial areas with enhanced mass transfer properties resulting in the efficient removal of pharmaceutical pollutants. The

magnetic catalyst coated on the surface of ozone microbubbles enhanced the production of ROS species that promoted the effective degradation of pharmaceutical pollutants. Ibuprofen, a commonly used non-steroidal anti-inflammatory drug, and Trypan blue, an azo-based blue dye, were selected to estimate the efficacy of magnetic catalyst-coated ozone microbubbles in the degradation of pollutants. Magnetic catalyst nanoparticle-coated ozone microbubbles exhibited 95% degradation efficiency within 10 minutes of treatment, while conventional ozone treatment resulted in only 30% of pollutant degradation. In addition to enhanced degradation, the catalyst can be retrieved back, leaving no traces of the treatment procedure, leaving pure water devoid of pharmaceutical pollutants. This purification method be easily scalable and can be used in large-scale water treatment plants.

Keywords: Ozone; Wastewater; Magnetic nanoparticles; Microbubbles

Abstract ID: WWT-PP18

Removal of dye using rice husk ash-based silica-supported catalyst coupled with a Fenton-like process

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Abstract
A novel, economically effective, and environmentally benign technique was used to treat textile dye wastewater by Fenton-like process using rice husk ash (RHA)-based silica-supported iron catalyst. SEM, XRD, and FTIR were performed to describe the prepared catalyst's comprehensive characterization. At response surface-optimized circumstances, which include catalyst dose of 30 mg/L, H_2O_2 concentration of 100 mg/L, and pH of 3.2, the maximum reduction of 95% was attained for trypan blue within 30 mins. Similarly, four parameters are optimized, i.e., catalyst dose of 750 mg/L, H_2O_2 concentration of 750 mg/L, and pH of 3 were achieved for 96% of methylene blue removal within 55 mins. Phytotoxicity demonstrated the non-toxic nature of the dye wastewater with green catalyst. Careful consideration has been given to the prudent use of one waste (RHA) in opposition to another significant waste (dye wastewater) abatement of the same business. Results made it abundantly evident that the developed plan offered an utterly sustainable solution for minimizing the production of various wastes.

Keywords: Rice husk ash; Catalyst; Fenton-like process; Trypan Blue; Methylene Blue; Phytotoxicity

Abstract ID: WWT-PP22

Photocatalytic Removal of Synthetic Organic Pesticides from Aquatic Environments: Recent Progress and Future Prospects

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Abstract
This review aims to be a comprehensive, authoritative, critical, and accessible review of general interest of contemporaneous scientific community addressing the environmental, pollution and energy crises situations faced by the humanity. In this scenario, the rapid increase in the use of synthetic organic pesticides has led to widespread contamination of aquatic environments, posing significant threats to ecosystems and human health. Consequently, the development of efficient and sustainable methods for the remediation of pesticide-contaminated water bodies has become a pressing need. Photocatalytic degradation has become a promising approach for the removal of synthetic organic pesticides due to its high efficiency, mild reaction conditions, and potential for mineralization into harmless byproducts.
This review highlights recent advances in the photocatalytic degradation of synthetic organic pesticides in aquatic environments. First, an overview of the key types and sources of synthetic organic pesticides found in water bodies is provided, highlighting their persistence and potential adverse effects. The principles underlying photocatalysis and the role of photocatalysts, particularly semiconductor materials, in pesticide degradation are discussed. Various factors affecting

photocatalytic efficiency, including catalyst properties, operating conditions, and pesticide characteristics, are explored. Furthermore, recent advances in the design and synthesis of novel photocatalysts with enhanced performance, such as composite materials and nanostructures, are presented. The review also addresses the challenges and limitations associated with photocatalytic degradation, including the presence of coexisting pollutants, the need for optimal catalyst loading, and the potential generation of toxic intermediates. Strategies to overcome these challenges, such as the use of co-catalysts, optimization of reaction parameters, and the combination of photocatalysis with other treatment techniques, are discussed. Additionally, the scale-up potential and practical considerations for the implementation of photocatalytic processes in real-world scenarios are examined. Finally, future research directions and potential areas for improvement in the field of photocatalytic degradation of synthetic organic pesticides. These include the development of photocatalysts with enhanced stability, selectivity, and recyclability, as well as the exploration of advanced reactor configurations and the integration of renewable energy sources.

Keywords: Photocatalysts; Pesticides; Aquatic environments

Abstract ID: WWT-PP23

Impact of Climate Change on Water Sources and Treatment Methods

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Abstract

This abstract addresses a critical research gap by examining the intricate relationship between climate change and wastewater systems, acknowledging their vulnerability to climate-induced effects. Despite being crucial for societal well-being, wastewater systems' susceptibility exposes communities to risks. This comprehensive study analyses the diverse impacts of climate change on wastewater systems across different timeframes and dimensions. The research begins by evaluating the direct climate-related effects on various components of wastewater systems, including reticulated and on-site systems, and treatment plants. This assessment covers both urban and peri-urban contexts. The identified impacts center on three key themes: nuisance flooding leading to spills and odors, deteriorating water quality from uncontrolled discharges, and physical infrastructure damage. These impacts, both immediate and long-term, resonate widely across social, cultural, environmental, and economic realms. Asset loss disrupts communities, while compromised water quality triggers cascading effects on various aspects of society, environment, economy, and culture. Concurrently, public health risks and economic burdens arise from damages, lost production, and insurance claims. Given the complexity and severity of these impacts, the study considers their distribution among different groups and their manifestation in various contexts and locations. The paper concludes by offering guiding principles for local government decision-makers. These principles serve as a strategic framework for addressing the challenges posed by climate-induced impacts on wastewater systems. In summary, this research enhances our understanding of climate change's consequences for wastewater systems, emphasizing the need for proactive mitigation and adaptation strategies. By highlighting the interconnected nature of social, cultural, economic, and environmental implications, the study underscores the requirement for holistic approaches that ensure the resilience of wastewater systems in an ever-changing climate.

Keywords: Intricate relationship between climate change and wastewater systems; Diverse impacts of climate change on wastewater systems; Strategic framework for addressing challenges posed by climate induced impacts

Abstract ID: WWT-PP24

Comparative research and design of Sustainable Techniques for precious metal refinement including into a wastewater treatment facility

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Abstract

The presence of precious metal granules in wastewater within a government-designated Special Economic Industrial Zone that is abundant in the Gem and Jewellery industries is discussed in this paper, also the study of most significant research methodologies for recovering metals from industrial wastewater using membrane techniques, nano- and bio-sorption techniques, and Magnetic Solid Phase Extraction (MSPE) techniques. The procedures for recovering valuable metals from industrial wastewater streams have recently drawn a lot of interest from researchers all around the world. Due to their exceptional physical and chemical characteristics that make them expensive and allow for their reuse in industrial-based processes like Jewellery, Electronics, Petrochemistry and catalysts, precious metals are known as rare and noble chemical elements. Additionally, as demonstrated in this research, this can lower operational expenses because we are making money from this extraction. Therefore, the main goal of this review paper is to give both expert and non-expert readers the chance to become familiar with the most recent innovations and techniques in the comparison of precious metals' percentage recovery from wastewater (including gold (Au), platinum (Pt), rhodium (Rh), palladium (Pd), ruthenium (Ru), silver (Ag), copper (Cu), and others). The recovery process of precious metals utilizing various ways is intended to be thoroughly understood in addition to describing practical applications. After discussing the benefits and drawbacks of various methods for recovering precious metals, it is demonstrated that appropriate membrane preparation can remove metals from industrial wastewater (up to 100%), including by incorporating functional groups and nanoparticles on the membrane surface. Additionally, various strategies and future perspectives for their sustainable use are introduced with basic 3D design of the refining processes incorporated into a Wastewater treatment plant and a Sewage treatment plant.

Keywords: Sustainable wastewater treatment; Precious metal refining; WWTP; STP

Abstract ID: WWT-PP27

Dye removal from wastewater using agro-waste based adsorptive approach

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Abstract
Wastewater treatment is a critical process aimed at mitigating environmental pollution and ensuring the sustainability of water resources. Dyestuff removal from wastewater effluents has been an area of concern due to its potential toxicity on human and aquatic life. Among various physical and chemical approaches of dye removal, the Bio-adsorption technique received notable attention in treating aqueous effluent with regard to cost, design, operation technique, and environmental point of view. Annually, cultivation and harvesting of crops produce a huge amount of agricultural waste. Agro-wastes are considered to be organic sorbent as a straightforward, successful, and financially viable process, because they provide the best output without any damaging by-products and produce high-quality treated effluents. This paper focus on dye removal from wastewater using agricultural waste based on adsorptive approach.

Keywords: Dye; Agro-waste; Bio-adsorption; Biomass; Toxicity

Abstract ID: WWT-PP30

Sulfate radical assisted advanced oxidation process for the enhanced degradation of pharmaceutical pollutants in wastewater

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Abstract
Pharmaceuticals are beneficial to all life forms but they also pose hidden risks to nature and affect the health of all life forms. Waste produced from pharmaceutical industries improperly discarded pharmaceuticals, and medical waste from hospitals and research labs results in water bodies getting polluted. These pharmaceutical products are often not completely degraded by the traditional methods. Hence, the exploration of advanced techniques that offer effective removal of these pollutants from water is the need of the hour. The work focuses on the utilization of sulfate radicals ($SO_4^{\bullet-}$) for the degradation of pharmaceuticals from wastewater through advanced oxidation processes (AOPs). Sulfate radicals ($SO_4^{\bullet-}$) offer high oxidation potential in comparison to hydroxyl radicals $^{\bullet}OH$. The effect of pH, temperature, persulphate salt concentration, and pollution concentration on the degradation efficacy of the sulfate radical-based advanced oxidation process. It also focuses on evaluating the mechanism involved in the degradation of the pollutant. By advancing the understanding of the results and mechanisms and further optimizing the process conditions the sulfate radicals shall significantly contribute to the preservation of the quality of water and protect human health and the environment.

Keywords: Sulphate radicals; Persulphates; Advanced oxidation process; Wastewater; Pharmaceuticals

Abstract ID: WWT-PP32

Wastewater treatment using adsorbents derived from fruit peel waste

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Abstract
The potential of utilizing fruit peel waste as an adsorbent for wastewater treatment is explored. Fruit peel waste, a readily available agricultural byproduct, offers a readily accessible and underused resource replete with natural adsorbent elements like cellulose, lignin, and polyphenols which also offers an eco-friendly and cost-effective solution for the removal of contaminants from wastewater. The study aims to evaluate the adsorption capacity and efficiency of different fruit peel waste-derived adsorbents in removing pollutants such as heavy metals, dyes, and organic compounds from water sources. Through experimental analysis and characterization techniques, the adsorption performance, kinetics, and mechanisms will be elucidated. The outcomes of this research could contribute to sustainable wastewater treatment methods, addressing both environmental and waste management challenges. By repurposing fruit peel waste into a valuable adsorbent material, this study aligns with the principles of circular economy and resource optimization. In conclusion, this investigation holds promise for developing innovative, efficient, and environmentally friendly approaches to wastewater treatment using naturally derived adsorbents.

Keywords: Pollutants; Fruit peel waste; Adsorbent; Biomass; Green technologies

Abstract ID: WWT-PP37

Acoustic Cavitation based Catalytic Ozonation for treatment of real effluent

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Abstract
Rare earth elements (REE) are used in variety of fields, resulting in increased usage and increase in rare earth industry production. This growing demand leading to increase in water pollution by addition of metals oxides, cyanides, etc. from mining, mineral processing and metallurgical operations. The current work focuses on Acoustic Cavitation (AC) based treatment of real effluent from rare earth metal industry containing NH_4SCN. In the present work no COD reduction was achieved with the single AC, which was improved by coupling AC with O_3, chemical oxidants and catalysts under optimized conditions of 120 W and 70% duty cycle. It was investigated that AC+O3 combined with chemical oxidants and catalysts results in significant COD reduction compared to only AC based approach. Effect of AC+H_2O_2 (at varying loadings 1400ppm to 800ppm), AC+O_3 (at Ozone flowrate from 0.15L/min to 2L/min), AC+O_3+Catalyst (TiO_2/MnO_2 at fixed loading of 1g/L) and pH (3-12) has been studied for degradation of NH_4SCN. US+O_3 (flowrate of 0.5 L/min) with H_2O_2 (1200 ppm) and catalyst TiO_2 (1g/L) resulted in maximum COD reduction of 64.28% and 69.45% respectively. Overall, it has been established that AC+O_3 based combined treatment are effective for the treatment of real rare earth effluent.

Keywords: Rare earth effluent; Acoustic cavitation; Catalytic ozonation; AOP

Abstract ID: WWT-PP38

Comparative Analysis of Radon concentration level in Groundwater and Non-groundwater sites Soil Samples from Pune Region, Maharashtra, India

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Abstract:
This abstract discusses the significance of radon, a naturally occurring radioactive gas, and its association with lung cancer. Radon exposure is a concern, especially for non-smokers, as even low levels can increase lung cancer risk. The source of radon in residential settings is primarily from soil, emphasizing the importance of testing. Radon's decay products can harm

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lung tissue and DNA structure, contributing to lung cancer. Previous studies in India have investigated radon levels in various regions, but there is a lack of data for the Pune region. This study aims to compare radon levels in groundwater site and non-groundwater site soil samples in Pune, Maharashtra, using the Smart RnDuo radon detector to assess potential health risks. The radon concentration in the soil above the groundwater site was found to exceed that found in soil without groundwater site influence but still remained below the global standard.

Keyword: Groundwater; Radon concentration; Smart RnDuo radon detector

Abstract ID: WWT-PP39

Potential of Green Emulsion Liquid Membrane in Industrial Effluent Treatment – A Mini Review

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Abstract

Industrialization and urbanization are accompanying environmental pollution particularly in developing countries. Different types of pollutants enter the environment from various industrial effluents which create a threat for the aquatic organisms, plants and humans. Separation techniques like precipitation, adsorption, reactive distillation, ion exchange, electro dialysis, solvent extraction, and ultrafiltration are available, but these techniques have various limitations like the use of excessive and expensive chemicals, high energy requirement, sludge formation, requirement of utilities in large amount. The green emulsion liquid membrane (GELM) is an emerging and promising method that incorporates the traits of ELM for the removal of various pollutants, metal ions, acids, and so on. In the present scenario, much focus has been diverted towards the use of green solvents derived from vegetable and plant origin. These solvents are environmentally friendly and economically viable making the ELM process more reliable. The traditionally used petroleum-based solvents for ELM formation are expensive, toxic, volatile in nature, and are detrimental to the environment. The present study tries to address the recent advancement in the field of GELM. The different factors like concentration of surfactant, carrier, types of diluents, effect of volume ratio of external feed phase to emulsion, agitation speed, effect of internal aqueous phase concentration, and emulsification time play a substantial role in the removal of several pollutants through GELM have been discussed in detail.

Keywords: Pollutants; Green emulsion liquid membrane; Diluents; Treatment

Abstract ID: WWT-PP42

DESALINATION OF SEA WATER BY USING RENEWABLE ENERGY SOURCES- AN OVERVIEW

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Abstract

Water is one of the vital components which is required by every living being on the earth. Even though 70% of the Earth's surface is covered by water, only 2.7% of the fresh water available globally and even less than that (0.3%) is fit for human use. By 2050, it is anticipated that threequarters of the world's population would experience a freshwater deficit. Opportunities and difficulties arise for the use and advancement of desalination technology, particularly seawater desalination. In desalination technology, freshwater is created by filtering out salt and other minerals. Seawater components have become one of the most important water treatment processes and the global production of drinking water. Desalination of sea, ocean, and brackish water is becoming more and more significant for the water industry. Develop cutting-edge desalination techniques using renewable energy. Even if there are many sources of renewable energy, it is still advantageous for the environment while being generally pricey and efficient. A new desalination method incorporating renewable energy sources like wind, sun, sea, and nuclear should be developed in order to reduce the consumption of conventional energy and carbon emissions. The goal of the current review is to present recent breakthroughs in membrane-based desalination techniques that take advantage of renewable energy sources and meet the challenges.

Keywords: Desalination; Renewable energy; Sea water; Membrane-based technique

Abstract ID: WWT-PP47

Analysing the efficiency of basolite for mefenamic acid degradation in pharma waste using HPLC method

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Abstract
Mefenamic acid (commonly known as Ponstan) is a widely used non-steroidal anti-inflammatory drug (NSAID) that frequently finds its way into wastewater systems due to incomplete metabolism and disposal practices. In this study, we investigated the efficiency of basolite (metal-organic framework) for the degradation and removal of mefenamic acid from pharmaceutical wastewater. High-performance liquid chromatography (HPLC) with C18 column (250 x 4.6 mm, 5 µm) and a binary mobile phase of A: potassium dihydrogen phosphate (commonly represented as KH_2PO_4) of 0.05M and 5.5pH and B:100% acetonitrile is employed as the analytical method for the quantitative analysis of mefenamic acid in the wastewater samples before and after treatment. The mobile phase flow rate was maintained constant at 1 mL min-1. The reaction progress is monitored by taking periodic samples, which are then analyzed using HPLC to determine the extent of mefenamic acid removal. The research encompasses several key aspects: firstly, different samples of pharma waste containing different concentrations of mefenamic acid, and the efficiency of the metal-organic framework will be assessed after treatment. Secondly, based on the results obtained a specific concentration of mefenamic acid will be selected as the optimum concentration for maximum Mefenamic Acid removal.

Keywords: Basolite; HPLC; metal-organic framework; mefenamic acid; pharmaceutical wastewater.

Abstract ID: WWT-PP50

Removal of Chromium (VI) from wastewater with using Aquatic Plant

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Abstract
The presence of textile dyes and metals in the aquatic environment is a serious problem because of the various negative consequences on the quality of ecosystems polluting the water bodies and aquatic life. There are various physico-chemical methods for removal of toxins from water bodies, but amongst them the adsorption could be considered as an alternative for removing toxic dyes as well as metals from aqueous media, due to better efficiency, high selectivity, low cost, ease of operation, simplicity, and availability in a wide range of experimental conditions. This research work investigates on the synergistic effect of aquatic plants in removing toxic metals from waste water. A set up of experiments were performed with different concentration of metal solutions using different aquatic plants determining the effects of initial dye concentration keeping pH, water level, etc as constant parameters. The maximum removal efficiency were observed using algae 71.89 % in a week of time.

Keywords: Methylene blue; Wastewater; Neem leaf

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Abstract ID: WWT-PP51

Wastewater Management

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Abstract
The objective of waste water management is to clean, prevent misuse and protect water. It is mainly done so that water can be clean enough for washing and drinking, and used for commercial purposes by the industry. If the water is clean enough, then it would not harm the aquatic organisms when released into lakes, ponds, rivers, seas and oceans.

Wastewater is classified into two main categories:

i) Point source wastewater- It includes wastewater entering natural water bodies like lakes, rivers, seas, oceans, etc. from definite locations, such as from sanitary sewers and storm drains. This type of wastewater is easier to manage as its source and the pollutants present in it are already known.

ii) Non-point source wastewater- It is the wastewater which is not connected to a definite source. It includes run-off water draining from agriculture in rural areas and some urban centres, and acidic water released from mines. It is both difficult to identify and treat.

Sewage Treatment

The largest source of wastewater is the one which comes from homes and industries. These flow into sanitary sewers, which send them into sewage treatment plants. They contain human wastes, scalps of food, soaps and detergents, pathogens, which are disease-causing micro-organisms. Industrial wastewater contains poisonous or toxic pollutants like pesticides, polychlorinated biphenyls(PCBs), heavy metals like lead, mercury and nickel. These are very harmful for the plants and animals as they depend on soil for their food and living. The main objective of sewage treatment is to remove all these harmful substances from water so that it becomes safe to be released into natural water bodies.

Sewage Treatment involves three stages:

i) Primary Treatment- It separates solids and liquids physically. The wastewater is made to pass through a grating that separates larger particles the remaining water is left to stand in a tank, where smaller sediments like particles of sand, clay and other materials, get settled at the bottom. These sediments are called sludge. Still, the liquid part of the wastewater contains many pollutants which are unsafe to be exposed to humans or the environment.

ii) Secondary Treatment- The liquid part of the wastewater passes through a trickling filter or an aeration tank in this step. A trickling filter is a set of pipes having small holes in it that dribble water over a bed of stones or corrugated plastic. Bacteria present in the stones or plastic absorb the pollutants from the water and break them down into simpler substances which aren't harmful. An aeration tank is a tank which contains bacteria that break down pollutants. The liquid part from primary treatment is pumped into a tank and mixed with the bacteria. Air is bubbled through the tank to help the bacteria grow, which on accumulation, settle to the bottom of the tank, forming sludge. The sludge is then removed from the bottom of the tank and buried in landfills.

iii) Tertiary Treatment- In this step, the water, which is free from the majority of the pathogens and heavy metals, but still contains high concentrations of nitrate and phosphate, minerals which highly increase the growth of algae and plants in natural water, and can ultimately cause them and also the surrounding aquatic organisms to die, are removed. One method of this step involves the use of biological, chemical and physical processes to remove these excess nutrients. Another method is to pass the water through a wetland or lagoon, which is a shallow water-body cut-off from a larger water-body.

Keywords: Sewage; Pollutants; Bacteria

Abstract ID: WWT-PP52

Synthesis of Iron-based Metal-Organic Framework (MOF) for simultaneous removal of Chlorpyrifos and Chromium (VI) from wastewater

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Abstract

A unique multifunctional Iron-based Metal-organic framework has been developed for multicomponent adsorption systems to establish effective decontamination processes for simultaneous water purification from both inorganic and organic impurities. This work employed the DMF-assisted solvothermal method (reflux temperature at 180℃ on atmospheric pressure) to synthesise Fe-MOF. It is utilised for the adsorptive removal of Chlorpyrifos and Chromium(VI) from wastewater. The Fe-MOF was characterised by X-ray diffraction (XRD), which confirms the tetrahedral crystal structure similar to previously reported JCPDS card no. 00-058-1582. Brunauer–Emmett–Teller (BET) analysis showed that the MOF has micropores ranging from 0.4 to 0.7 nm and a surface area of 50.94 $m^2.g^{-1}$. ATR-Fourier transform infrared spectroscopy (ATR-FTIR) was used to confirm the synthesis of Fe-MOF and the adsorption of contaminants over the adsorbent. Scanning electron microscopy (SEM) and Energy dispersive X-ray spectroscopy (EDX) were used to examine the morphology and elemental composition of the Fe-MOF. The effects of several factors on adsorption were studied, including pH, adsorbent dose, adsorption period, temperature, and the influence of adsorbate starting concentration. Adsorption isotherm and kinetics studies were conducted to understand the nature and extent of adsorption. Langmuir adsorption capacity of the adsorbent for Chromium(VI) and Chlorpyrifos was found to be 250 $mg.g^{-1}$ and 238.06 $mg.g^{-1}$, respectively. Adsorption kinetics followed a pseudo-second-order kinetics model. Thermodynamics analysis, Indicating the adsorption process's random, feasible, spontaneous, and endothermic. The regeneration of Fe-MOF is obtained using 1% HNO_3 and n-Hexane for Cr(VI) and Chlorpyrifos, respectively, and it can be reused up to five successful cycles with minimal leaching of metal ions (Fe^{3+}, Ca^{2+}, Na^{+}, and Mg^{2+}) into the solution. This research offers fresh perspectives on developing three-dimensional MOFs to address the removal of contaminants from industrial wastewater, potentially reducing health hazards to humans and the environment.

Keywords: Fe-MOF; Cr(VI) ion; Chlorpyrifos; Water remediation

Abstract ID: WWT-PP53

Cerium-based metal-organic-frameworks with ligand tuning of the microstructures for fluoride adsorption: Linear and nonlinear kinetic and isotherm adsorption models

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Abstract
We present the synthesis and characterization of novel Ce–based metal–organic–frameworks (Ce-MOFs) containing fumaric acid (Fu) and terephthalic acid (BDC) as linkers. The use of different linkers influenced the size of the MOFs particles, surface area, crystallinity, and microporous structure, which intern effect the adsorption capacity (AC) of the adsorbent. The use of ultrasound as a mediator for adsorption study over conventional method gives rapid adsorption rate, in which 85 % of the fluoride uptake took place just in 10 min and reached maximum AC in 30 min. The kinetics data were best fitted to the pseudo-second-order model (PSO). The presence of co-existing ions such as HCO_3^-, NO_3^-, Cl^-, and SO_4^{2-} have a negligible effect on fluoride removal. The interaction between the F^- ions and the adsorbent surface took place *via* the electrostatic force and the ion exchange process. These findings reveal remarkable adsorption capacity and rapid kinetics as compared to the existing literature and sustained its relatively higher F^- ions removal efficiency up to the five cycles. This research might help in the development of novel microporous Ce-based MOFs since it possesses a highly stable crystalline structure in water, suggesting a promising role in aqueous applications.

Keywords: Fluoride removal; Ce–Fu MOF; Metal−organic framework; Adsorption; Water treatment

Abstract ID: WWT-PP54

Advanced Methods for Wastewater Treatments

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Abstract
Pollution of water resources by various organic chemicals has been identified as a growing crisis all over the world. Growing need to eliminate undesirable microorganisms in different industrial treatments, mainly in the food and agricultural sector and the pharmaceutical industry, a number of increasingly effective systems for disinfection to eliminate microorganisms have been devised. Water is the heart of sustainable development; however, it is a restricted resource. Global warming gave

rise to a terrifying deterioration of freshwater resources and their accessibility, therefore causing a large dare throughout the world. We are analysing different methods to eliminate and/or significantly reduce the number of microorganisms in water. advanced oxidation processes are possibly one of the most effective methods for the treatment of wastewater containing organic products (effluents from chemical and agrochemical industries, the textile industry, paints, dyes, etc.). More conventional techniques cannot be used to treat such compounds because of their high chemical stability and/or low biodegradability. Reactive oxygen species (ROS) produced in AOPs react with target pollutants to initially form several intermediate compounds that finally undergo complete mineralization. Such observations are reported, especially for laboratory-scale experiments performed in pure water. We are analysis different mechanism to reduce pollution in water.

Keywords: Industrial treatments; Pharmaceutical industry; Microorganism; Global warming; Reactive oxygen species; Advanced oxidation processes

Advanced Chemical Engineering (ACE)

Carbon Capture and Sequestration; Computational Fluid Dynamics Polymer Engineering and Technologies; Catalysis and Reaction Engineering; Chemicals and Fertilizers; Novel Separation Processes; Crystallization, Filtration & Drying; Novel Drugs; Instrumentation and Process Control; Upstream and Downstream Petroleum Processes; Membrane Separations;

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Membrane Technology; Process Modeling Simulation and Optimizations; Wastewater Treatment; Industry 4.0; 3D-Printing; Applications of Machine Learning & IoT in Chemical Engineering.

Abstract ID: ACE-OP1

Optimized Modelling of 5-Lumped Fluid Catalytic Cracking Riser Reactor using Polymath

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Abstract
Fluid Catalytic Cracking (FCC) is one of the most versatile of all petroleum-refining processes. It usually converts heavy and low-quality feedstock into lighter and more valuable transportation fuel, contributing significantly to the overall profitability of the refinery. The unit consists of a riser reactor where all the endothermic cracking reactions and coke deposition on the catalyst occur, and the regenerator where the air is used to burn off the accumulated coke.
In the present paper, a mathematical model for the riser reactor of FCC has been developed and an approximation based on 'lumps' has been adopted due to the complexity of the mixture. This paper adopts five lumped kinetic model along with the kinetic constant. The five lumps adopted are gas oil, gasoline, LPG, coke and dry gas. The riser is modelled as a plug flow reactor where gas oil and the catalyst enter the reactor.
The mathematical model predicts yield patterns of various lumps, temperature and pressure along the riser height. It is also used to analyze the effect of different operating parameters like inlet temperature and Catalyst-to-Oil Ratio (COR) on the performance of the FCC unit. It has been observed that with the increase in the riser height, the yield of gasoline is increased while that of gas oil is decreased monotonically. The developed 5-lumped riser reactor FCC model has been simulated in the Polymath software package and validated, which is found to be in good agreement. The model has better yield, optimum yield temperature, reduced riser height and good COR.

Keywords: Catalyst-to-oil ratio; Fluid catalytic cracking; Riser reactor; Kinetic modelling

Abstract ID: ACE-OP2

Physical separation of lithium-bearing spodumene from the pegmatites

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Abstract
The selective properties of lithium make it crucial for varied applications, resulting in an ever-increasing demand. In the present investigation, characterization and beneficiation studies were conducted on the spodumene-bearing lithium pegmatites of India. The collected feed sample analyzed a Li_2O content of about 1.10%. The mineralogical investigations indicated an association of spodumene with quartz, albite, and muscovite. The beneficiation studies were conducted following gravity concentrators (mineral jig, dense media separation (DMS), shaking table, Falcon, and Knelson concentrators) to remove the silicate gangue minerals. The enrichment of Li_2O content was very marginal by using shaking table and advanced gravity concentrators as the concentration criteria was very low. However, better separation of spodumene and associated silicate gangue was achieved in DMS and mineral jig. Further, reverse flotation studies conducted on the feed sample using dodecyl amine as the collector resulted in the enrichment of Li_2O content to 6.2% at a weight recovery of 15%. Based on the laboratory-scale investigations, a process flowsheet has been developed for the recovery of lithium content. The investigation results indicate that the beneficiation of Indian spodumene-bearing pegmatites can yield a product of 6-7% Li_2O content, which could further be used for the extraction of battery-grade material.

Keywords: Lithium; Spodumene; Gravity concentrators; Flotation

Abstract ID: ACE-OP3

Desulfurization of model aviation turbine fuel by a novel cellulose based ionic liquid adsorbent

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Abstract

Petroleum based fuels contain different sulfur compounds which when combusted, result in the formation of sulfur oxides (SO_x), which are potential air pollutants. For aviation turbine fuel (ATF), 3000 ppm is the maximum permissible limit according to BSVI standards; since most of the emissions for ATF occur at high altitude, the maximum allowable quantity of sulfur in ATF is much higher compared to other mineral oil based fuels. However, combustion of high sulfur ATF, do cause some degree of air pollution at lower altitudes. The high concentration of sulfur in ATF also does not allow it to be used in advanced applications, such as onboard fuel cell. In order to reduce the amount of sulfur in fuels, the conventional method is hydrodesulfurization (HSD). However, this method is energy intensive and does not remove refractory sulfur compounds like thiophenes effectively. In this study, a novel cellulose acetate based ionic liquid adsorbent immobilized on cellulose for desulfurization of model ATF has been synthesized and characterized using Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). The desulfurization efficiency was 94.95% at ambient temperature for an adsorbent: feed ratio of 1.9:100 and a time period of 75 minutes.

Keywords: Ionic liquid; adsorbent; aviation turbine fuel; desulfurization

Abstract ID: ACE-OP4

Development of mixed-ligand ruthenium complexes bearing phosphine and imine ligands for utilization as catalyst in Suzuki-type C-C cross-coupling reaction

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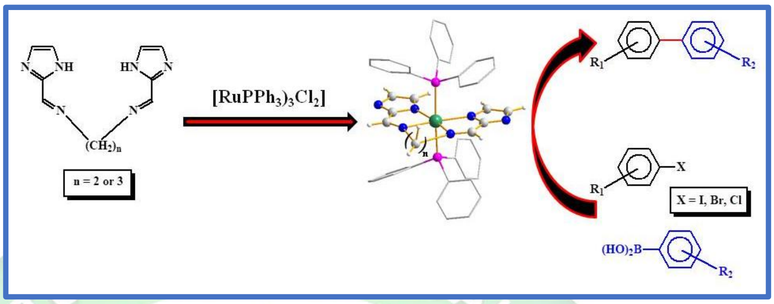
Abstract

Herein we report the development of two mixed-ligand ruthenium(II) complexes bearing phosphine and imine ligands, their thorough characterization, and their utilization as homogeneous catalyst in Suzuki-type C-C cross-coupling reaction. Reactions of two tetradentate Schiff base ligands, derived from imidazole-2-carboxaldehyde and ethylenediamine (**H_2L^1**) or propylenediamine (**H_2L^2**), with [Ru(PPh_3)$_3$$Cl_2$] in refluxing ethanol in the presence of NEt_3 afforded two complexes of type [Ru(L^1)(PPh_3)$_2$] and [Ru(L^2)(PPh_3)$_2$] respectively. Solid state structure of [Ru(L^2)(PPh_3)$_2$] was determined by single crystal X-ray diffraction analysis. Molecular structure of [Ru(L^1)(PPh_3)$_2$] was optimized by DFT method. Electronic spectra of the complexes showed intense absorptions spanning over the visible and ultra-violet regions, the origin of which was probed with TDDFT calculations. Redox properties of the complexes were studied by cyclic voltammetry. These mixed-ligand ruthenium(II) complexes were found to serve as efficient catalyst-precursor for Suzuki-type C-C cross-coupling reactions.



Keywords: Schiff base ligand; Ruthenium complexes; Catalysis; Suzuki cross coupling; TDDFT

Abstract ID: ACE-OP8

Numerical Analysis of Flow and Heat Transfer of MCVD Process for Preform Production for Optical Fibre Manufacturing

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Abstract

The present work is focused on mathematical modelling and numerical simulation of Modified Chemical Vapour Deposition (MCVD) process for preform formation for optical fibre manufacturing. This high temperature process involves complex flow and heat transfer, heterogeneous chemical reaction, moving heat source boundary condition, moving boundary problem, particle projectile tracking in rotating gas field, and deposition kinetics in the reaction chamber. Extensive theoretical investigation of this multi-parameters, multi-phenomena process is required to optimize process parameters for quality improvement and cost reduction of optical fibre manufacturing. The computational method involves solving continuity, momentum, energy, and species continuity equations along with heterogeneous reaction module, particle dynamics in rotational flow field and travelling heat source.

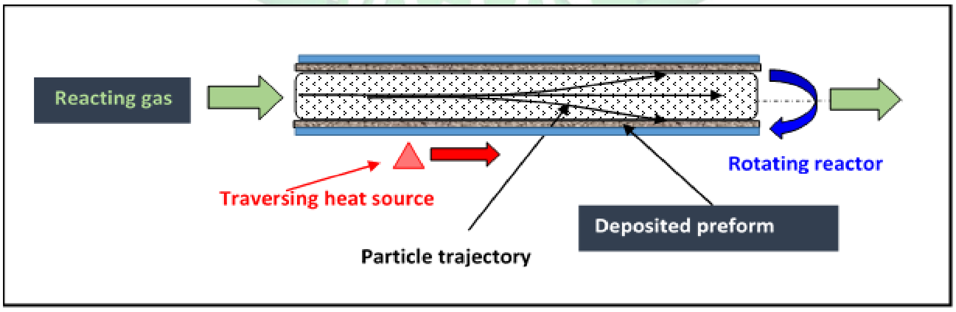

Figure: Schematic of preform formation for optical fibre manufacturing process

Keywords: MCVD; Optical fibre; Numerical modelling

Abstract ID: ACE-OP9

Design of Membrane Reactor Using Multi-Objective Optimization for the Methane Reforming Process

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Abstract
Hydrogen production by the methane reforming process using a membrane reactor can improve methane conversion and hydrogen yield as compared to the cylindrical reactor. This is because the equilibrium can be shifted by removing one of the products through the membrane. In this work, we have done reactor design for the membrane reactor using multi-objective optimization. We have considered two objective functions for this study, i.e. maximization of H2 production and minimization of CO2 emission for the said purpose. Multi-objective optimization problem has been solved using a non-dominated sorting genetic algorithm. The solutions of optimization problem are further analyzed in terms of the trade-off solutions also termed as the pareto solution points.

Keywords: Membrane reactor; Cylindrical reactor; Multi-objective optimization

Abstract ID: ACE-OP11

Oxidative Desulfurizing of Fuels using Alcohol-Based DESs

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Abstract
Nowadays, the environment is polluted due to the emission of harmful gases from transportation fuels, which are also harmful to human health. In transportation fuels, refractory sulfur compounds such as dibenzothiophenes, 4,6-dimethyldibenzothiophene, etc., are present in sufficient concentration. These refractory sulfur compounds are a significant source of gases emitted by combustion engines. Therefore, it becomes necessary to reduce level of sulfur compounds in fuels. In our study, these sulfur compounds were
reduced by oxidation followed by solvent extraction method using synthesizing deep eutectic solvents (DESs) as extraction solvents. The oxidation study was performed using 30% aqueous hydrogen peroxide as an oxidant and 98% formic acid as a catalyst. DESs were synthesized using citric acid (CA), adipic acid (AA) as a hydrogen bond acceptors (HBAs), & triethylene glycol (TEG) as a hydrogen bond donor (HBD) in different mole ratios. The results revealed that desulfurization efficiency was observed at around 45%,
and 44% at a temperature of 30oC in model fuel using CA/TEG(1:7) and AA/TEG(1:8) DESs, respectively. However, on oxidation, this desulfurization efficiency goes on increasing up to 98%, and 97% at 30oC in model fuel using CA/TEG(1:7) and AA/TEG(1:8) DESs, respectively.

Keywords: Oxidative desulfurization; Deep eutectic solvents; Extractive desulfurization

Abstract ID: ACE-OP12

Low to high pressure CO_2 adsorption using amine-functionalized ZIF-8, isotherm modelling and heat of adsorption study

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Abstract
Zeolitic imidazolate framework-8 (ZIF-8) is well known for its high thermal stability, high surface area and remarkable water stability as compared to the other adsorbents. In this study triethylenetetramine impregnated ZIF-8 is used to enhance CO_2 adsorption capacity. The materials are synthesized and characterized using BET, FT-IR, XRD, TGA, FESEM and Elemental analysis techniques. The CO_2 uptakes are measured using iSorpHP2 pressure sorption equipment in the temperature and pressure ranges 25-80°C and 0-30 bar. The effect of amine loading is pronounced in the chemisorption of CO_2.The Sips isotherm is better to correlate the experimental data that that of in Freundlich, Langmuir and Toth models. The isosteric heat of adsorption of ZIF-8 and amine impregnated samples are also calculated from Vont's Hoff plot in the experimental temperature range of 25-60°C. The CO_2 adsorption capacity (3.87 mmol CO_2/g) of 30 % TETA impregnated ZIF-8 is highest among the amine-functionalized ZIF-8 adsorbents reported till date in the open literature. The ZIF-8-30% TETA

shows 4.34 times higher CO_2 adsorption capacity compared to ZIF-8 at 25°C and 1 bar pressure. The adsorbent developed in the present work has a potential to be used in the direct CO_2 capture from air.

Keywords: Metal-organic framework; CO_2 adsorption; Isotherm modelling; Heat of adsorption

Abstract ID: ACE-OP17

Surface functionalization of synthesized sodium alginate from Brown algae for maximizing the yield of refined oil using extraction-flocculation – an environment-friendly approach

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Abstract
Sodium alginate extracted from brown algae was functionalised using polyacrylamide (PAM) as a monomer and ceric ammonium nitrate as an initiator under microwave irradiation to maximize the yield of refined lubricating oil. Present investigation explored the influence of irradiation time and monomer concentration on the grafting efficacy. The synthesised bio-flocculant has been characterised by a diversity of characterisation techniques, such as Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Thermogravimetric Analysis (TGA). Gas-Chromatography (GC-MS), Fourier Transform Infrared Spectroscopy (FTIR) and Nuclear Magnetic Resonance Spectroscopy (NMR) analysis were used to characterize the chemical composition, chemical nature, and functional group of fresh, used and refined lubricating oil. Experimental findings showed that grafting efficacy of 73 % can be achieved with optimal condition of reaction temperature - 70℃, irradiation time - 6 min, monomer concentration - 2.5 wt.%, microwave radiation - 800 w. Maximum yield (94 %) can be obtained with optimal process constraints such as refining time - 60 minutes, refining temperature - 80℃, solvent to used oil ratio - 3:1 g/g and flocculant dosage - 1 g/kg of solvent. Fuel characterisation studies reveal that refined oil has improved physicochemical properties that are very similar to those of fresh oil.

Keywords: Grafting; Microwave irradiation; Extraction-flocculation

Abstract ID: ACE-OP18

AI enabled prediction model for standpipe pressure against invert emulsion synthetic oil based drilling muds

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Abstract
Standpipe Pressure (SPP) is one of the important controllable parameters in underbalanced drilling. The major factors influencing SPP are the drilling parameters such as mud flow, well depth, drill pipe rotation speed, mud weight, and rheological parameters namely Apparent Viscosity (AV), Plastic Viscosity (PV), Yield Point (YP), Flow behavior index (n), and Flow consistency factor (k) of the drilling mud. In underbalancing wells, Invert Emulsion Synthetic based Oil Mud (IESOM) provides outstanding performance, especially in High Pressure High Temperature (HPHT) conditions. Hence, this study aims at developing a generic model for predicting SPP in steady state condition based on drilling and rheological parameters of IESOMs. Firstly, the rheological parameters and SPP are estimated for various IESOM using Bingham plastic model, Power law model and Herschel-Bulkley model. Secondly, Artificial Neural Network (ANN) model is developed to automate SPP prediction by considering drilling and rheological parameters as inputs and SPP as output. Finally, the performance of ANN prediction model is evaluated by evaluating Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Average Absolute Percentage Error (AAPE). The results of this study can help in developing a decision-making system for optimization, drilling mud selection and automatic control of SPP for underbalancing HPHT drilling wells.

Keywords: SPP; IESOM; HPHT; AI; ANN; Under balanced drilling; PV; YP; AV

Abstract ID: ACE-OP19

Improved Photocatalytic Urea Oxidation by Cyclodextrine Loaded Heterocomposites

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Abstract
Due to enormous growth in population, there will be decline in the availability of land for cultivation resulting shortage of food. Consequently, sustainable agriculture becomes particularly essential. To improve cultivation fertilizers are utilized to supplement the required minerals (nitrogen, phosphorous, potassium, etc.) present in the soil. The nitrogenous fertilizers such as urea undergo oxidation to give nitrate ions that are readily assimilated by the plants. Unfortunately, nearly 60-70% of nitrogen is lost as either ammonia or molecular nitrogen. Therefore the improvement of nitrate yield as well as avoid nitrogen loss is very vital to result desirable crop production.
Our recent studies includes designing different cyclodextrin derived hybrid hybrid composites and evaluating their activities towards photocatalytic urea oxidation. The polar exterior of cyclodextrine can act as an anchor to load different nanoparticles (eg. Ag.) and bind with polar guests like urea. Whereas the hydrophobic interior can encapsulte non-polar molecules such as molecular nitrogen. Such distict bind abilty of cyclodextrines results reduction of nitrogen loss as well as improvement of nitrate yield. We believe such observation will attract lot of attention from a large section of chemists and agricultural scientist to design new photocatalyst to afford sustainable agriculture.

Keywords: Hybrid composites; Photocatalytic degradation; Urea oxidation; Nitrate production; Sustainable agriculture

Abstract ID: ACE-OP20

Integration of HAZOP Study and Machine Learning

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Abstract
Process Safety as against general safety plays a prime role in preventing accidents in chemical process industries. As part of the PSMS (Process Safety Management System), PHA-Process Hazard Analysis is one of the key elements. Under this PHA, HAZOP is one such methodology. HAZOP stands for Hazard Operability Study. It is conducted by a cross-functional team with the help of updated diagrams of a process, PFD and P&ID. This work focuses on the HAZOP study for a laboratory experiment and a process plant. Subsequently, Machine Learning (ML) implementation to identify Safe Guard Categories from the recommendations reported in the HAZOP sheet. The main outcome of this study is to give a recommendation in terms of Safe Guard towards a specific hazard identified for the node selected. The safeguards identified in the study may be passed to different departments for detailed design and deployment.

Keywords: HAZOP; ML; Safe guards; PFD; P&ID; PSMS: Process safety

Abstract ID: ACE-OP24

Application of Bio-additive for Flow Assurance of Indian Waxy Crude oil

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Abstract
Wax deposition in pipeline during production, storage and transportation is a very serious issue in upstream petroleum industry. Lots of money and time needs to be invested by the petroleum industries to restart the flow. Present study deals with the application of alkyd resin as bio-additive for flow assurance of waxy crude oil. Epoxidized Jatropha oil was co-polymerized with phthalic anhydride to prepare alkyd resin. Characterization of crude oil was carried out by ASTM standard procedure. FTIR and NMR spectrum analysis were performed to characterize the bio-additive. Rheological behavioral changes of crude oil like pour point, viscosity were checked after treatment waxy crude oil with synthesized bio-additive at

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different concentration. Significant reduction of Pour point and viscosity was observed after addition of 400 ppm PPD. It was observed that pour point and viscosity was decreased to 9℃ and 45% respectively. Morphology of wax crystal for both treated and untreated crude oil were studied through Cross polarized microscope (CPM) and it was observed that maximum wax crystals were dispersed in crude oil after addition of 400 ppm bio-additive. Bio additives are applied because these are biodegradable, eco-friendly, non- toxic and these are cost-effective comparison to commercial flow improver.

Keywords: Crude oil; Bio additive; Flow assurance; PPD; Alkyd resin

Abstract ID: ACE-OP25

CFD based analysis of an inverse fluidized bed of LDPE beads and Non-Newtonian fluid

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Abstract
Inverse fluidization refers to a process where low density solid particles are suspended in a liquid chamber with the help of a downwardly directed pressurized liquid flow. This technique is used in a variety of applications, including chemical reactions, drying, heating, waste water treatment, washing of catalyst, etc. Inverse fluidization can be achieved by carefully controlling the gas/liquid flow rate, the size and density of the particles, and the temperature and pressure of the system. In the present study, a computational fluid dynamics (CFD) based analysis of an inverse fluidized bed was shown. For analysis, two cases were considered where the fluid was taken as water and a non-Newtonian solution (sodium salt of carboxymethyl cellulose (SCMC)). Solid phase was considered as low-density polyethylene (LDPE) beads of different dimensions. A detail hydrodynamics of fluid inside the fluidization column were studied. Pressure and velocity distribution of the fluidization column was determined at different conditions. Such type of analysis helps in optimizing the design and performance of inverse fluidized bed reactor.

Keywords: Inverse fluidization; CFD; Non-newtonian fluid; LDPE

Abstract ID: ACE-OP30

Density Functional Theory study on the Molecular Interactions between Choline chloride-Ethylene glycol based Deep Eutectic Solvents and CO_2

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Abstract
With the increasing interest in CO_2 utilization using deep eutectic solvents(DES),a systematic approach to identify nanoscopic behavior on how CO_2 interacts with DES is highly significant to understand an effective DES-based CO_2 utilization.This work focuses on the structural formation choline chloride(CHCl)-ethylene glycol(EG) based DES and their interactions with CO_2.DES1,DES2 and DES3 respectively denotes molar ratios of the ChCl: EG as 1:2,1:3 and 1:4.The molecular interactions have been performed via density functional theory method using B3LYP/6-311G++(d,p) basis set in Gaussian 6.0.16 version.Counterpoise correction method was employed to evaluate basis set superposition errors (BSSE) for their pairwise interactions.The interaction energy of DES1 was the least (-33.27 kcal/mol) comfirming its lowest stability and more interactive nature with other systems.The electrostatic potential derived charges were calculated employing the CHELPG scheme.DES1 and CO_2 had the highest interaction(-10.65 kcal/mol).Bader's Quantum Theory of Atoms-in-Molecules and Reduced Density Gradient analysis were employed to study the type and intensity of interactions.

Keywords: Deep eutectic solvents; Density functional theory; Carbon dioxide; Molecular interaction

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Abstract ID: ACE-OP31

Catalyst Activity Predictor

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Abstract
The decreased conversion of reactants over time that occurs in companies using catalyst beds is one of the primary issues. To turn reactants into products, several companies use a reactor packed with catalyst particles. Over time, catalyst activity declines, negatively affecting conversion. By using machine learning, this issue can be solved. Chemical engineering decision-making processes, such as iterative experimental design, process scheduling, control, and optimization, can be aided by machine learning. To overcome the problem discussed above, iterations must be performed with the help of machine learning. Iteration refers to the process of repeating a given series of steps until a specified condition is reached. The iterations are used to continuously collect samples from outlet stream and calculating its conversion. The conversion at the outlet is calculated using AI and will be regularly monitored. If the conversion falls below the allowable threshold, a signal that the catalyst needs to be replaced is generated. The conversion values can be saved to predict the reduction in activity of catalyst. We can use this prediction in batch processes to decide whether the catalyst is appropriate for the following batch. The conversion values can also be used to determine the purity and taking further refining steps will help us to achieve a highly pure component. It can also be used for determining the purity of input stream as pure substances gives rise to pure products.

Keywords: Machine learning; Iteration; Catalyst; Catalyst activity; Conversion; AI

Abstract ID: ACE-OP32

Economic Process Equipment Analyser

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Abstract
There are over 20,000 chemical manufacturing facilities located throughout the globe. Numerous cross-references are used to identify the 21,500 unique chemical products. Over 4.7 trillion dollars in sales were generated by the chemical industries worldwide. More than 11,000 chemical businesses operate in India. Because of the world's rapid industrialization, many industries are developing products that fall short of the fundamental standards needed to achieve the highest levels of productivity in their fields. This is a bad idea because there is a great demand for raw materials worldwide, and insufficient use of those resources results in the production of products of a different kind of pollution that is manifesting as a major catastrophe. Using this as our foundation, we are developing a process economisation program called "Economic Process Equipment Analyser" with the help of Machine learning and Artificial Intelligence, which by entering a process gives all the possible outcomes of the process. It also provides us with the optimum parameters like Temperature, Pressure Etc. And alerts the user about the after-effects and the major pollutants that will be emitted as a result of the process. The main goals of our project are to develop an all-in-one platform that helps the upcoming Process Engineers and Entrepreneurs to gain knowledge about several processes and their effects. Also, to avoid the insufficient use of the raw materials.

Keywords: Machine learning; Artificial intelligence; Process economisation; Process engineer; Entrepreneur

Abstract ID: ACE-OP33

Use of Artificial Intelligence to Optimize Energy and Profit of a Commercial Chemical Plant in Tune with the Market Fluctuation

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Abstract
Cut-throat competition in chemical process industries forced the companies to explore new innovative ways to reduce production costs and maximize profit. In this study, a commercial Ethylene glycol plant has been chosen and Artificial intelligence-based modeling and optimization are used to increase the profit of the plant. In the ethylene glycol reactor, water, and ethylene oxide (EO) reacts to form higher glycols like Mono Ethylene Glycol (MEG), DEG, and TEG, and unreacted water, which is separated in the multi-effect evaporator system. The production of these higher hydrocarbons greatly depends on the water-to-EO ratio. More water to EO ratio favors the MEG production and suppressed the DEG TEG production but also consumes more steam in the evaporator. The reverse is also true. In this study, an online real-time optimizer is developed which will optimize the water EO ratio based on the relative market price of MEG DEG and TEG. While doing this optimization the online optimizer will also calculate and obey all the operational and safety limitations of EG reactors and multiple-effect evaporators. The main benefit of this AI-based optimizer is to change the plant operating parameters in tune with the international market price of glycols and steam.

Keywords: Ethylene glycol Reactor; Water to EO ratio; Artificial Intelligence (AI)

Abstract ID: ACE-OP34

Optimization and Numerical Modelling of Vacuum Membrane Distillation Process for heavy metal ion removal

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Abstract
This paper presents the application of Vacuum Membrane Distillation (VMD) process utilized for the concentration and recovery of heavy metal ions namely molybdate and nickel. VMD involves separation of non-volatile components from feed water solution using hydrophobic membrane that permits only pure vapor which allows higher concentration of ions along with very less fouling on the membrane surface. An attempt has been made to intensify the process by minimizing the energy consumption which limits this technology for wider commercialization. Multi objective optimization of increasing the water flux and minimizing the energy consumption were studied using Response Surface Methodology (RSM). Integration of heat recovery equipment at multiple location in the process unit were studied thereby it increases the thermal efficiency of the system. The net specific energy consumption decreases by 40 to 45% for producing one liter of pure water. Numerical modelling and simulation of the process is coded in Modelica modelling language in Dymola software to validate the experiment. The overall developed process would be handy for process industries where these heavy metal ions used as catalyst which can be reclaimed as fresh catalyst and can be re-used in the upstream process.

Keywords: Specific energy consumption; Response surface methodology; Process simulation

Abstract ID: ACE-OP35

Assessing the Viability of Geological Formations as Carbon Capture and Storage Sites: A Review of Depleted Oil and Gas Reservoirs, Saline Aquifers, and Coal Seams

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Abstract
This study examines the possibility for carbon capture and storage (CCS) in geological formations such as depleted oil and gas reservoirs, saline aquifers, and coal seams in detail. The primary goal is to evaluate the feasibility and viability of these geological formations as long-term CO2 storage alternatives. Each formation's geological attributes are explored in terms of its capability for carbon storage, considering the qualities of the rock formations and the accompanying hydrogeological systems. Second, the study examines the present state of CCS technology, particularly the geological storage component, and discusses the possible advantages and disadvantages of adopting each geological deposit for CO2 storage.

Keywords: Carbon Capture and Storage (CCS); Geological formations; Depleted oil and gas reserves; Coal seams; Saline aquifers

Abstract ID: ACE-OP36

Experimental Studies on Treatment of Industrial Effluent Using Activated Carbon Synthesized From Green Algae

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Abstract
Worldwide, fossil fuel-powered automobiles emits harmful pollutant gases such as CO_2, CO, NO_2, etc., and many industries discharge harmful effluents into the environment that cause global warming, ozone depletion, and serious health issues to livelihood. In order to address this frightening issues, many works were reported in the literature. Most common practices includes advanced treatment methods like adsorption, absorption, and filtering before they are released into the environment. Adsorption is found to be the most effective method utilizing activated carbon, silica gel, alumina, zeolites as adsorbents. This work intends to identify a cost-effective, easily available and efficient adsorbent. Hence, activated carbon, in this work is prepared from biological species such as green algae which are abundantly available in nature. The algae powder, collected from these green algae are mixed with activators in different proportions. The mixture is placed in a muffle furnace for hydrothermal carbonization followed by centrifugation., to induce its adsorption capability metal oxides are impregnated with Biochar. Then its properties are analysed using UV DRS, SEM, and TEM. Its specific surface area and porosity are also studied. The treatment of industrial effluent is studied by the obtained activated carbon.

Keywords: Green algae; Adsorption; Activated carbon; Biochar; Porosity; Carbonization

Abstract ID: ACE-OP39

A Green Energy Approach on Carbon Sequestration using CO_2 foam: Enhanced Oil Recovery Applications

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Abstract
A critical area of research focuses on the requirement for practical ways to close the high-permeability channel and extract the remaining oil from the tiny pores in the old oil deposits. CO_2 foam flooding is a potentially feasible approach that can improve oil recovery from old oilfields in addition to assisting with carbon sequestration. The majority of the surfactants investigated are difficult to degrade in oil reservoirs, and their discharge can have detrimental effects on the environment. In this study, we have presented an experimental investigation of the foam stability, and rheology of conventional natural surfactant-assisted foam. In this experiment, the effects of subsurface factors such as surfactant concentration (0.5, 1.25, 2 wt %), flow rate (1, 1.5, 2 LPM), brine oil ratio (1:4, 4:1, 3:2), and salt concentration (0.5, 1, 2 wt %) on CO_2 foam were made. The surface tension data shows a reduction in the values ranging from 73.2 to 39.62 mN/m. Foam stability was measured through gravity drainage by using a sparger, through half-life measurement and microbubble size distribution with Gauss distribution function, and the rheological data represents the shear thinning behavior of foam and the viscosity of the microemulsion solution increases as the surfactant concentration increases.

Keywords: Enhanced oil recovery; Foaming; Stability; Half-life time

Abstract ID: ACE-OP40

Methanation of CO_2 over Ni/Al_2O_3 catalyst: An experimental and Microkinetic modelling study

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Abstract
Carbon dioxide significantly contributes to global warming and results in issues like climate change. This greenhouse gas can be converted into CH_4 using renewable H_2 by the Sabatier or methanation reaction.

$$CO_2 + 4H_2 \rightarrow CH_4 + H_2O \qquad (1)$$

The CH_4 formed can be used as an important chemical intermediate. Consequently, the CO_2 methanation reaction is an efficient approach towards carbon capture and net-zero emission. A previous study on CO_2 methanation used a thermodynamically consistent MKM comprising of 42 different chemical reactions involving 14 surface-adsorbed species [1]. To validate their MKM, experimental data from another study was used. The experimental data was limited to studying the effect of reaction temperature on the conversion. The effect of different feed compositions was not considered. Here, we develop a MKM for CO_2 methanation and validate it for different feed compositions and reaction temperatures. To achieve our goals, we synthesize a Ni/Al_2O_3 catalyst. This catalyst is then characterized by using various techniques so that the catalyst properties used in the MKM are available. Finally, the catalyst will be tested for CO_2 methanation under different operating conditions and attempts will be made to validate their MKM model.

Keywords: Microkinetic Modelling; Surface-adsorbed species; Carbon capture

Abstract ID: ACE-OP41

Modeling of Chemical Looping Combustion Process using Different Biomass for the Determination of Carbon Efficiency and Hydrogen using ASPEN PLUS

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Abstract
Nature has an ever-increasing need for clean energy sources to help in reducing the effects of global warming because it reduces carbon emissions and greenhouse gases that contribute to global warming by mitigating the use of fossil fuels. Carbon dioxide accounts for about 80% of anthropogenic greenhouse gas emissions. Chemical looping combustion is an emerging technology for both effective power generation and carbon capture it is an oxy-combustion carbon capture technology that is used to produce hydrogen with less carbon emission. For this (CLC) process we choose three biomass types as feedstock this process utilizes an iron-based ore as an oxygen carrier in order to simulate the experiment as accurate as possible. Flowsheet and Simulations were done by using the ASPEN PLUS software. A complete chemical looping combustion system was simulated using the three biomass types as feed, and the effect of the fuel reactor temperature on gas concentrations and the carbon capture efficiency are examined. It is found that the CO_2 concentration and hydrogen vary across three biomass types. It is concluded that the thermodynamic data for the real operating conditions, ASPEN PLUS could provide a comprehensive evaluation of the chemical looping process.

Keywords: Hydrogen; Carbon capture; Chemical looping combustion; ASPEN PLUS

Abstract ID: ACE-OP42

Simulation and Optimization of Distillation Train for Fractionators in Oil and Gas Plants using ASPEN PLUS

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Abstract
Distillation is a unit operation, which is having lots of importance in the practical world (various industries). There are many different types of distillation, of which, 'Distillation Train' is the more recently invented process. Distillation Train is a sequence of distillation columns, which is used to separate components from a multi-component. 'Distillation Train' is a novel distillation type that can possibly achieve high component purity, more than any other currently existing methods. It also plays a major role in reducing energy consumption and costs, without compromising the purity of the component. In this work, crude oil refining was done using a distillation train. The most optimum distillation sequence for the crude oil in the distillation train was found based on the component purity and other factors affecting the distillation like component purity, energy consumption, number of stages needed, etc. Comparative studies were also carried out between the distillation train process and the fractional distillation process (which is a widely used technique for crude oil refining, in petroleum refineries) to determine the best distillation process for crude oil refining. This problem was simulated in ASPEN PLUS software.

Keywords: Fractional distillation; Distillation train; Petroleum refineries; ASPEN PLUS

Abstract ID: ACE-OP43

Computational Simulation of Cost-Effective Petlyuk Distillation System using ASPEN PLUS

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Abstract
Distillation is the operation that fractionates the quality top and bottom by-products from a feed mixture in a column. Distillation is chargeable for a massive amount of the energy consumption of the world's technique to fractionate the different by-products and is having a negative impact on energy consumption. A possible way to reduce energy consumption is by using the Peltyuk distillation column operation. The Petlyuk distillation system is a Vapour-Liquid method, that significantly saves energy by reducing the energy consumption from loss of more energy basis. The process of Petlyuk distillation is offering a very cost-effective process in petroleum industries. In this distillation function, the recycling process is done to receive more efficiency of fractionate by-products. We introduce ASPEN PLUS software to simulate the whole operation. For this case study, sensitivity analyses are carried out to analyze the effect of different parameters like temperature, pressure, energy requirement etc. This analysis is used to bring good to fractionate product efficiency, and cost-effectiveness and to reduce energy consumption. The effective results are analyzed and the predicted results are found to be in good with the literature experimental data.

Keywords: Distillation column; Petlyuk distillation column; Energy consumption; ASPEN PLUS

Abstract ID: ACE-OP44

Modeling and Simulation of kinetic effect on PFR using ANSYS FLUENT and ASPEN PLUS

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Abstract

In this modern world, Simulation is a very important and popular tool used to select the desired reactor. This work deals with simulation approaches on the Plug Flow Reactor which is one of the commonly used reactors in the process industry today to carry out liquid and gas phase reactions. Simulations have several advantages over experimenting with a real model. Here we use numerical computational techniques for steady-state analysis and dynamic analysis. The flow behavior inside the reactor of fluid can either change from dispersion to ideal or ideal to dispersion state based on the conditions. Computational fluid dynamics (CFD) simulation using ANSYS Fluent and ASPEN PLUS simulations are used to determine the kinetic effects. The effective results are analyzed and it is juxtaposing with both simulation approaches (ASPEN PLUS and ANSYS Fluent) and the predicted results are found to be in good with the literature experimental data.

Keywords: Computational fluid dynamics (CFD); Plug flow reactor (PFR); ANSYS Fluent; ASPEN PLUS; Simulation; Modeling

Abstract ID: ACE-OP46

Artificial Neural Network Modeling of CO2 Vapor-Liquid Equilibrium in Tertiary Amine and Ionic Liquid Blends for Effective Removal Technologies

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Abstract
The dire need to reduce CO_2 emissions has led to extensive research into effective removal technologies. Amine-based solvent absorption is currently the best available choice for CO_2 removal, and solvent development is a highly sought-after research topic. Tertiary amines and ionic liquid blends are the most researched solvents for CO_2 removal. In this study, Multiple data points of vapor-liquid equilibrium (VLE) data were collected from literature. The study aimed to develop an artificial neural network (ANN) model to predict the VLE behavior of CO_2 in different solvents. Pressure, Temperature, Amine concentration, Density was taken as input, and CO_2 loading was taken as output, and two hidden layers with up to 20 neurons in each layer were used. Three different ANN models were compared for their performance: feed-forward (FF), radial basis function neural network (RBFNN), and back-propagation neural network (BPNN). Additionally, seven different training functions were used. Results showed that the trainlm and trainbr training functions performed the best, with 9% and 11.8% average absolute deviation (AAD), respectively. Overall, the study provides valuable insight into the development of ANN models for predicting the behavior of CO_2 in different solvents, assisting future progress of effective CO_2 removal technologies.

Keywords: ANN; VLE; MDEA; Ionic liquids

Abstract ID: ACE-OP47

Modeling and Optimization of Benzol recovery from Coke-Oven Gas using Aspen™

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Abstract
An Integrated Steel plant in Angul, Orissa, has a byproduct unit focused on removing Benzene, Toluene, and Xylene (BTX) from Coke-Oven Gas produced in the process of Coke production. The Coke-Oven (CO) Gas, has a high calorific value and thus, it can be used as a fuel. But CO gas contains many undesired compounds which need to be removed such as - sulphur, ammonia, naphthene, and BTX. These compounds are removed in separate absorption towers where the gas is allowed to come in contact with wash liquor /wash oil. The extraction of BTX from CO Gas is done after the removal of sulphur, ammonia, and naphthene. This process of removing BTX from CO gas is profitable as the removed BTX can be further processed to produce different by-products, such as benzene and nylon. The benzol recovery unit in the plant is old and no infrastructural improvements can be made. A model was developed in Aspen™ to simulate the plant environment and the results were validated with actual plant data. Sensitivity and Optimization studies were carried out on the Aspen™ model such that the overall benzol recovery yield could be improved with the given set of parameters.

Keywords: Aspen™; Coke-Oven Gas; BTX

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Abstract ID: ACE-OP48

A Deep Neural Network (DNN)-CFD Modeling of a Slurry Bubble Column Reactor

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Abstract
The Slurry Bubble Column Reactors (SBCR) have applications in various industries, such as CO_2 methanation, FT synthesis, pharmaceuticals, wastewater treatment, and petroleum refining. However, predicting the hydrodynamic behaviour of SBCRs is challenging, primarily due to the complex interactions among solid, liquid, and gas phases. Computational Fluid Dynamics (CFD) is the most suitable technique for designing and scaling these reactors. However, the high computational requirements and the need for expertise in numerical modeling make it difficult for everyone to utilize this approach. Machine Learning accelerated CFD has vast potential for reducing computational time and can be used for simulating industrial-scale SBCR. In this work, we performed CFD simulations of SBCRs with diameters of 0.15m and 0.2m, respectively, with initial solid concentrations of 0.2 and 0.05. The data generated by these CFD simulations are used to develop a CFD-Deep Neural Network (CFD-DNN) model to predict the vital hydrodynamic parameters of SBCR at different operating and design conditions. The model is validated against the experimental data and the CFD simulations. The CFD-DNN model can predict hydrodynamics parameters on various input parameters, including solid concentration, superficial gas velocity, time, geometrical parameters, etc.

Keywords: DNN; CFD; Slurry bubble column; Machine learning

Abstract ID: ACE-OP49

Comparative study on hydrodynamic simulation through CFD analysis between Multiple Shaft Disk (MSD) and Intermeshed Spinning Basket Membrane (ISBM) module

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Abstract
Application of membrane technology in treatment high fouling feed where the standard cross-flow modules become inoperative was effectively continued after the introduction of a new class of filtration device, namely Dynamic Shear Enhanced Membrane Filtration Pilots (DSEMFPs). As the name suggest, all DSEMFPs operate on the principle of shear-induced solute scoop up upon generating a feed flow rate-independent high shear field that is majorly localized over the membrane surface. Imperatively, Multi-Shaft Disk (MSD) and Intermeshed Spinning Basket Membrane (ISBM) pilots are recognized to be the most advanced designs of DSEMFP group that largely enriched the state-of-the art in terms of maximum specific filtration area and inbuilt cleaning facility, respectively. In spite of several performance characterization studies on MSD and ISBM over the last decade, no modelling and simulation attempts were undertaken to the best of our knowledge. Nevertheless, such studies are necessary for design upgradation and intensification. In this study, we have attempted the baseline hydrodynamic simulations of both MSD and ISBM pilots under varying parametric conditions of transmembrane pressure and rotational speed using the coupled GAMBIT-FLUENT computational fluid dynamics (CFD) package. Outcomes of the study were corroborated with the respective flux profiles.

Keywords: Multiple Shaft Disk; Intermeshed Spinning Basket Membrane; Fouling; k-ε model; CFD.

Abstract ID: ACE-OP50

Aspen based Optimizer for Automatic Selection of Mixed Amine Solventsfor CO_2 Capture

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Abstract

Post-Combustion CO2 capture (PCC) through chemical solvents is the predominant pathwayfor CCUS. Traditionally, Mono-Ethanol Amine (MEA) is the industry reference solvent forlarge scale CO2 capture. However, in spite of the high capture efficiency, MEA requires highenergy for solvent regeneration. Also, with CO2 capture becoming more of a necessity than an option, the scale of CO2 capture increased in recent times with substantial energy requirements. Mixed/ blended amines are beneficial in such cases with reduced energy demand. However, selection of a suitable amine /amine blend from numerous combinationsthrough experiments becomes tedious and time consuming. In the present work, an optimizeris developed based on Aspen Platform which can suggest the type of amine blends and concentrations for maximum CO2 absorption capacity with minimum regeneration energy requirement. A model study with two amine blend system carried out, where among the 25 possible combinations, two combinations i.e. MDEA/PZ (39 wt%) and DGA/DEA (38 wt%)were automatically selected by the Optimizer with more than 95% CO2 absorption capacity and reboiler duty in the range of 2.4-3.1 MJ/Kg CO2, which is ~40% less than that of reference Amine i.e. MEA.
Keywords: Post-combustion; CO2 capture; Chemical solvents; Mixed amines; Optimizer; Regeneration energy

Abstract ID: ACE-OP51

Effect of concentration of phosphoric acid used in SDU dissolution onquality of nuclear grade UNPS

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Abstract
Sodium Di-Uranate (SDU) powder being received from Thummalapalli mill is dissolved in Nitric Acid to form Crude Uranyl Nitrate Solution (CUNS). The produced CUNS is adjusted to the required 'Uranium' and 'Free Acidity' before taking up for solvent extraction with Tri-Butyl Phosphate (TBP). The uranium loaded extract is stripped withDe-mineralized Water to generate nuclear grade Uranyl Nitrate Pure Solution (UNPS).During solvent extraction of SDU CUNS, extensive emulsification was observed leading tophase separation issues. To overcome this issue, dissolution operation has been modified. In the modified dissolution operation, phosphoric acid is added for minimizing the effects of emulsifying agents. This has improved phase separation in solvent extraction. However, addition of phosphoric acid has affected the purity of nuclear grade Uranyl Nitrate Pure Solution (UNPS). This paper aims at studying the effect of concentration of phosphoric acid used in SDU dissolution on quality of nuclear grade UNPS.

Keywords: Sodium Di Uranate (SDU); Uranyl Nitrate Pure solution (UNPS); Crude UranylNitrate Solution (CUNS)

Abstract ID: ACE-OP52

Assessment of crystallization techniques for Na_2SO_4 and NaCl recovery from saline solutions

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Abstract
Saline solutions containing sodium sulphate (Na_2SO_4) and sodium chloride (NaCl) are generated as byproducts or effluents from common salt production units, tannery common effluent treatment plants, textiles industries, mineral processing, etc. Recovery of these inorganic salts (Na_2SO_4 and NaCl) using three different types of crystallization processes, i.e., evaporative crystallization, cooling crystallization, and antisolvent crystallization, is assessed in this study. A representative saline solution generated from a salt refinery unit containing Na_2SO_4 and NaCl is considered for this study. Lab-scale experiments were performed to determine the optimum process conditions for each crystallization process, and their performance was

evaluated by estimating the product yield & purity. Chemical, XRD, and TGA analyses were performed to characterize the product composition, purity, and hydration state. From Na_2SO_4 and NaCl recovery viewpoints, cooling crystallization, and antisolvent crystallization were suitable over evaporative crystallization. The process configuration for cooling crystallization and antisolvent crystallization-based separation was developed, and material balance & energy consumption estimates were performed. Further techno-economic feasibility analysis was performed to establish the crystallization-based recovery of Na_2SO_4 and NaCl from saline solutions/effluents.

Keywords: Evaporative crystallization; Cooling crystallization; Antisolvent crystallization; Sodium Chloride; Sodium sulphate; Saline solution

Abstract ID: ACE-OP53

Heat Energy Minimization and High Purity Ethanol separation through vacuum distillation in UOP3CC Binary Distillation Column

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Abstract
An effective vacuum assisted distillation is attempted for the first time on UOP3CC binary distillation column to separate ethanol from ethanol water mixture. The objective is to operate the binary distillation column at reduced vacuum pressure so as to minimize the heat input requirements to the reboiler thus saving energy. The optimum operating temperature and reflux ratio is identified. The column is operated in batch mode and the vacuum is created with the help of air jet. Ethanol water ratio of 1:1 is fed into the column and the separation of ethanol from water is achieved with a vacuum pressure of -315 mbar. It is found that the minimum reboiler input required is 0.25KW compared to 0.5KW for atmospheric distillation for the same feed conditions. This contributes to reboiler temperature of 78.44°C to 66.25°C. The purity of the top product is estimated through density measurement using weight and volume method. It is observed that the traces of water in the top product achieved through vacuum distillation is 0.0049 g/cc compared to 0.056 g/cc for atmospheric distillation.

Keywords: UOP3CC binary distillation column; vacuum distillation; reboiler; ethanol.

Abstract ID: ACE-OP54

Hybrid CFD-Mixing Cell Network modelling of an industrial slurry phase reactor for vacuum gas oil hydrocracking and hydrotreating

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Abstract
The limitation of conventional oil reserves and stringent environment constraints, the upgradation of heavy oil is required in order to meet the global demand of light end products such as gasoline, kerosine and low-Sulphur diesel. Slurry-phase hydrocracking and hydrotreating are the emerging technologies to process the heavy oil. This study is more oriented towards the Mixing Cell Network (MCN) modeling of vacuum gas oil for the industrial slurry-phase reactor by using lump kinetic. The hydrodynamic parameters like velocity and volume fraction are evaluated by performing Computational Fluid Dynamics (CFD) simulation and further coupled with the reaction kinetics. The operating conditions and model parameters such as kinetic intrinsic rate constants, activation energies and catalyst deactivation rate are taken from the literature. The performnece of MCN model is compared with the plug-flow reactor model to access the accuracy. Both, steady and dynamic concentration profiles and the yields of valuable products such as distillate, naphtha and gas are reported.

Keywords: MCN; Vacuum gas oil; Hydrocracking; Hydrotreating; CFD; Industrial slurry-phase reactor

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Abstract ID: ACE-OP56

Performance Improvement of a PSA Oxygen Concentrator Using a Magnetic Field

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Abstract
Selection and development of an adsorbent for separation of oxygen from air for medical use based on rapid pressure swing adsorption (RPSA) is ongoing research. Oxygen, being a paramagnetic gas, its separation is also influenced by magnetic fields. Here, a small portable PSA oxygen concentrator (DEDAKJ Model no. DE-1A with capacity 1 to 7 LPM) is used to study its performance measuring the behaviors of oxygen concentration with time at different product flow rates. Without any modification of the unit (as supplied by the manufacturer), it was found that oxygen concentration drops drastically from 92% (at 1 LPM flow rate) to 60% (at 7LPM flow rate) which is detrimental for the patient in severe condition. To improve its performance, similar studies were performed with the unit by incorporating magnetic fields (~0.1 Tesla) in the fine molecular sieve column. A significant improvement in performance, in the higher flow rate range, was observed with this modification. It was due to the guided transport of oxygen molecules through the bed by magnetic field-pulling thereby increasing convective diffusion.

A mathematical model to predict the oxygen concentration with time at different flow rates was develop considering all the hydrodynamic effects withing the bed. It was then solved and simulated using ASPEN simulator. Predictions of computer simulation correspond well with the experimental results with more than 90% accuracy.

Keywords: PSA; Molecular sieve; Guided transport

Abstract ID: ACE-OP57

CFD model to estimate drag coefficient for a spherical droplet in liquid-liquid flow

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Abstract
Estimation of drag force / drag coefficient on a solid particle or a gas bubble or a liquid droplet is very important for design and optimization of multiphase chemical process equipment. In case of a solid particle or a gas bubble, estimation of drag coefficient using Computational Fluid Dynamics (CFD) is relatively easy as interfacial boundary conditions (no-slip in case of a solid particle, zero shear stress in case of a gas bubble) are easy to implement in CFD model. For such cases, only continuous phase flow field determines the drag coefficient. However, for a liquid droplet, interfacial boundary conditions of velocity, shear stress and normal stress are more complex to implement in CFD model. Also, flow field inside the droplet and continuous phase flow field both affect the drag coefficient. In the present work, a CFD model is developed to estimate drag coefficient on a spherical liquid droplet kept in a continuous liquid phase flowing past it. Flow of the continuous phase is simulated using Reynolds Averaged Navier-Stokes equations along with equations of standard k-ε model of turbulence. Flow inside the drop is modelled using laminar flow. The two flow fields are coupled at the liquid-liquid interface using appropriate interfacial boundary conditions. The CFD model is validated by comparing the drag coefficients predicted by it with the drag coefficients estimated from analytical result reported for creeping flow regime. For larger Reynolds numbers (> 50), the CFD model is validated by comparing drag coefficients predicted by it with the drag coefficients estimated from the correlation reported by Harper and Moore, 19681(Reynolds number 50-250). The validated CFD model reported in this work can be used for estimating drag coefficient for a spherical liquid droplet kept in a continuous liquid phase flowing past it for a desired value of Reynolds number.

Keywords: CFD model; Drag coefficient; Liquid drop

Abstract ID: ACE-OP59

Capacitive deionization cell design performance analysis and optimization principles for water treatment

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Abstract
Clean water is a necessity and among the emerging technologies, capacitive deionization (CDI) is a promising water treatment technology capable of treating water for producing affordable potable water. This method involves applying an electric field to electrodes, which causes ions in the water that are passing by or passing through the porous electrodes to be absorbed on the electrode's surface and removed from the water. The absorbed ions can be desorbed from the electrode and removed by changing the electrode polarity. The scalability of the CDI cells depends on various parameters such as that of cell design, electrode, and spacer which need to be optimized to increase the efficiency of the system and reduce the operational costs. Thus, the performance of various CDI cell designs were analyzed using multiple parameters such as electrode material, spacer permeability, CDI cell design, fluid flow rate, and inlet and outlet port positions. The analysis of the pressure drop and fluid flow distribution in the system helped in identifying the optimization principles for obtaining the most optimized performance with reduced operational cost. In conclusion, by optimizing the CDI cell architecture by considering the optimization principles, modularization and scaling up of the CDI system is possible.

Keywords: Capacitive Deionization; COMSOL; CDI Cell Architecture; Optimization; Upscaling

Abstract ID: ACE-OP60

Melting of Sodium in storage tanks of a Fast Reactor

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Abstract
Mastering fast reactor technology is important towards ensuring future energy security for India. The core of a fast reactor is designed to be very compact with very large energy densities and requires use of highly efficient coolant medium to transfer heat from reactor core A majority of operating fast reactors use liquid sodium as the coolant medium A typical 500 MWe pool type fast reactor requires several hundreds of tons of sodium for operation of its heat transport systems. Sodium is often transported in solid state and is liquified and pumped into reactor systems. Before filling in heat transport systems, sodium for fast reactors is stored in large sodium storage tanks in solid state within inert atmosphere. This sodium is heated and melted with the help of heaters that consume a large amount of heat for melting the stored sodium. The first part of the present work involves development of a two-dimensional axi-symmetric CFD code that simulates melting and is capable of tracking the melt front. The Enthalpy-Porosity approach is implemented to allow buoyancy driven flow within the liquid regions. This allows accurate estimation of the melt front. The developed code is validated against phase change experiments. Finally melting of sodium in storage tanks of a typical fast reactor is analyzed and an optimal mode and sequence of heating is derived allowing efficient melting of the whole volume within the storage tank.

Keywords: CFD; Melting; Enthalpy-porosity; Axi-symmetric; Phase change

Abstract ID: ACE-OP64

Study on Nd-Pr precipitates and their calcined products

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Abstract

Nd-Pr is predominantly used in production of permanent NdFeB magnets, which, in turn, is used in the production of electric motors in electric vehicles and for direct drive wind turbines, amongst other applications. Praseodymium and neodymium oxides are also used in welder and glass blower goggles to protect the eyes from yellow flare and UV light. Monazite in beach sand is the main source of Rare Earth Materials (REMs) in India. Uranium and Thorium are first recovered from REMs. Pure Nd-Pr is then separated out from other REMs by multistage solvent extraction method as NdPr Chloride. The Nd-Pr from solution is then precipitated and further calcined to produce oxides. In present paper, different precipitation agents like oxalic acid, sodium carbonate and ammonia were used as a precipitating agent. Precipitation characteristics and morphology & crystal structure of all the precipitates were analyzed. Thermal decomposition of the precipitates was investigated thermos-gravimetrically and calcination temperatures were identified. The precipitates were then calcined in a furnace to produce Nd-Pr oxides. Morphology and crystal structure of the oxides were systematically studied.

Keywords: Nd-Pr precipitate; Oxide; Morphology; Crystal structure

Abstract ID: ACE-OP66

Optimization of low cost modified adsorbent for the removal of oxycodone and ciprofloxacin from pharmaceutical waste water using combination of Central composite design and Artificial neural network

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Abstract
The presence of various active pharmaceutical ingredients (APIs) in pharmaceutical waste water is an increasing environmental concern since these APIs can have detrimental effects on aquatic ecosystems and human health. Due to their potential to lead to addiction and antibiotic resistance, respectively, oxycodone and ciprofloxacin, two often discovered APIs in pharmaceutical waste water, are of significant concern. To ensure that the results are consistent with the hypotheses underlying the experiment, optimisation of the critical parameters is essential. The current study used a factorial design, central composite design (CCD) and artificial neural network to optimise the reduction of oxycodone and ciprofloxacin in pharmaceutical waste water. For enhanced adsorption of pharmaceutical waste, the basic adsorbents were chemically treated with additional components. This CCD technique is able to provide similar information as the three-level full factorial design (FFD) but with a fewer number of experiments, making it a more cost-effective design method. Next, using the RSM data and non-controllable variables, an ANN model with a back-propagation technique was built. Through the use of scanning electron microscopy (SEM) examination and Fourier transform infrared (FTIR) spectroscopy, the surface modifications was verified.

Keywords: Pharmaceutical waste water; Central composite design; Response surface methodology

Abstract ID: ACE-OP68

Emerging Techniques of Carbon Capture and Storage (CCS): A Review

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Abstract
The typical process of Carbon Capture and Storage (CCS) mainly involves the capture of carbon dioxide (CO_2) emissions from various industrial processes or from the flue or stack gas which is generated as a result of burning of fossil fuels or from the atmosphere. Therefore, the main processes of Carbon Capture and Storage (CCS) basically categorized as post-combustion carbon capture, pre-combustion carbon capture and oxy-fuel combustion systems. The first method is specially used in various steel and power plants whereas the pre-combustion carbon capture process is mainly employed in different industrial processes. Apart from these techniques, Direct Air Capture and Storage (DAC) method is also used in order to capture CO_2 directly from ambient air. The main characteristics of the CCS process includes capturing CO_2 from the point sources of where it is been produced such as, smokestacks of iron and steel factories and then transporting the captured CO_2 to the storage site for subsequent sequestration. The captured CO_2 is firstly compressed to a liquid form and then it

is being transported via ship or in a pipeline to store beneath the ground where it is geologically sequestrated by injecting it into porous rock formations in geological basins.

Keywords: Carbon Capture and Storage (CCS); Carbon sequestration; Geological basins

Abstract ID: ACE-OP69

Simulation of Two-Dimensional Fluidized Bed using OpenFOAM

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Abstract
The objective of the present work is to investigate the effect of superficial gas velocity on the bubble size and temperature profiles in a two-dimensional gas solid fluidized bed using numerical simulation. To fulfil the objective, a fluidized bed with Geldart B particles is simulated using Eulerian multiphase models implemented in the opensource software OpenFOAM. Simulations were performed for both laminar and the two-equation standard turbulence model, often known as the ϰ-ε turbulence model for the fluid phase. Kinetic theory of granular material based constitutive relations are used for the solid phase. Drag force between the solid and the fluid phase is modeled using Syamlal O'Brien formulation. The Ranz-Marshall model is used for modeling the heat transfer between phases. Pressure drop and the voidage in the bed are determined for a variety of superficial gas velocities. The heat transfer coefficients are also determined for a constant wall flux operation.

Keywords: Fluidized bed; Open FOAM; Eulerian multiphase models

Production of syngas by the tri-reforming of methane over a $La_{1-y}Zr_yNiO_3$ perovskite catalyst

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Abstract
Tri-reforming (TR) is the combination of steam reforming, dry reforming, and the partial oxidation reaction, and this is a promising route for the conversion of CH_4 and CO_2 to syngas in the presence of oxygen and water. TR is favored at atmospheric pressure and 500-800°C. At this temperature, catalyst deactivation due to sintering, coke deposition, and reoxidation of active metals are the major issues. Therefore, the development of a suitable catalyst, process, and optimization of the reaction conditions is essential to control the H_2/CO ratio in the syngas. In this study, a perovskite-based $La_{1-y}Zr_yNiO_3$ catalyst was synthesized and characterized by various techniques, and the tri-reforming activity was assessed in a downflow tubular packed bed reactor. Results demonstrated that at an optimized molar feed (CH_4: CO_2: O_2: H_2O: N_2) ratio (1: 0.5: 0.1: 0.0125: 1), a constant syngas yield (H_2/CO~1.5-2.0) was observed at 800 °C. The $La_{1-y}Zr_yNiO_3$ perovskite catalyst developed was also fairly stable for a longer period. The catalytic activity was mostly due to the highly dispersed small size (8.1 nm) nickel particle and the presence of a strong metal-support interaction. Results established that the perovskite catalyst is a promising option for the tri-reforming of methane.

Keywords: Perovskite; tri-reforming; syngas; H_2/CO ratio.

Abstract ID: ACE-OP71

Hydrogenation of CO_2 to formic acid: An optimization of reaction parameters by response surface methodology

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Abstract

Rapid industrialization and the utilization of fossil fuels increase the CO_2 level in the atmosphere, which is accountable for global warming and other environmental issues. In the last 200 years, the CO_2 concentration is increased by ~33%, which is remarkable. Therefore, CO_2 sequestration and value addition are a global focus these days. Among the various CO_2 conversion processes proposed in the recent literature, the hydrogenation of CO_2 to formic acid production is a promising route if hydrogen is available. Formic acid is a valuable chemical, and the current world demand is ~1.137 million metric tons per annum. Thermodynamically, the hydrogenation of CO_2 to formic acid is more favorable in a basic aqueous medium as compared to the gaseous phase. The fundamental reaction mechanism of this reaction is not well known. Very few studies have reported the performance of a nickel-based catalyst in a batch reactor. In this study, a new nickel-metal catalyst was synthesized by the precipitation method, characterized, and tested for selective hydrogenation to formic acid in a high-pressure batch reactor. The reaction parameter was optimized for the higher yield of formic acid. The initial yield of formic acid was 2352.47 µmol g^{-1} h^{-1}.

Keywords: CO_2; Hydrogenation; Ni catalyst; Precipitation; Formic acid

Abstract ID: ACE-OP72

Study of Viscous Fingering Phenomenon in Paper Membranes/Pads –A Point-of-Care (POC) perspective

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Abstract

Hydrodynamic instability or viscous fingering is the unstable displacement of a more viscous fluid by a less viscous fluid at the fluid-fluid interface in a confined porous media such as paper membranes/pads. In the context of flow through paper-based medical diagnostic kits, viscous fingering can significantly impact the fluid transport and mixing. The unstable 'finger' like behavior coupled with convective fluid flow may severely affect the visualization on the paper membranes resulting in loss of sensitivity. Therefore, understanding the fundamental aspects of viscous fingering in paper pads is important. The major objective of the present experimental work is to analyze and quantify the viscous fingering phenomenon in cellulose-based paper membranes which are conventionally used in paper-based diagnostic industry. The experimental set-up consists of a base material made up of acrylic over which a paper membrane of 5 cm × 0.5 cm is placed. The experimental time-lapse flow images is captured using webcam secured just over the platform, operated using HandyAvi. Primarily, dye-water solution of different concentration will be injected through the cellulose paper-pad pre-imbibed with hydrogel. Overall, it is found that the time taken for the pre-imbibition of the hydrogel on the paper membrane is an important parameter affecting the viscous fingering.

Keywords: Viscous fingering; Paper membranes; Fluid flow

Abstract ID: ACE-OP73

Flow Control on Paper Pads using Hydrogel towards Point-of-Care Diagnostic (POC) Applications

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Abstract

Fluid flow control in porous media is of considerable importance especially in paper-based diagnostic kits. Controlling of flow is expected to enhance the residence time thereby increasing the extent of reaction/detection on paper surfaces. Recently, hydrogel has been found to exhibit significant influence on the fluid flow in paper membranes. Hydrogels exist naturally in three-dimensional network arrangement and have high absorption capacity. Hydrogel can be strategically layered on the paper membranes resulting in the development of a considerable barrier to the incoming fluid flow. The major objective of the present work is to study the influence of hydrogel on the fluid flow in a cellulose-based paper membrane for different concentrations of hydrogel as well as various viscosities of the injected fluid. Additionally, reusability studies will also be performed for different operation cycles. The experimental set-up consists of a webcam placed just above an acrylic sheet over which a cellulose paper-membrane of dimensions 5 cm × 0.5 cm is attached via pressure sensitive adhesive.

Results are demonstrated in terms of images at different time frames and Lucas-Washburn profiles for the various cases. Overall, it is found that hydrogel beyond a threshold concentration considerably influences the fluid flow on the cellulose-paper membranes.

Keywords: Hydrogel; Paper membranes; Flow behavior

Abstract ID: ACE-OP74

A study on the Development of Sulfamethazine-Acetylsalicylic acid Cocrystal with Improved Aqueous Solubility and Dissolution Rate

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Abstract
In this work, sulfamethazine (SMZ), a potential sulfa drug with low aqueous solubility is cocrystallized with coformer acetylsalicylic acid (ASA) which contains antipyretic and anti-inflammatory properties in a stoichiometry ratio of 1:1. A thermodynamic analysis of the SMZ-ASA system in acetonitrile was performed at 25℃ and a solid-liquid ternary phase diagram has been constructed. The study revealed that successful preparation of the SMZ-ASA cocrystal using the isothermal slurry cocrystallization method could be achieved through the appropriate selection of coformer ratios. The aqueous solubility of the SMZ-ASA cocrystals has been compared with the solubility of the individual components at different temperatures. It was found that the cocrystallization of SMZ with ASA can potentially increase the aqueous solubility of SMZ by 2.46 times at 37℃. The SMZ-ASA cocrystal exhibited a faster dissolution rate than the pure SMZ, and the SMZ concentration reached 1.44 mM at 4 hours, about 1.5 times higher than that of pure SMZ 37℃.

Keywords: Sulfamethazine; Acetylsalicylic acid; Cocrystal; Ternary phase diagram; Dissolution rate

Abstract ID: ACE-OP75

Optimization of Ethylene Oxide Production from Ethylene and Air: A Process Flowsheet Design Approach with Aspen Plus® and Sensitivity Analysis

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Abstract
The present work gives a comprehensive study on the simulation and optimization of the production of Ethylene Oxide (EO) from Ethylene and Air using Aspen Plus. The study employed Aspen Plus®, a widely used chemical process simulation software, and incorporated sensitivity analysis to enhance the process design. The design procedure followed a systematic approach consisting of three fundamental steps: Feed preparation, reaction in a Plug Flow Reactor (PFR), and separation using a distillation column. By employing sensitivity analysis over the process flow parameters such as temperature, pressure, and reactant concentrations, several iterations in determining feed flow rates, selection of reactor & separation technologies were performed to fine-tune the operating parameters to achieve impressive yield of 86%. The utilization of sensitivity analysis facilitated a systematic evaluation of the process variables, enabling the identification of critical factors affecting the EO production and yield. The developed process flowsheet exhibits a robust design approach, ensuring both high EO yield and a consistent production rate. This research contributes to the advancement of chemical technology and provides valuable insights for the industrial-scale production of Ethylene Oxide. Detailed analysis

Keywords: Ethylene Oxide, process flowsheet, optimization, Aspen Plus, sensitivity analysis.

Abstract ID: ACE-OP76

Use of Deep Eutectic Solvent for the Extraction of Mandelic Acid

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Abstract
To overcome the problems caused by the organic solvents, a much greener solvent, i.e., deep eutectic solvent (DES) was introduced in the chemical industries. For the extraction of mandelic acid, a DES was prepared using choline chloride and ethylene glycol at different molar ratios. The density and refractive index of DES were determined at 300 K. The extraction was performed using a probe type sonicator. The experiments were designed using CCD of RSM, and three process variables (acid concentration, DES: aqueous phase volume ratio and ultrasonication time) were chosen to perform the experiments. From the experiments, it was found that extraction efficiency decreased with the increase in the acid concentration and with the increase in the ultrasonication time, there was a considerable amount of acid was extracted. Further, a small volume of DES can extract a large quantity of the acid. At optimized conditions, the highest extraction efficiency was predicted to be 86.78%. Again, the used DES was regenerated by using 1 N NaOH solution.

Keywords: Mandelic acid; Deep eutectic solvent; Ultrasonication; Extraction

Abstract ID: ACE-OP77

Need & Tools for Plant Digitization In Chemical Process Plants

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Abstract
Chemical Process plants keep on getting updated, processes are evolved, augmentations are carried out. P&IDs are an integral part of a process plant. P&IDs need to be kept updated always. manual updation of CAD based P&IDs is time-consuming & error prone. Therefore, digitization of plant assets is necessary for chemical industry. It is important to have a real time data of the actual plant in the form of an intelligent 3D model. 3D laser scanning & conversion into an intelligent 3D model can be a best suited tool for this purpose. Intelligent 3D models can be linked with the P&IDs. This provides real time data of plant assets, can be linked with ERP system.
This paper discusses advantages of using Visio based non-CAD Intelligent P&ID software for process P&IDs. As the software platform is non –CAD, this can be used by process engineers very easily. Built in libraries & symbols, easy drag & drop options make P&IDs creation easy.
This paper also discusses use of 3D laser scan, create a point cloud data & using these scans for conversion into intelligent 3D Models for process plant digitization. Digitization tools are performing well & helping to better manage chemical process plant.

Keywords: Digitization; Process plants optimization; Intelligent P&ID; Non-CAD; 3D models; 3D laser scan; Scan to model

Abstract ID: ACE-OP79

Continuous Anti-Solvent Crystallization in a Coil Flow Inverter Device

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Abstract
Continuous crystallization is a rapidly growing research area especially in fine chemicals and pharmaceutical industry because of increasing interest in continuous pharmaceutical manufacturing which is more efficient compared to conventional batch processing. Producing crystals consistently with desired attributes such as purity, size, and polymorphic form is of great importance for both product effectiveness and efficient downstream processing. Compared to batch crystallization, continuous crystallization offers possibilities for more consistent crystal product quality, shorter process times, improved control, and higher throughput. Recently, a variety of continuous crystallizers have been designed with improved mixing and mass transfer characteristics to meet product quality requirements. This study investigates the continuous anti-solvent

crystallization of pyrazinamide ($C_5H_5N_3O$), an important anti-tuberculosis drug, in a Coiled Flow Inverter (CFI) device using acetone as solvent and cyclohexane as anti-solvent. The effect of CFI geometry, ultrasonic amplitudes (10% to 50%) and initial supersaturation on yield and crystal size distribution are studied. Narrow crystal size distribution with small mean size is obtained with increasing ultrasonic amplitude and the number of bends in CFI. Crystallization using CFI with longer tube increased both crystal size and yield. The obtained crystals are always plate-like metastable δ-polymorph of pyrazinamide as confirmed by PXRD and FESEM analysis.

Keywords: Continuous crystallization; Coil flow inverter; Anti-solvent crystallization; Pyrazinamide; Ultrasonic amplitude

Abstract ID: ACE-OP80

Optimization of Batch Cooling Preferential Crystallization under Model Parameter Uncertainty

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Abstract

Model-based optimization of chemical processes under uncertainty is an active research area. Quantification and propagation of uncertainties is essential to reduce their impact on any decision-making process. Preferential crystallization is a powerful chiral resolution technique used in the separation of L/D enantiomers for therapeutic and metabolic uses. The objective of the present work is to determine the optimal cooling profile that maximizes the final volume of the desired enantiomer during batch cooling preferential crystallization of L/D-Threonine while meeting the terminal product purity constraint under various instances of uncertainties. First, the deterministic optimization is carried out considering nominal model parameter values reported in literature. Then, a global sensitivity analysis is conducted by introducing ±5% uncertainty over the nominal values of the nucleation and growth kinetic parameters, assuming that they follow normal distribution. Subsequently, the model-based stochastic optimization of the crystallization process are performed under the most influential parametric uncertainties. The results clearly exhibit superior performance of the optimal cooling profiles obtained by stochastic optimization in reducing purity constraint violation and increasing final product volume compared to deterministic approach.

Keywords: Preferential crystallization; Stochastic optimization; Sensitivity analysis

Abstract ID: ACE-OP81

Dimensional analysis of the hydrodynamic properties in a Trickle Bed

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Abstract

Gas-liquid trickle bed systems are packed beds of catalytic or non-catalytic particles in which the liquid phase always flows downward through the bed, whereas the gas phase can flow either upward or downward. Pressure drop and dynamic liquid saturation are the important hydrodynamic parameter that affects the performance of a trickle bed system. The variables that affect the Pressure drop and dynamic liquid saturation are gas and liquid flow rates, surface tension and viscosity of the liquid phase, and bed configuration. By using non-linear regression analysis and least square estimation using Gauss-Newton method are developed for the pressure drop and dynamic liquid saturation from the experimental data. The experimental data are non-Newtonian and foaming liquids.
The following equations were obtained for hollow cylindrical particles:

$$\varepsilon_l = (0.124)(\mathrm{Re}_l^{0.325})(\mathrm{Re}_g^{-0.063})(\frac{\sigma_l}{\sigma_w})^{0.490}(\frac{\mu_l}{\mu_w})^{0.062} \qquad (1)$$

$$\Delta P = (0.056)(\mathrm{Re}_l^{1.446})(\mathrm{Re}_g^{1.230})(\frac{\sigma_l}{\sigma_w})^{-0.637}(\frac{\mu_l}{\mu_w})^{0.304} \qquad (2)$$

The following equations were obtained for spherical particles:

$$\varepsilon_l = (0.195)(\mathrm{Re}_l^{0.364})(\mathrm{Re}_g^{-0.112})\left(\frac{\sigma_l}{\sigma_w}\right)^{0.519}\left(\frac{\mu_l}{\mu_w}\right)^{-0.04} \quad (3)$$

$$\Delta P = (2.391)(\mathrm{Re}_l^{1.63})(\mathrm{Re}_g^{0.529})\left(\frac{\sigma_l}{\sigma_w}\right)^{-1.916}\left(\frac{\mu_l}{\mu_w}\right)^{0.34} \quad (4)$$

Keywords: Trickle bed; Dimensional analysis; Pressure drop; Dynamic liquid saturation

Abstract ID: ACE-OP83

Economic Model Predictive Control in a CSTR with multiple reactions

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Abstract
The standard Model Predictive Control (MPC) minimizes a cost function which tracks an optimal steady state point as a reference in a given system. This steady state point is determined prior to implementation of the MPC by performing plant wide optimization to determine the suitable operating point which corresponds to minimal economic cost. On the other hand, economic MPC directly solves an economic cost function at every iteration which replaces the conventional reference tracking cost function. In this work, we explore the benefits of economic MPC with regards to improving economic performance of a chemical process. We have used a CSTR with multiple reactions for implementation of both economic MPC and standard reference tracking MPC. We then present and compare the performance results of both controllers.

Keywords: Economic MPC; Reference point tracking; Economic cost function

Abstract ID: ACE-OP84

CFD Analysis of Heat transfer studies in Gas turbine Rotar Blade

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Abstract
A gas turbine engine is the prime mover in which the potential energy of the air is converted into the kinetic energy; the gas turbine used in power plant, and it is a combustion turbine, is a type of continuous flow internal combustion engine. Since the Cooling of blades of turbine is a major exposition for continuous and safe operation of gas turbines with the high performance. The present work shows that turbine blade cooling through staggered 9, 13 and 14 holes. And there is a comparison between 9 and 13 staggered and inline holes with respect to temperature and heat transfer rate.
For the analysis uses CFD - ANSYS FLUENT (a turbulence realizable k-ɛ models with enhancing treatment of wall) on evaluation the contour plot of the pressure, velocity and velocity vector using Newton's second's Law: The summation of the forces on a fluid particle is equal to the rate of change of momentum:

$$\frac{\partial(\rho u_i u_j)}{\partial x_i} = \frac{\partial}{\partial \mathrm{x_i}}\left(\mu \frac{\partial \mathrm{u_j}}{\partial \mathrm{x_i}}\right) - \frac{\partial \mathrm{p}}{\partial \mathrm{x_j}}$$

First Law of Thermodynamics: The rate of head added to a system plus the rate of work done on a fluid particle equals the total rate of change in energy:

$$\frac{\partial}{\partial x_i}(\rho u_i T) = \frac{\partial}{\partial \mathrm{x_i}}\left(\frac{\mathrm{k}}{\mathrm{C_P}} \frac{\partial \mathrm{u_j}}{\partial \mathrm{x_i}}\right)$$

Blade leading edge temperature wills minimum at 14 staggered holes. The heat transfer is also increases and the average blade temperature will decreases in the 14 staggered hole arrangement.

Keywords: Computational fluid dynamics (CFD); Staggered holes; Heat transfer rate; Turbulent-Intensity model

Abstract ID: ACE-OP85

Regulating Aluminium Speciation within Zeolitic Framework of Beta (β)

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Abstract
Distribution of Al in framework T sites of zeolite β strongly influences its acidic behavior as well as the catalytic functionality. Mild carboxylic acid treatment can potentially reshuffle the Al distribution in these T sites by extracting Al from specific T sites. The mechanism of Al removal strongly depends on the molecular dimensions of the acid, pH of the aqueous solution and treatment conditions. Herein, a zeolite β with low Si/Al was dealuminated with aqueous solutions of different carboxylic acids with varying molecular size. The relative distributions of Al were carefully monitored through MAS NMRs which revealed that Al atoms were less selectively removed when smaller and stronger acid were used. Large acid molecules were unable to intrude into the microchannels of β and could not remove Al. Treatment with moderately sized acid resulted in more selective Al removal. The relative Al distribution in specific T sites and the corresponding Brønsted acidity were used as the descriptors in a liquid phase alkylation reaction of Phenol. Normalized yield of Alkylphenols was maximum when proper balance of Al atoms in various T sites was maintained, while absence of Al in some T sites favored dehydration and ether formation reactions.

Keywords: Zeolite; Beta (β); Aluminium (Al); Dealumination; T sites; Carboxylic acid

Abstract ID: ACE-OP86

Modeling and Temperature Control of Real time CSTH Process

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Abstract
Achieving the temperature control of chemical reactors, distillation towers and in fluid circulating re-boilers is the challenging task in industrial scenario. This work presents the procedure to obtain the data driven model of a real time Continuous Stirred Tank Heater (CSTH) process. The two tanks (Tank 1 and Tank 2) are provided with the heaters and the hot fluid from Tank 1 is given as the feed to Tank 2 i.e. the overflow from Tank 1 is fed to Tank 2. The complexity involved in this process is controlling the temperature of fluid in Tank 2 by maintaining level in both the tanks. Experimental data from step testing is collected to obtain the process model of two tanks present in the CSTH Process. The real time CSTH process is modeled as a MIMO system and De-couplers are configured to eliminate the interaction between two loops. The obtained transfer function model of CSTH process is validated with the real time CSTH process data. To achieve the closed loop control, conventional PID controllers and MPC are simulated to control the temperature of the two tanks using MATLAB Simulink and the results shows that the MPC gives better performance. The performance of proposed controllers is validated on the real time CSTH setup.

Keywords: CSTH; Temperature control; PID controller; MPC

Abstract ID: ACE-OP87

Modeling and Control of Auto-Refrigerated CSTR Polymerization Reactor

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Abstract
Continuous bulk free radical styrene polymerization is the most common and cost- effective method for producing polystyrene, but it is also the most complex and fragile. This work seeks to provide a complete examination of an auto-refrigerated (Continuous Stirred Tank Reactor) CSTR on an industrial scale. To do so, a dynamic mechanistic model of an operating styrene polymerization CSTR is built and various control assessments of the understudied system are performed. The current control scheme of a real running polystyrene plant involves a vacuum system which is coupled to a condenser to give better temperature control. The proportional-integral (PI) control approach is already in use in the auto-refrigerated

polymerization CSTR under investigation due to its good nominal control action and simple. However, models of polymerization reactions used in CSTRs produce extremely nonlinear sets of differential equations (owing to nonlinearity in reaction kinetics and physical characteristics), making control a challenge. As a result, we will consider implementing more powerful control strategies for the process, such as nonlinear model predictive control (NMPC). A comparison of NMPC and traditional PI controllers for the auto-refrigerated polymerization reactor under investigation is presented. When input/output constraints and the heat removal capability of the condenser in auto-refrigerated cooling scheme are taken into account, simulation results indicate the improved performance of the NMPC technique.

Keywords: Auto-refrigerated CSTR; Styrene polymerization; PI controller; NMPC

Abstract ID: ACE-OP88

Insights into synthesis and application of graphene oxide-PAN composite derived from waste mobile battery for adsorptive separation of Rare earth metal: Adsorption characteristics and dynamic separation studies

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Abstract
An increasing number of lithium ion batteries are being used in mobiles, e-vehicles, and other electronic devices. After their service life, they are generally discarded. However, such batteries contain ~10-20% graphite, which is the costlier component, having costing around 5-20 $/kg. In this work, graphite from spent batteries are recycled using organic acid leaching and converted to graphene oxide through modified hummers method. The prepared graphene oxide was used to study the batch-mode adsorptive separation of Neodymium, a rare earth metal extensively used in NdFeB magnets. The maximum adsorption capacity was found to be 240 mg/g, and pseudo-second order kinetics and lagmuir isotherm were best fitted with the adsorption data. To further scale-up, the powder graphene oxide was then immobilized in Polyacrylonitrile matrix with polydopamine as the binding agent and used in dynamic filtration mode for the separation of Neodymium. Thus, the work provides an interesting insights for the use of graphite of spent batteries towards the separation of rare earth metals.

Keywords: Graphite; Lithium ion batteries; Neodymium; Adsorption

Abstract ID: ACE-OP90

Application of Machine Learning in Paper Based Channel

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Abstract
Intelligent microfluidics is an emerging interdisciplinary research field that combines together microfluidics and machine learning. In this work, a paper channel is simulated in the COMSOL environment to track the movement of the liquid in the porous media for a given set of boundary conditions and material properties. The large representative data sets, generated from this COMSOL simulation, is used to develop machine learning (ML) model to investigate the physical phenomena and interaction effects of a paper-based microfluidic device. In the first part of our study, we have estimated the liquid front position at a given time using machine learning model. We have also analyzed the power law behavior of liquid front position with time and validated with Lucas-Washburn equation. In the second part, we have generated the concentration profile for a given set of boundary condition and material properties using deep neural network. This computational study clearly indicates that Machine Learning can lead to the logical evolution from traditional approach involving rigorous manual intervention to Intelligent Microfluidics for analysis of fluid flow in paper- channels.

Keywords: Microfluidics; Paper based channel; Machine learning

Abstract ID: ACE-OP92

Simulation studies on CO_2 Absorption using the blends of MEA and Piperazine

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Abstract
The most common method for carbon capture from power plant flue gas is by chemical absorption and desorption method using amine solvents such as monoethanolamine (MEA) and Piperazine (PZ). Currently, the major issue faced by the industry is the large requirement of heat for the desorption of CO_2 (or regeneration energy). The reduction of heat consumption is possible by blending these two solvents. In the present work, simulations were performed to evaluate the performance of eight different blending compositions of the two solvents. The objective was to have 99% capture efficiencies. Flowsheets based on different solvent blends were simulated and were compared for energy consumption and total cost. It was found that the blend of 30% MEA with 5% Piperazine performed best among all different solvents. The effect of various parameters on the absorption efficiency of the solvent was also studied. Simulations were performed using Aspen.HYSYS and Aspen Plus. Both the simulators gave similar results.

Keywords: CO_2 capture; MEA; Piperazine; Regeneration energy; Aspen Plus; Aspen HYSYS

Abstract ID: ACE-OP93

Numerical Studies on Non-Newtonian Slurry Flow During Casting of Composite Solid Rocket Propellants

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Abstract
Vacuum/gravity casting is the most widely adopted technique for propellant casting in which propellant slurry is poured into a rocket motor casing from the mixer bowl through feed pipelines. The driving force for flow of propellant slurry is gravitational force and vacuum inside casting chamber.
Propellant slurry being rheopectic in nature results in continuous increase of viscosity with casting time which makes it difficult to maintain constant casting rate throughout the process. To maintain the constant casting rate throughout the process, it is pertinent to obtain the relationship between casting rate and viscosity. The aim of this study is to evaluate numerical governing equations for propellant flow through casting channel and establish the relation between casting rate and viscosity. Theoretical predictions are validated with experimental data obtained from actual casting process.

Keywords: Casting rate; Viscosity; Slurry level; Slurry distributor

Abstract ID: ACE-OP94

A Simple, Reliable & Cost-effective Method for Detection of Blood Components

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Abstract
This study presents a non-invasive method for measuring oxygen saturation (SpO2) and heart rate (HR) using a photoplethysmography (PPG) technique; the novelty of the study lies in the implementation. The PPG waveform reflects changes in blood volume during pulsatile flow, and thus estimates SpO2 and HR. Several PPG-based pulse oximeters are available, but cost-effectiveness and reliability do not go together in these devices. This paper describes a simple PPG-based device to detect HR and SpO2 in human blood to achieve this objective. The pulse oximeter developed customizes the MAX30100 sensor to function with the Arduino Uno microcontroller and uses a program to calculate HR and SpO2 from the sensor readings. Among the programs surveyed, Oxullo Intersecans, claimed to be designed for this purpose, was found inaccurate. The open-source program developed by Strogonovs in 2017 (https://morf.lv/implementing-pulse-oximeter-using-max30100) was customized. Validation involved comparing readings from 45 healthy subjects of both genders with those from a commercially available EL560 pulse oximeter (ELKO make). A very good match is obtained with HR data. The match with SpO2 data needs improvement and will be considered in future studies. The set-up cost was less than Rs.

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1050/- (USD 14 at the exchange rate during purchase).

Keywords: Saturated oxygen; Heart rate; Pulse oximeter

Abstract ID: ACE-OP95

Influence of nanofluids on liquid-liquid flow patterns in vertical milli channels

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Abstract
This study examines the impact of nanofluids on liquid-liquid two-phase flows in vertical milli channels. With their potential to enhance heat and mass transfer, nanofluids can reduce equipment size and improve performance, such benefits find relevance in various applications such as exothermic liquid-liquid reactions, instantaneous reactions and solvent extraction etc. Experiments were carried out in a 1m long, 2.38 mm diameter circular glass milli-channel. The test fluids are deionized water, 0.01% (Al2O3) nanofluid, 0.01% (SiO2) nanofluid, toluene, and (sodium dodecyl sulfate) surfactant. Two phases were introduced at opposite points of a T-junction, Flow patterns were observed in the following cases: i) toluene-water, ii) toluene-water with surfactant, iii) toluene-water with (Al2O3) nanofluid, and iv) toluenewater with (SiO2) nanofluid. The flow rates of each of the phases are varied from 1-80 ml/min. The observed flow patterns are classified as plug, droplet, transition, and annular flow. Nanofluids were found to enhance the plug flow regime as compared to deionized water. Water with Al2O3 nanofluid gives a greater enhancement in the plug region than SiO2.The enhanced plug region, rich in the dispersed phase, has the potential to improve mass transfer characteristics. Nanofluids are also observed to increase the contact between the phases within the plug region allowing enhanced mixing and interaction leading to better mass transfer rates between dispersed and continuous phases.

Keywords: Nanofluids; Macro/Milli channels; Flow patterns; Mass transfer

Abstract ID: ACE-OP96

Design and Energy Analysis of Ammonia Production Process using Aspen Plus and Aspen Energy Analyzer

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Abstract
In this work, the design and energy analysis of the ammonia production plant has been investigated. Initially, a process flow diagram for the production of ammonia is designed using the Aspen Plus V10.0 simulating tool. In this study, the simulation of the ammonia process flowsheet and optimization of parameters to achieve a high percentage of pure ammonia are also investigated. In comparison to the traditional energy approach, pinch analysis as an energy integration technique saves more energy and reduces utility costs. Therefore, in the second part of this work, pinch analysis is applied using Aspen Energy Analyzer for the developed process plant, and a base case heat exchanger network (HEN) is developed. Energy analysis using Aspen Energy Analyzer suggested 68 % and 79 % of energy and cost-saving potential of the designed process. Greenhouse gas emissions are reduced by 68%. The base case design is subjected to retrofit analysis to find an alternate HEN that saves the energy of the process by minimizing the operating costs. In the retrofit analysis, two new heat exchangers are added to the base case design which reduced the operating cost with a payback period of 0.1565 yrs. A design alternative for the base case HEN is also proposed with a payback period of 0.1055 yrs.

Keywords: Aspen plus; Energy analysis; Aspen energy analyzer; Retrofit analysis

Abstract ID: ACE-OP97

Energy and Cost Savings in Cyclohexane Production Plant: Use of Heat Integration Method and Simulation Tools

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Abstract

Process system impacts on environmental pollution have both regional and global implications. The heat exchanger network (HEN) design and its performance in a plant is an important aspect of energy conservation. Pinch technology and its recent modifications offer an effective and productive method for HEN design for both new and retrofit projects. In this study, we have considered the cyclohexane production process for the improvement of energy efficiency and cost savings through heat integration. The first objective of this work is to design and optimization of parameters for the cyclohexane production process using Aspen Plus. The second objective is to design HEN for the process plant by performing pinch technology using Aspen Energy Analyzer. The optimum minimum approach temperature of 10 °C is used to determine the energy target and the pinch point temperature. The plant is designed with fewer emissions and produces cyclohexane that is 99.87% pure. Energy analysis using Aspen Energy Analyzer improved energy and cost-saving potential by up to 41 % and 19 % to the designed process. Greenhouse gas emissions are reduced by 23 %. The base case design performance is improved with retrofit analysis. The retrofit analysis for the base case HEN saves the energy of the process by minimizing the operating cost.

Keywords: Heat integration; Aspen plus; Aspen energy analyzer; Retrofit analysis

Abstract ID: ACE-OP98

Estimation of dispersed phase holdup in air pulsed column having circular slotted plate internals: a CFD study

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Abstract

Absence of mechanically moving parts makes air pulsed column maintenance-free. Due to being maintenance-free, air pulsed columns are immensely useful for solvent extraction processes in nuclear fuel cycle (Herbst et al., 2011). Pulsed Sieve Plate Column (PSPC) and Pulsed Disc and Doughnut Column (PDDC) are the two main variants of air pulsed columns which have been extensively studied (Sen et al., 2018). However, for intensification of solvent extraction processes using air pulsed columns, looking beyond the above-mentioned two variants is necessary. In this work, which is an effort in this direction, an Euler-Euler two-fluid 2D axisymmetric CFD model is developed to capture liquid-liquid two-phase hydrodynamics in an air pulsed column (3 inch diameter) equipped with a novel plate internal namely slotted plate. The novel plate internal features concentric rings (3 mm wide) of different diameters as openings/free area available for counter-current two-phase flow through the columns. The model solves conservation equations for mass and momentum for both liquid phases and equations of turbulence model for the mixture of the two-liquid phase. Monodispersed drops have been assumed. The CFD model is used to estimate dispersed phase holdup (volume fraction) in the column. Water and 30% (V/V) tributyl phosphate (TBP) in dodecane are considered as the continuous phase and the dispersed phase, respectively. Unstructured triangular mesh with mesh density of 1.1 X 106 elements/m2 has been used. Standard k-ε turbulence model (mixture) has been used to estimate the turbulence parameters. Drag coefficient is estimated using Ishii-Zuber drag model. The model has been validated with the experimental data on dispersed phase holdup. Dispersed phase holdup is seen to increase with increase in pulsing velocity and dispersed phase velocity. A comparison of dispersed phase holdup for the slotted plate internal vis-à-vis disc-doughnut plate internal and sieve plate internal is also reported.

Keywords: CFD; Euler-Euler; Pulsed column; Slotted plate internal

Abstract ID: ACE-OP99

Application and Comparison of Multi Gene Genetic Programming and Artificial Neural Network to evaluate critical velocity of slurry flow in pipelines.

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Abstract
Accurate prediction of critical velocity of slurry flow through pipelines is required for the operation engineer at industries to maintain the flow at a critical velocity and achieve the lowest pressure drop vis-a-vis the lowest power consumption and operating cost. The closed-form model equations for critical velocity developed can be used to design slurry pipelines and pumps and at the same time optimize energy while transportation. The two most cutting-edge AI modeling techniques currently in use are Multi-Gene Genetic Programming (MGGP) and Artificial Neural Networks (ANN). To determine the critical velocity of a sand water slurry flow, this paper compares the abilities of artificial neural networks and multi-gene genetic programming. By keeping the slurry's velocity higher than or equal to the critical velocity, the model equation can be effectively used in industries to reduce the power consumption of the slurry pump in the transportation of the sand-water slurry. Additionally, MGGP's closed-form model equation for critical velocity can be used to design slurry pumps and pipelines. When compared to published critical velocity correlations from the literature, these two algorithms have significantly higher prediction accuracy, lowering the projection error for sand water slurry from 20.11% to around 5.69% (ANN) & 8.12% (MGGP).

Keywords: Artificial neural network; Genetic programming; Critical velocity; Slurry flow

Abstract ID: ACE-OP100

IOT Based Smart Air Health Monitoring System for Process industries and Domestic Uses

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Abstract
Real-time pollution monitoring devices are becoming mandatory norms for the industries to take immediate action to troubleshoot. Contact and non-contact type sensors are useful to measure the components of industrial as well as domestic emissions. The present development of the model for analyzing air health is based on contact type smart system for outdoor and indoor uses. The device consists of contact type electro-chemical sensors to monitor CO_2, SO_2, Temperature, Particulate matters and NO_x. The device can be useful for other parameters also if required by incorporating specific sensors on demand. The device was tested in a steel making industry as well as in indoor room for its reliability. The optical sensing device based SPM sensor for detecting presence of SPM within the air in said indoor closed environment and microcontroller for sampling sensory data from the sensors and processing the same to calculate Air Quality Index of the air in said indoor closed environment including concentration of flue gases in the air. This model is totally a wireless device which is divided into 3 basic parts – Control Box/unit, Sensor Unit, Display unit.

Keywords: Smart device; Pollution monitoring device; IOT based device; Air health

Abstract ID: ACE-OP101

Multidimensional Population Balance Modeling and Kinetic Monte Carlo Simulation for Batch Sonocrystallization

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Abstract
Mathematical models play very important role in crystallization process understanding, design and optimization. The δ-polymorph of pyrazinamide, a drug for mycobacterium tuberculosis, exhibits plate-like morphology and such crystals are best described by atleast two dimensions: length and width. A multi-dimensional population balance model for batch cooling sonocrystallization of pyrazinamide from its 1,4-dioxane solution is developed and validated. A series of experiments are

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performed with different ultrasound amplitudes to study the effect of ultrasound on nucleation rate, crystal size, and polymorphism. The ultrasound is applied for various length of crystallization process and only nucleation, growth and breakage of crystals are considered as fundamental events of crystallization. A high-resolution finite volume scheme (HRVM) and an event-driven constant volume Monte Carlo (CVMC) algorithm are developed to predict the time-evolution of bivariate crystal size distributions. The CVMC and HRVM models were simulated with optimized kinetic parameters, which predicted all experimental results with great accuracy. It is shown that the both schemes agree very well with experimental data related to both concentration and crystal size distributions. Finally, it is concluded that both schemes are capable of doing quantitative prediction of multivariate sonocrystallization processes.

Keywords: Sonocrystallization; Monte-Carlo simulation; High-resolution finite volume scheme

Abstract ID: ACE-OP106

Targeting and Designing the Natural Gas Sweetening Solvent Network Simultaneously from a Conceptual Perspective

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Abstract
Natural gas is one of the promising energy resources that emit Carbon-di-oxide (CO_2) emissions in less volume as compared to other fossil fuels such as coal and oil. The contribution of Natural Gas (NG) to the world energy basket is significant. Natural gas will act as a bridging energy source between coal and renewable energy. Recent studies reveal that natural gas acts as an intermittent energy source to avoid greenhouse gas emissions. It acts as a substitute for low carbon fuel instead of higher content fossil fuels such as coal, petroleum. Natural gas is able to synergize with renewable technologies to balance intermittent electricity outputs and able to supply uninterrupted energy during peak demand. The rising demand for low-sulfur product natural gas has become important in natural gas purification plants, leading to significant energy costs for sweetening solvent regeneration. This paper will investigate the integration of a sweetening solvent network and develops a systematic targeting and design method for the improvement of overall solvent utilization. Initially, the sweetening solvent sink-source and sweetening solvent network will be defined referring to the characteristics of natural gas sweetening units. Next, a novel problem table method will be developed in order to identify the minimum fresh solvent requirement and design the sweetening solvent network simultaneously. A case study based on real plant processes to come up with quantitative insights for the design of a sweetening solvent network that will save fresh sweetening solvent.

Keywords: Natural Gas; Sweetening process; Solvent network; Low sulfur product

Abstract ID: ACE-OP107

COMPARATIVE SIXER SHOT STUDY BETWEEN ANTEGRADE AND RETROGRADE PERISTALSIS UMPIRING BY ACTION POTENTIAL

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Abstract
Viscera of human body is concerned with mouth to stomach which is physiological support of upper half and intestine to rectum is associated with lower part so upper part comes under vomiting and lower part of GIT is associated with bowel clearance. Action potential is an electrical discharge by PQRST the five phase graphical plot inside the cell by sodium influx and potassium efflux to control over the biological wave function towards vomiting center to cause emesis by mouth in upward direction through GIT and bowel evacuation through rectum by downstream direction. In both cases peristalsis action follows antegrade as well retrograde direction to give comfort of body homeostatic physiological behavior. The vomiting out from the gut and stool clearance from anus gives a relief and satisfaction which is followed by peristalsis action

through wave that is fully under control by action potential. The electrical discharge through ion channel distributed throughout the body is controlled by polarization of Na+/K+ influx/efflux in cellular level. The change in membrane potential from a positive to a negative value is referred to as repolarization. Depolarization is caused by a rapid rise in membrane potential opening of sodium channels in the cellular membrane, resulting in a large influx of sodium ions. Membrane Repolarization results from rapid sodium channel inactivation as well as a large efflux of potassium ions resulting from activated potassium channels.

Keywords: Depolarization; Repolarization; Hyperpolarization; Refractory period; PQRST plot; CTZ

Abstract ID: ACE-OP110

Production of Soluble Natural Sweetener from Date Fruit Extract by Colloid Gas Aphrons

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Abstract
Date palm (*Phoenix dactylifera*) is the main fruit tree in the United Arab Emirates. The presence of large quantities of sugars with substantial amounts of phenolic, minerals, and antioxidants ensures that date fruits would be of great use as a food source. Date fruit extracts generally have not received much attention due to the use of an expensive enzymatic and ultrasonically assisted extraction process. This research work aims to produce soluble natural sweeteners from date fruit extract by colloidal gas aphrons (CGAs). CGAs are surfactant-produced microbubbles that are widely applicable in biotechnology. CGAs generated with food-grade non-ionic Tween 20 surfactant were used to enrich soluble sugars (fructose, glucose, and sucrose) and polyphenolic antioxidant compounds present in date fruits. CGAs were characterized by their half-life and air hold-up capacities. Different process parameters, such as CGAs flow rate, volume of feed, and temperature of both the CGAs and feed solution, were varied to obtain optimum parameters. Maximum soluble sugar enrichment of 91% was achieved in the foam phase at a CGAs flow rate of 50 mL/min and a solution temperature of 23 ^{o}C. Thus, CGAs technology has proved to be a useful technique for the enrichment of food extracts from date fruit.

Keywords: Colloidal gas aprons; Date fruits extract; Floatation; Natural sweetener; Surfactant

Abstract ID: ACE-OP112

Synthesis of catalyst for direct conversion of methane to methanol

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Abstract
Methane is the main component of natural gas and also a greenhouse gas which has 25 times more capacity to absorb heat than CO_2. Therefore, methane needs to be converted into some valuable product such as methanol, formaldehyde etc. Currently methane is converted to methanol via two-step process. 1st step involves steam reforming of methane and 2nd step is Fischer Tropsch process which converts syngas generated in step 1 to methanol at a very high temperature and pressure which makes it very energy intensive and expensive method. In order to bypass energy intensive process, methane can be directly converted to methanol in single step process by partial oxidation of methane. This can be performed in the temperature range of 473-573K and pressure ranging from 1-8 bar using oxidizing agent such as H_2O_2, H_2O, O_2 etc. in the presence of the metal catalyst such as Cu, Ni, Fe oxide on supports such as Alumina, Ceria, SSZ-13, Zeolite, etc. In the current work alumina and ceria supported catalyst is synthesized. The complete characterization of catalyst is performed by using BET, XRD, SEM, and TEM. The activity of catalyst was tested in packed bed reactor at lab scale for different temperature, pressure and flowrate. The high yield of methanol was obtained the effect of catalyst metal loading on the methanol selectivity was studied.

Keywords: Chemical looping; Steam reforming; Impregnation; Packed bed reactor; Selectivity

Abstract ID: ACE-OP113

Kinetic study of methane steam reforming reactions for Ni-Fe bimetallic catalyst

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Abstract
The kinetics of methane steam reforming over a Ni-Fe/Al_2O_3 catalyst in a packed bed reactor has been studied through experiments. In the temperature range of 500-800°C at 1 bar, kinetic rate data for the water gas shift process and methane steam reforming over Ni-Fe/Al_2O_3 are presented. A one-dimensional heterogeneous mathematical model of a catalytic packed bed reactor was created using MATLAB R2023a, and it included the kinetic model of rate equation. In order to validate the mathematical model of the SMR process, simulation results were compared to experimental values. Methane conversion, CO and CO_2 selectivity, hydrogen production, and rate equation derived from power model were predicted and compared with experimental findings. The effects of various operating parameters, including temperature, were also studied.

Keywords: Hydrogen production; Steam reforming of methane; Catalyst synthesis and testing

Abstract ID: ACE-OP114

Effect of non-condensable gas on thermal characteristics of thermosyphon relevant to nuclear fuel storage vault

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Abstract:
Presence of non-condensable gas (NCG) in two-phase heat transfer device adversely affects the thermal performance as well as the durability of the device. Quantification of the adverse effect is necessary for design of such systems. This work presents the experimental work carried out to evaluate the effect of NCG on the startup of thermosyphon designed for passive cooling of nuclear fuel storage facility. As part of the experiments, nitrogen was introduced as NCG along with water into the loop thermosyphon. By varying the nitrogen pressure, the impact of the NCG on start-up behavior of the thermosyphon was studied by monitoring the wall temperature, heat transfer coefficient at condenser and thermal resistance. It was noticed that increase in nitrogen pressure delays evaporation of water, and causes temperature fluctuations in the evaporator. The NCG accumulates in the condenser and does not allow the condensation of the working fluid and hence start-up is delayed. However, with increase in heat load at a particular pressure, reduces the time required for the start-up.

Keywords: Thermosyphon; Non-condensable gas (NCG); Wall temperature; Thermal resistance; Heat transfer efficiency

Abstract ID: ACE-OP116

Harnessing Urban Farming for Carbon Sequestration in the Energy Transition Era

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Abstract
The ongoing energy transition presents an urgent need to mitigate climate change and reduce greenhouse gas emissions. As urban migration continues to accelerate, cities play a crucial role in this endeavor. Urban farming holds promise for carbon sequestration in cities. As urban migration increases, cities' role in mitigating climate change becomes crucial. Utilizing underused spaces like rooftops and balconies, urban farming offers opportunities for carbon capture on approximately 20-25% of urban surfaces. It has already demonstrated carbon sequestration potential through plant biomass and soil organics. Additionally, by incorporating crushed calcium- or magnesium-rich silicate rocks into urban soil, inorganic carbon sequestration can be enhanced. Promising field studies with wollastonite, a silicate mineral, have shown positive effects on soil health and plant productivity. To maximize carbon capture, an integrated approach that combines urban farming with agricultural Enhanced Rock Weathering (ERW) techniques is proposed. Globally, there are around 68.8 million hectares of urban land, including up to 17.2 million hectares of green roofs. By tapping into these underused urban spaces and employing

innovative techniques, urban farming could sequester up to 0.34 gigatons of carbon annually through green roofs. To ensure successful implementation, comprehensive, long-term studies across diverse regions are required for integrating alkaline silicates into urban farming practices. By harnessing the potential of urban farming and carbon-capturing silicate soil amendments, cities can play a significant role in climate change mitigation during the energy transition era. This innovative solution contributes to a more sustainable future amid the pressing issues of climate change and global warming.

Keywords: Urban farming; Carbon sequestration; Climate change mitigation; Sustainable development

Abstract ID: ACE-OP117

Study on interacting nature of fluids in esterification and kinetics modelling

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Abstract
Esterification has been a very well established technique with many kinetic models reported in literature. Despite the availability of vast database, the inclusion of interactive nature of fluids is still debatable. The effect of volume change due to the deviation from ideal behavior is often neglected in kinetic modeling of esterification. The primary focus of this study is to incorporate the system deviation from ideal behaviour into the kinetic model of esterification. Three different systems (Acetic Acid-Ethanol, Oxalic Acid-butyl alcohol, Benzoic Acid-Ethanol) were considered to study the impact of non-ideality with respect to nature of the system. We also have compared the models derived without considering non-ideal nature with models derived by incorporating non-ideality parameter into them. Volume change in reacting fluid has been studied with respect to reaction time to analyze its impact on concentration profile. The effect of this non-interacting nature on rate constants of kinetic model has also been included in this work. The relation between temperature and reaction mixture behavior have also been considered to establish optimum conditions for maintaining ideal nature of fluid during reaction.

Keywords: Esterification; Kinetic modelling; Acetic Acid; Ideal fluid; Rate constant

Abstract ID: ACE-OP118

Combating climate change and ensuring agricultural resilience

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Abstract
Terrestrial enhanced weathering of alkaline silicate minerals is a promising climate change mitigation strategy during the global energy transition. This process creates a substantial carbon sink through the accumulation of pedogenic carbonate and bicarbonate in soils and groundwater. However, little attention has been given to the influence of local climate, soil inorganic carbon (SIC) content, soil pH, and agronomic factors on silicate weathering in croplands. Understanding these factors is crucial for establishing terrestrial enhanced weathering as a globally scalable carbon dioxide removal (CDR) strategy. This study highlights the significance of local climate, SIC content, and soil pH in determining the effectiveness of silicate weathering and its potential to reduce reliance on energy-intensive chemical fertilizers. Estimating the global capacity for enhanced rock weathering (ERW) to accumulate pedogenic bicarbonates by 2100 allows us to identify regions with high CO2 sequestration potential. Asia and Europe show the highest potential, followed by Africa, North America, South America, and Oceania. The incorporation of buffer strips with switchgrass and miscanthus plays a vital role in ensuring agricultural resilience. These buffer strips effectively reduce phosphorus (P) loss to nearby water bodies, thereby preventing eutrophication and mitigating soil erosion. By protecting water quality and maintaining soil health, these buffer strips contribute to the sustainability of agriculture. Chemical engineers, through interdisciplinary collaborations, play a pivotal role in addressing climate change challenges and advancing sustainability. In conclusion, the synergy between climate change mitigation through enhanced weathering and reduced dependency on energy-intensive fertilizers exemplifies a vital link in our pursuit of a sustainable and resilient agricultural system within the energy transition, offering a harmonious pathway towards a greener and more responsible future.

Keywords: Terrestrial enhanced weathering; Alkaline silicate minerals; Climate change mitigation; Soil inorganic carbon; Global capacity

Abstract ID: ACE-OP119

Interactive effect of Mo and W with Vanadia supported on ZrO2 for the ODH of Propane

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Abstract
Oxidative dehydrogenation of propane to propene is a process of industrial and scientific importance. Supported vanadium oxide (vanadia) catalysts are known to be active for this conversion and its activity can be improved by using another relatively inactive metal oxide. However, the cause for this improvement has not been satisfactorily addressed. Here we use a zirconia supported catalysts to examine the cause(s) for improvement of the catalytic activity of the supported vanadia system. To achieve our goals, several supported metal oxide catalysts are synthesized and characterized that contain the oxides of vanadium and molybdenum as monometallic or bimetallic supported oxides. Indeed, preliminary studies reveal that the catalytic activity is increased when vanadium and molybdenum oxide are simultaneously present as supported phase. Simultaneously, DFT simulations are carried out on molybdenum and vanadium oxide clusters to assess the oxygen vacancy and hydrogen removal phenomena and its implication on the catalytic activity. Our preliminary results shows that it is much easier to create an oxygen vacancy on a vanadia cluster as compared to a molybdena cluster. However, simultaneous presence of a moly and a vanadia cluster reduces the oxygen vacancy formation energy on a MoOx cluster, suggesting a more active catalysts. We believe that our DFT simulations would assist in finding the mechanism behind the effect of adding molybdenum to the supported vanadia catalyst. We are also investigating the effect of using tungsten oxide as the other supported phase to generalize our understanding of the promotional effect.

Keywords: On-purpose propene production; ODH; DFT simulations; Sustainability

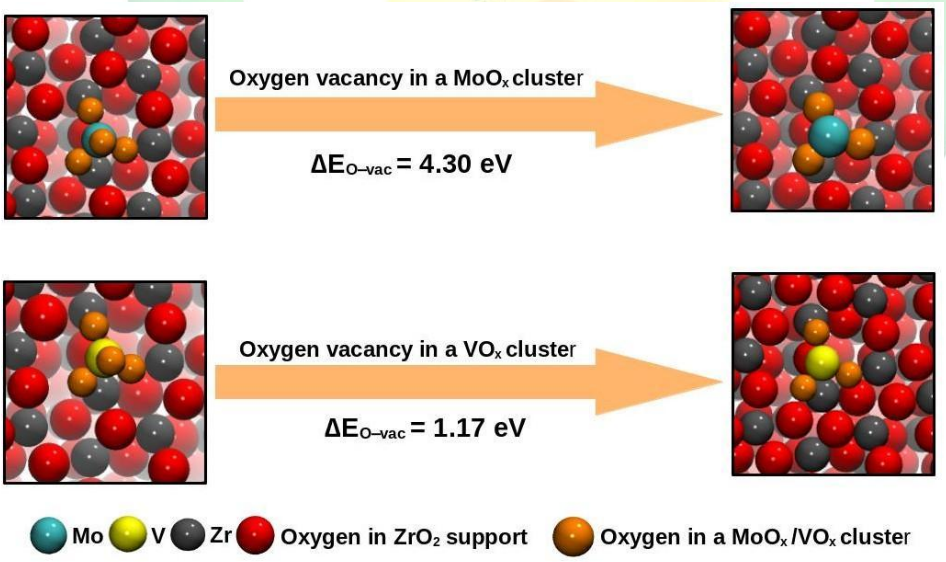

Figure 1. Top views of optimized structure of isolated monomeric clusters of MoOx and VOx supported on on ZrO_2. The figure on the right panel shows the optimized structure of clusters after the creation of an oxygen vacancy.

Abstract ID: ACE-OP121

Temperature control of sulfonation reaction in a semi-batch reactor

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Abstract
Due to the basic dynamic nature of a batch or semi-batch reactor, during operation, the control duty may be altogether a set point tracking problem rather than a regulatory task with a fixed set point as often found in case of continuous systems. In addition to that in a large number of such exothermic reactor control, usually the reaction mass has to be raised to a higher temperature for initiation, and after the reaction sets in large amount of heat has to be extracted, so that the control system has to have the capabilities to heat as well as to cool the reaction mixture (As like as LAB Sulfonation). This may be done by manipulating the ratio of hot and cold streams of heat transfer fluids to make a mixed stream to be used as the heat transfer medium by using two 2-way control valves, and heating and cooling loads are splitted between them. The choice of this reactor type has been made on the basis of an earlier statement that the target system of our study is Sulfonation of Linear Alkyl Benzene (LAB) to synthesize the product, Linear Alkyl Benzene Sulfonic Acid (LABSA) which is the active species for manufacturing a wide variety of domestic as well as industrial detergents. The reaction is essentially carried in semi-batch jacketed reactor.

Keywords: Semi-batch reactor; Sulfonation; Exothermic reaction; Control Strategy

Abstract ID: ACE-OP124

Investigation of Solid Fraction Distribution in Binary Fluidized Bed Using Gamma-ray Densitometry Technique

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Abstract
Binary fluidized bed reactor is widely used rector in the petroleum, mineral, and food processing industries due to better separation, transport and mixing characteristics. The development of a binary fluidized bed is vital to understand the design conditions of the binary fluidized bed. In the present work, the experiment was performed on lab scale gas-solid fluidized bed reactor with an inner diameter of 0.085 m. The Geldart 'B' class of glass bead particles is used as a binary mixture of solids. The particle density of 2500 kg/m3 and two different sizes of fine and coarser particles are used in a range of 100-200 µm and 400-600 µm, respectively. The fine particle composition is varied from 0-8 Wt.%. The compressed air is used as a gas phase. The gas flow rate is controlled using an air rotameter. The superficial gas velocities of 0.3-0.54 m/s were employed to study the variation of the solid distribution using the gamma-ray densitometry technique. The gamma-ray densitometry technique is a non-invasive radiation-based technique. In this technique, a scintillation detector (NaI(Tl)) and gamma source (137Cs) are placed at 180° in the plane. The effect of binary mixture composition and superficial gas velocity are studied on chordal average solid fraction distribution at three axial heights (Z/H = 0.25, 0.5 and 0.75). The solid fraction distribution map illustrates that the solid fraction rises from the centre to the wall region. The Euler-Euler 2D CFD data compared with the experimental data.

Keywords: Gamma-ray densitometry; Binary fluidized bed; Solid fraction distribution

Abstract ID: ACE-OP125

Machine Learning (ML) enabled prediction on activity, selectivity and stability for water gas shift reaction

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Abstract

The catalyst is an essential component in any reaction pathway, and in former times, experimental methods were used to identify viable candidates for a reaction. Our present study is built on the use of machine learning approach to reduce the complexity in catalyst screening step. Our primary concern is to accelerate the screening of suitable catalyst than the conventional Copper based catalyst for Water Gas Shift reaction (WGS). Previous studies were carried out excluding the support complex materials like hydroxyapatite, zeolites and activated charcoal which led into leaving out a large number of catalysts not considered in the ML-aided screening process. In this work, available experimental data on catalysts from literature are represented using Sorted Weighted Elemental Descriptor (SWED) technique, which is modified to represent the properties of complex support materials. After a 10-fold validation and RMSE evaluation, the best model will be used to predict new potential candidates for the chosen reaction. In order to improve the parameters (Activity, Selectivity, and Stability) while taking the temperature limitations into account, other options like catalyst preparation methods, catalyst properties, and reaction conditions will also be explored. Later on the identified potential candidates will be considered for experimental validation.

Keywords: Water gas shift reaction; Machine learning; Support complex material; 10 - fold validation; SWED; RSME

Abstract ID: ACE-OP126

Synthesis and Characterization of High ERBP Borate Ester for Automobile Brake Fluid Applications

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Abstract
Borate esters form the major constituent of automotive brake fluids, affording enhanced antifreeze, lubricity and corrosion-inhibition properties. In 2021, the global brake fluid market was valued at USD 832 billion, rendering it an enormous and evergreen industry. Brake fluids are qualified to be DOT4, DOT5, etc by the US Department of State if the content of borate ester exceeds 63% of the brake fluid. A borate ester of high Equilibrium Reflux Boiling Point (ERBP) is desirable for brake fluids. In this work, triethylene glycol monomethyl ether (TEGMME) and boric acid were reacted together, forming borate ester and water. Toluene was added as dehydrating agent and reaction was stopped when collection of water had ceased. The product mixture was further purified in a rotary evaporator to eliminate residual water, toluene and TEGMME. The borate ester was subjected to characterization studies to confirm formation of the desired ester. ERBP was measured according to ASTM standards and was found to be around 255°C. This confirmed that the ester synthesized qualifies as a component in brake fluid. FTIR confirmed the presence of C-O (ester), B-O and other functional groups. GC-MS results suggest high molecular weight of the product, which accounts for the high ERBP.

Keywords: Borate ester; Brake fluid; Equilibrium reflux boiling point; Esterification

Abstract ID: ACE-OP127

Analysis of mass transport for electroosmotic flow through a porous-walled, rough microtube

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Abstract
The walls of several microfluidic systems of interest (such as microchannels or microtubes) are inherently rough; the reason for the same may be attributed to surface defects, micromachining and fabrication inaccuracies, etc. The earlier studies reported in the literature were limited to the analysis of hydrodynamic and thermal effects only in an impervious microtube. In this context, the current study offers a novel analysis towards exploring the impact of the wall roughness on mass transfer in the case of flow through a microtube with porous wall. In particular, the effects of the corrugation amplitude and the wavenumber have been assessed in detail in this work. It has been revealed that these pertinent parameters have significant effects on the mass transfer coefficient, permeation flux, wall surface concentration, and delivery flux of the solute. It has

been unveiled that it is possible to enhance the delivery of solutes by appropriate tuning of the corrogation amplitude and wavenumber.

Keywords: Rough microtube; Electroosmotic flow; Mass transfer; Porous microtube

Abstract ID: ACE-OP130

Effect of Metal Amount on the Catalytic Performance of Alumina-supported Ni-Co Bimetallic Catalyst for Flue-gas Reforming of Methane

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Abstract
Flue-gas from fossil-fuel based industries primarily contains CO2, H2O, O2, and N2. The flue-gas reforming of methane (FGRM), which involves co-feeding of methane to the existing flue-gas stream, is an effective route to convert flue-gas into syngas (CO + H2). Supported Ni catalysts are active for FGRM; however, bimetallic catalysts containing nickel (Ni) are more active than the monometallic nickel catalysts during methane reforming reactions. Furthermore, the total metal loading significantly affects the physicochemical properties of the catalyst, such as dispersion and reducibility. Consequently, the catalytic performance is affected. In the present study, five Ni3Co-Al2O3 catalysts with a Ni/Co ratio of 3 and varying total metal (Ni+Co) loading (5─25 wt.%) are synthesized, characterized, and tested for the FGRM reaction. Ni-Co alloy was detected in all Ni3Co-Al2O3 catalysts. Furthermore, the dispersion of the Ni-Co alloy initially increases with an increase in metal loading from 5 to 10 wt.% and then monotonically decreases with further increase in metal loading. An optimum dispersion for 10wt.% Ni3Co-Al2O3 is reflected in the variation of CH4 and CO2 conversions and H2 and CO yields, which also shows an optimum conversion and yield for this catalyst. An industrially relevant H2/CO ratio >2 was observed in all Ni3Co-Al2O3 catalysts. Therefore, the metal loading significantly affects the catalytic activity of the supported Ni-Co bimetallic catalyst for the FGRM reaction.

Keywords: Flue gas; Metal amount; Ni-Co alloy; CO2 abatement; Syngas

Abstract ID: ACE-OP131

Purification of Quercetin from Aqueous Onion Extract

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Abstract
Quercetin is a natural flavonoid with various nutraceutical and pharmacological applications. Onion peel is a rich source of quercetin, but its extraction and purification from onion extract is a challenging task. Aqueous extraction is a green method for extracting quercetin from onions. However, its industrial implementation is limited due to extensive method for purification of the extracted quercetin. In this study, a simple one-step liquid-liquid extraction method was developed for the efficient purification of quercetin from aqueous solution by using a solvent mixture of ethyl acetate and hexane. The analysis of extracts was performed by using TLC, UV-visible spectrophotometry, FTIR, HPLC, GC, HRMS, NMR and the quantification was carried out using standard quercetin in calibration curve. Furthermore, the use of a mixture of ethyl acetate and hexane as extraction solvents made the method environmentally friendly and economical. It was observed that the maximum extraction yield of quercetin of 8.8mg/g dry scales of onion was obtained using liquid-liquid extraction as compared to the extraction yield of 2.8mg/g dry scales of onion by column chromatography. Also, the solvent required and the time taken for the purification of quercetin by using liquid-liquid extraction was 10 times less as compared to column chromatography. The one-step purification method developed in this study has the potential for large-scale production of pure quercetin from onion extract for various applications in the food, pharmaceutical, and cosmetic industries.

Keywords: Quercetin; Purification; Liquid-liquid extraction; Aqueous extraction; Extraction yield

Abstract ID: ACE-OP134

Prediction of Physico-Mechanical Properties in Alumino-Silicate based Ceramic Composites using artificial neural network

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Abstract
Ceramic materials are heterogeneous in behaviour with varying polycrystalline and complex microstructural features.The physico-mechanical properties of ceramic composites differ significantly depending on the nature and type of starting materials, the batch composition used as well as the temperature of firing during production. In this study, the ANN method is utilized to investigate the relationship among processing parameters (batch composition, processing temperature) and physico-mechanical properties (flexural strength, bulk density, apparent porosity, etc.) of alumino-silicate-based ceramic products. Herein, the different physico-mechanical properties of sintered ceramic products of 18 batch compositions containing different proportions of kaolinitic clays like fire clay, china clay, grog, industrial wastes like fly ash, granulated blast furnace slag and agri-waste like rice husk ash as starting ingredients being fired at the temperature of 1100°C for 2 hours were measured according to standard methods of testing respectively. Theoretical values of flexural strength for the sintered products were also calculated by nine ANN models selecting two batch compositions in each model and considering nine variables to a single variable opting either from starting materials in the batches and/ or some of the physical properties of products in the input layer, 5-25 neurons in the hidden layer and flexural strength only in the output layer. Out of nine models, model II with six input variables, 15 hidden neurons, and flexural strength as output has been proven to be a robust model as it is observed that the experimental flexural strength results closely resemble theoretical values computed by the said ANN model which exhibits a striking correlation coefficient and least mean square error respectively. Therefore, the mechanical strength of alumina-silicate-based ceramic composites prepared with different batch compositions at a given temperature of firing can be predicted promptly and accurately by the optimal model developed using the ANN method.

Keywords: Alumina-silicate ceramics; Solid wastes; Batch composition; Physical properties; Flexural strength; ANN

Abstract ID: ACE-OP137

Extraction of BTX from naphtha reformate

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Abstract
Catalytic reforming is a process in which low octane number compounds are converted to high octane number reformates. Naphtha reformate is one such product that consists of a complex mixture of paraffins, naphthenes, and aromatics. It contains Benzene, Toluene, and Xylene (BTX), which have high commercial value. BTX is highly sought after in the chemical industry, with global production exceeding 40-50 million tons annually1. Enhancing the separation process for BTX from naphtha can significantly improve production efficiency. In this study, process flowsheet for BTX extraction from naphtha reformate is developed and simulated using Aspen HYSYS to study the process behavior. In the study, extractive distillation is followed by a separation train to get products of high purity. Thermodynamic properties were estimated using UNIFAC thermodynamic package. Furthermore, the various operating parameters were optimized to improve the process efficiency.

Keywords: BTX; VLE; Naphtha reformate; Extractive distillation; Sulfolane

Abstract ID: ACE-OP141

Modelling and simulation of reactive distillation for ethyl acetate production

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Abstract
The simulation of reactive distillation is performed in both the equilibrium as well as rate-based model. Esterification reaction occurs inside the reactive section of the reactive distillation column and it happens between an acetic acid and ethanol. Ethyl acetate and water are the products of the reaction; here ethyl acetate is taken as bases for the comparison between equilibrium and rate-based model. The inlet components are charged into the column at 25°C and 1 bar pressure and standard volumetric flow rates are maintained in the range from 0.02 to 0.09. Acid stream is fed at 8th stage and ethanol is fed at 14th stage to contact with catalyst surface. The variations in temperature, composition, K- value, liquid flow are observed from condenser to reboiler in both the models. The comparison is done to find the better model for the production of ethyl acetate. Sensitivity analysis is performed for both the models to find better conditions for the production of desired product with more purity.

Keywords: Catalytic distillation; Modeling and simulation; Equilibrium model; Sensitivity analysis

Abstract ID: ACE-OP143

Temperature and vapour pressure polarization coefficients in solar driven flash vaporization Membrane distillation during arsenic removal

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Abstract
Temperature polarization coefficient (TPC) and Vapour pressure ppolarization coefficient (VPC) were estimated after being observed fluxes during carrying out experimental investigation on a solar driven flash vaporization membrane distillation (FVMD) set up. The solar-driven FVMD set up used an evacuated glass panel to heat up groundwater containing arsenic of 396 ppb concentration; a thermostatic/cold bath to maintain cold distillate temperature; a direct contact membrane distillation FVMD module containing feed and permeate cells, separated by each of two hydrophobic membranes (Polytetrafluroethylene (PTFE) and polypropylene (PP) membranes). From the experimental FVMD set up, permeate flux increases with feed temperature almost exponentially as expected according to Antoine equation. Permeate arsenic concentration is analyzed in atomic absorption spectroscopy and found to be negligible. A FVMD model has been developed to capture mass and heat transfer phenomena within the system. Simulated TPC values from FVMD model show TPC for the FVMD system decreases with increasing of feed temperature for both PTFE and PP membranes. VPC for PP membrane increase with an increase of feed temperature, whereas the VPC values for PTFE first increases slowly up to 41 ^{o}C and then its value decreases when temperature further increases.

Keywords: Flash vaporization membrane distillation; solar driven membrane distillation; arsenic removal; hydrophobic membranes; polarization.

Abstract ID: ACE-OP146

Numerical Investigation of Steady Natural Convection from a Heated Cylinder Enclosed in Diamond Cavity

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Abstract
Present work describes the outcome of natural steady convection from a heated cylinder within diamond enclosure. Using varying Grashof numbers, the convection processes caused by the temperature difference between the heated surface of the cylinder and the enclosure walls were examined. The governing partial differential equations have been numerically solved for the Grashof number ranges from 10 to 104, while the Prandtl number ranges from 0.7 to 90. The impact of Prandtl and Grashof numbers on the streamline contours visually depict the complex flow patterns and convection currents around the heated inner cylinder, revealing how to buoyancy-driven forces shape the circulation within the square enclosure. Isotherm

contours illustrate temperature distribution within the diamond enclosure, highlighting thermal gradients and the impact of buoyancy-induced flow. The regional Nusselt number distribution is to determine the varying contributions of dimensionless numbers on heat transfer rate. Data are often presented through variation of average Nusselt numbers on the cylinder surface. The local Nusselt number indicates how much convective heat transfer occurs at a particular location on a surface compared to conductive heat transfer. The results of heat transfer have been connected as a function of Grashof and Prandtl numbers thereby enabling its prediction in a new application.

Keywords: Free convection; Diamond Enclosure; Circular cylinder

Abstract ID: ACE-OP147

Formulation of Food Grade Pickering Emulsion Stabilized using Chitosan Particles

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Abstract
Demand for organic, sustainable, and bio-compatible products has recently increased; consequently, research has focused on Pickering emulsions stabilized by food-grade particles. The current work sought to determine how the concentration of chitosan and pH affected the physical stability of emulsions stabilized by chitosan particles. A high-speed homogenizer at 20,000 RPM was used to synthesize the emulsions, and its stability against flocculation, creaming, and coalescence was assessed. It was observed that the stability of the emulsion could be improved by increasing the chitosan content from 0.3 to 0.5 wt%. The effect of the surface charge of particles on emulsification is explored by altering the pH of the medium used for dispersing the particles. At pH 6, the emulsions were likewise quite stable. It was discovered that lowering pH encouraged droplet creaming, with demulsification at low pH. The increased emulsion stability may result from particle aggregation at the oil-water interface and the formation of chitosan networks in the continuous phase. Both factors decreased the amount of contact between the droplets in the emulsion. In conclusion, it was discovered that Pickering emulsions stabilized by chitosan particles responded to environmental cues regarding their physical stability. This characteristic may create stimulus-responsive emulsions for use in food or drugs.

Keywords: Pickering emulsion; Ionic strength; External Stimuli

Abstract ID: ACE-OP148

Bayesian security risk assessment technique for hazardous chemical handling facilities - A case study of fireworks manufacturing industry

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Abstract
Security incidents are happening around the world at an alarming rate due to the highly dynamic political and economic conditions. Some of the security incidents reported have revealed the deliberate misuse of hazardous explosives at various locations. Fireworks are categorized as low grade explosives and intended to be used for display events during festivals/celebrations; and also used for destruction activities. The fireworks manufacturing and storage facilities are attractive targets for determined adversaries as they can use these facilities to inflict maximum damage to people and the environment. Dynamic risk assessment techniques are effective in assessing security risks in a constantly changing atmosphere in chemical facilities. In this article, Bayesian network analysis, one of the promising dynamic risk assessment techniques, is used to assess the probability of a successful security attack and associated the security risk contributing factors. Further, the estimated risk is used for prioritization of the most important risk factors and addressing the same on a timely basis. This work also provides recommendations to improve the safety/security of the firework manufacturing unit and a similar approach can be adapted to the other hazardous chemical handling facilities.

Keywords: Bayesian network; Security risk; Chemical facility; Threats; Vulnerability; Fireworks

Abstract ID: ACE-OP149

Taguchi method to study the interactive effects of various parameters on adsorption of cationic dye on Bentonite

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Abstract
Due to its longevity, toxicity, and detrimental effects, wastewater originating from textile industries is a serious concern. Many studies have been conducted recently on the development of an effective and feasible method to treat wastewater from such industries. Present work highlights the study of the effect of interactive parameters on adsorptive removal of cationic dyes using bentonite clay. Experiments were designed to study the interaction effects of various operating parameters on the adsorption capacity. For the purpose Taguchi's method was applied with three levels of variation including initial dye concentrations (100, 200, and 300 mg/L), temperature (30 ºC, 40 ºC, and 50ºC), and adsorbent dose (0.1, 0.15, and 0.2 g/L). Analysis of variance (ANOVA) suggested that among the three parameters, temperature is the most significant parameter which affects the adsorption capacity followed by the dose of adsorbent. The optimum temperature 30ºC with an adsorbent dose of 0.15 g/L at 300 ppm with adsorption capacity 536.4 mg/g of dye concentration are reported. The study is further extended for adsorptive removal of mixed dye systems.

Keywords: Bentonite clay; Cationic dye; Adsorbent; Adsorption; Taguchi method

Abstract ID: ACE-OP150

Ni and Sr modified ZSM-5 catalyst for the selective dehydration of bioethanol to ethylene

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Abstract
Ethylene is the leading petroleum; global ethylene production stood at 165 million metric tons in 2017 and is expected to increase at a CAGR of over 6 % by 2025. Conventionally, it is produced by steam cracking of naphtha (a non-renewable feedstock), leading to carbon footprints. The production of ethylene from renewable sources would be a sustainable approach and reduce the loads on fossil resources.
In the present work, catalytic dehydration of bioethanol to ethylene was studied over Ni/Sr-ZSM-5 catalyst. The metal functionality alters the acidity and hydrothermal stability, which significantly improves ethylene production and controls side reactions. NH_3-TPD studies revealed a decrease in the strong acidity of H-ZSM-5, thus leading to selective ethylene production. Detailed characterization data of the catalyst reveals that Ni sites are responsible for the enhanced, near quantitative ethylene selectivity at optimum reaction conditions (temperature of 250 °C, 9 h^{-1} WHSV), the Ni/Sr-ZSM-5 catalyst exhibited >96% conversion of ethanol with 95% yield of ethylene, facilitated by discouraging undesired side reactions of ethanol. The synthesized catalyst was active in the presence of water in the feedstock, making it suitable for the dehydration of bio-derived ethanol.

Keywords: Ni/Sr-ZSM-5; Heterogenous catalyst; Catalytic dehydration; Ethanol, Ethylene

Abstract ID: ACE-OP151

CFD Study of Heat Transfer Enhancement in a Rib-Groove Corrugated Channel Using Nano-Fluids.

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Abstract

CFD Simulation is carried out for flow of nanofluid in a rib-groove corrugated channel. The continuity, momentum and energy balance equations have been solved using Finite Volume Method (FVM) based software ANSYS FLUENT (Version 22). The constant wall temperature of 500ºC is used at top and bottom of cylinder. A grid independence study is performed to obtain optimum grid size. The channel height(H) is fixed as 20mm, groove height is 2mm and rib width is 3mm. whereas overall channel length is 35H, which is divided into three sections, namely, inlet section, test and exit section. Cuo-water nanofluid is used in the present study with nano particle diameter in range of 20≤d≤100nm. The Reynolds number range for the study was 200≤Re≤1000. The Nusselt number increases with Reynolds number, nano particle volume fraction and decreases with increases in particle size.

Keywords: Nanofluids; Nanoparticles; Rib-groove channel; FVM

Abstract ID: ACE-OP152

A quantitative analysis using cross-correlation weighted lag for root cause identification in connected control loops

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Abstract
Present-day industrial plants utilize a complex network of connected control loops to enhance product quality and maximize productivity. Over time, plant performance declines due to aggressive controller tuning and static non-linearities, introducing oscillatory/non-oscillatory disturbances that affect overall plant performance. Detecting root causes of faults using routine operating data is highly challenging. Existing methods relying on causal maps often lead to inefficient predictions. Techniques based on prior knowledge are time-consuming and may lack essential information. The spectral envelope method can detect root causes directly from data but is limited to oscillatory faults and not suitable for non-oscillatory faults. In this article, we introduce a data-driven approach using the cross-correlation weighted lag metric (τ-metric) to identify root causes in multivariate processes with connected control loops. The proposed algorithm efficiently detects both oscillatory and non-oscillatory faults and does not rely on prior knowledge. Rigorous testing with synthetic datasets generated in MATLAB Simulink yielded a high accuracy of 88.45%, correctly identifying 86.31% of non-oscillatory faults and 89.96% of oscillatory faults. The metric's ease of calculation, based on variance and cross-correlation, adds to its practicality. Furthermore, the technique performed better and faster than existing methods in literature when tested on various industrial case studies.

Keywords: Cross-correlation; Root cause identification; Interacting control loops

Abstract ID: ACE-OP153

2-(Methylamino)ethanol and 2-Dimethylaminoethanol aqueous amine blend for post-combustion CO_2 capture – Targeting net-zero emission

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Abstract
Population explosion, industrialization, and various human activities adversely impacted the environment by liberating the large amount of carbon dioxide (CO_2) emission in the environment. This study targeted to provide a suitable amine blend solvent that would be a contribution in the journey of net-zero emissions. An aqueous amine blend of 2-(Methylamino)ethanol (MAE) and 2-Dimethylaminoethanol (DMAE) was prepared for capturing CO_2. In this amine blend, MAE and DMAE acted as an activator and promoter, respectively. The CO_2 absorption and desorption investigations were done to judge the amine blend's performance. A bubble column and desorption reactors were used to conduct the entire investigation. A semi-empirical model was established, and a commendable % average absolute relative deviation (%AARD) of 3.74 % was obtained that validated practical results. Equilibrium CO_2 loading (0.936 mol CO_2/mol amine), absorption capacity, cyclic capacity, heat duty and regeneration efficiency, and toxicity assessment were the major parameters that were focused. Heat of CO_2 absorption was calculated through Gibb's-Helmholtz equation and was estimated to be –72 kJ/mol of CO_2. Overall, this amine blend outperformed in every aspect.

Keywords: 2-(Methylamino)ethanol; Amine blend; Toxicity assessment;

Abstract ID: ACE-OP154

Studies on single sided and double-sided photo chemical machining

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Abstract
Photo Chemical Machining (PCM) is a well-established non-conventional machining technique and is widely used to make printed circuit boards (PCB), micro-fluidic channels in polymers and metals, decorative items, precision metal parts, etc. In this technique the photo-resist (PR) coated metal foil is exposed under ultra violet (UV) light through a desired mask which defines the pattern to be made on the metal foil. After the exposure the photo-resist is developed and then the metal is chemically etched using suitable chemical. For single sided PCM, UV exposure is done on one side of the PR coated foil whereas exposure is done on both sides for double sided PCM. Resolution achieved in the PCM process is an important criterion to establish the process capabilities and it ultimately decides the level of complexities which can be drawn in an artwork for mask printing. A systematic study has been carried out to study the resolution achieved in both single sided and double sided PCM process. Experimental investigation has been carried out by drawing parallel lines of thickness varying from 0.1mm to 0.5mm having different gap widths in between them as artwork for mask printing which is used for carrying out these studies. All process steps of a typical PCM process has been followed in the experimental investigation to study the effects of various process parameters on the achieved resolution for single sided photo-lithography as well as for double sided photo-lithography and is reported here.

Keywords: Photo chemical machining; Single sided and double sided PCM process; Resolution achieved in PCM process

Abstract ID: ACE-OP155

Evaluation of Ethanol-Based Acetaldehyde Synthesis: Experimental and Simulation Approach

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Abstract
Acetaldehyde synthesis from ethanol is a major chemical transformation study. Acetaldehyde, a versatile intermediate chemical, is important in medications, polymers, and fuels. Present work examines ethanol-to-acetaldehyde synthesis. Detailing ethanol-to-acetaldehyde conversion catalytic routes and reaction conditions. Metal oxides and supported metal catalysts are tested for reaction efficiency. To find causes and restrictions, reaction kinetics, selectivity, and yield optimisation are examined. The study also examines acetaldehyde yield, selectivity, temperature, pressure, and feed composition. Explore by-products and side reactions to improve process efficiency and reduce negative effects. The results demonstrate the complex interaction between catalyst characteristics, reaction circumstances, and acetaldehyde formation. These findings enable sustainable and efficient ethanol-to-acetaldehyde strategies to manufacture valuable chemical intermediates from renewable resources. This research aids businesses in greener acetaldehyde production. The present study compares DWSIM with UNISIM for acetaldehyde manufacturing simulation. The simulation programme findings were compared and analysed.

Keywords: Natural Pesticides; Extraction; Oleic Acid; Neem Leaves.

Abstract ID: ACE-OP157

Study of Yeast Cell Broth Clarification by using Tangential Flow Filtration System

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Abstract
Tangential flow filtration system is not only a lab scale process also a scalable downstream process technique in the bioprocess industries. The fermented both contain the product of interest either intracellular or extracellular. In the current study the fermented broth of yeast is being subjected to clarification, where the product is of extracellular in nature and the process parameters were concluded in terms of the concentration of cells, viscosity of broth and the membranes filtration parameters in terms of area, flux and time of processing.. The cell concentrations were of 2 to 5 percent and the flux rates varied from 40-50 LMH. The yeast broth is clarified to a clear cell free broth with a good flow rates and the subsequent downstream process steps can be initiated. In conclusion the experimental data can be used to scale-up the fermented yeast cell broth clarification step.

Keywords: Clarification; Tangential flow filtration; Flux

Abstract ID: ACE-OP158

Enrichment the Extraction of 4-HBA with Conventional and Natural Diluent

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Abstract
The Physical extraction of the 4-hydroxybenzoic acids (4-HBA), a type of phenol carboxylic acid was separated from fermentation waste. Due to less (<5%) percentage of solute available in the residue the solvent extraction was shows better recovery of this chemicals over other separation process. The physical extraction of 4-HBA was performed in presence of conventional (n-Butanol and Dichlorobenzene) and natural solvent (Karanja oil). In the experiment, five different concentration 0.005mo/L to 0.035mol/L of solute was extracted in the presence of three different solvent n-Butanol, Dichlorobenzene, Karanja oil at specified temperature 2980C and orbital shaking time 4hr. The sample was analyzed in the UV photo spectrometer. 63% of the maximum extraction efficiency was achieved in n-Butanol while other solvent has shown low efficiency. The following extraction pattern n-Butanol> Karanja oil > Dichlorobenzene were obtained. The distribution coefficient KD and partition coefficient P were calculated for each solvent. The distribution coefficient range was varies from 0.096-1.704 and the partition coefficient 0.258-0.810). Highest distribution coefficient of n-Butanol has shown better separation of solute (4-HBA) from aqueous solution.

Keywords: Physical extraction; Diluent; Distribution coefficient; Partition coefficient

Abstract ID: ACE-OP160

Utilization of Blast Furnace Slag as an Effective Adsorbent for Treatment of Tannery Wastewater

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Abstract
Due to the substantial amount of chromium present in tannery wastewater, it can seriously harm human health and the environment. In this research work, the potential option for the elimination of chromium from tannery effluent is examined using the blast furnace slag (BFS), a by-product of the iron and steel industry. BFS underwent additional treatment with sodium dodecyl sulfate (SDS) to alter the surface morphology of the slag. X-ray diffraction (XRD) and Field Emission Scanning Electron Microscopy (FESEM) were used to characterize the BFS and modified BFS (m-BFS). The effects of several parameters, including pH, adsorbent dosage, contact time, and starting concentration, were evaluated by conducting exploratory tests followed by batch investigations. The results of the study revealed that the solution's pH significantly impacts the removal efficiency. According to the investigations, pH 2 with 40 g/L adsorbent dose and 30 min of contact time for BFS and pH 7 with 40 g/L adsorbent dosage and 45 min of contact time for m-BFS were found to be the ideal conditions for the removal of chromium (VI). The actual tannery effluent was treated under optimal conditions as well. BFS and m-BFS were shown to have removal efficiencies for chromium (VI) of 52% and 75%, respectively.

Keywords: adsorption; tannery wastewater; chromium removal; SDS

Abstract ID: ACE-OP163

Hydrometallurgical Extraction for the Beneficiation of Iron and Aluminum from their Ores

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Abstract
Beneficiation in the mining industry or extractive metallurgy is any procedure that increases the economic value of ore by eliminating gangue. Aluminum and iron ore were studied for their extraction using various acids. Both organic as well as inorganic acids were used for these experiments. Citric acid, Oxalic acid, sulfuric acid were used for leaching discretely, also Oxalic acid and Citric acid were used in combined form with 1:2 ratio for Aluminum. Similarly Hydrochloric acid, Nitric acid and Methyl isobutyl ketone (MIBK) were used for Iron. Since Aluminum and iron are quite heavily used in various Industries hence if we can find best solvent and optimum conditions for extraction of Aluminum and Iron more economically then the extracted aluminum and iron can furthermore be used in the alumina and hematite industries. It was observed that maximum percentage of aluminum was dissolved with Sulfuric Acid. Highest percentage of iron was solubilized with MIBK at lower temperatures and with Nitric acid at higher temperatures. Further it was found out that the extraction increases as the volume of solvent is increased.

Keywords: Aluminum; Beneficiation; Extraction; Hydrometallurgical; Iron

Abstract ID: ACE-OP166

Studies on holdup and characteristic velocity in a pulsed disc and doughnut column of diameter of 25 mm

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Abstract
Studies on holdup and characteristic velocity in a pulsed disc and doughnut column (PDDC) of diameter of 25 mm for the system of 30%TBP/n-Dodecane/Nitric Acid were carried out. The PDDC was operated with a plate spacing of 50 mm and free area of 23 % under non-mass transfer condition. Variation of holdup with intensity of pulsation, phase flow ratio and dispersed phase flow velocity were investigated. The aqueous phase was considered as dispersed phase while the organic phase was considered as continuous phase. Experiments were conducted for various pulse velocities ranging from 7.16-10 cm/s and phase flow velocities ranging from and 0.33-4.41cm/s. Correlation for holdup prediction is proposed with an average relative deviation (ARD) of 15.77 % and a comparison of predicted holdup with experimental holdup is reported within a deviation of ±20%. It was observed that the variation of holdup increased with the dispersed phase velocity for the range of pulsing and phase flow velocities reported in this study. Characteristic velocity, a vital parameter in the design of extraction column was investigated. A decreasing trend of characteristic velocity with pulsing velocity was observed as the drop sizes became smaller and the results are reported.

Keywords: Holdup; Pulsed column; Characteristic velocity; Pulsation; Flow ratio

Abstract ID: ACE-OP167

A Computational Study on the Mechanism of Phosphonic Acid Tautomerization Equilibria

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Abstract
Phosphonates have been studied theoretically and experimentally as an extractant for actinide separations and recovery in the nuclear fuel cycle. The application of diester of phosphonic acid, also known as H-phosphonates, has increased recently because of its richer chemistry, primarily attributed to its reactive P-H group. This P-H group in the O=PH(OR)(OR') takes part in keto–enol type of tautomerism leading to the formation of the P(OH)(OR)(OR'). In order to understand the behavior of these compounds and the extraction phenomena with the actinides in a different medium, it is necessary to study the tautomeric equilibrium. In this context, we set out to investigate the mechanism of interconversion between two tautomers of phosphonic acid [$O{=}PH(OH)_2 \rightarrow P(OH)_3$] by applying density functional theory (DFT) calculations. The tautomer and transition state (TS) geometries were established using BP86 density functional in conjunction with the triple-ζ def2-TZVP basis sets. The resolution-of-identity (RI) approximation and Grimme type dispersion correction with Becke-Johnson damping (D3BJ) were applied throughout the calculations. Intrinsic reaction coordinate (IRC) calculation connects the TS with its downhill nearest intermediates. All calculations were performed with the ORCA version 4.2.1 quantum chemistry package. Both uncatalyzed and water catalyzed tautomerization pathways are explored. Based on our quantum chemical calculations, some important insights are drawn by analyzing the transition state structures. The energetically most favorable pathway proceeds via water catalyzed transition state structure for which a Gibbs free energy barrier ($\Delta G^{\neq}$) of 19.0 kcal/mol is estimated based on our quantum chemical calculations.

Keywords: DFT; Phosphonic acid; Intrinsic reaction coordinate

Abstract ID: ACE-OP168

Process optimization and membrane fouling analysis in microalgal biomass harvesting using robust ceramic membranes

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Abstract
The rapid usage of fossil fuel which is considered one of the major reason for the global climate shifting phenomenon which is leading researchers to look for alternative source like biofuel. Microalgae based biofuel can be a potential candidate in this regard compared to other biofuel producing crops due to its bio-sequestration and bio-remediation potential, but the utmost challenge encountered in production of microalgae derived biofuel is efficient up-concentrating of microalgal biomass from suspension. The study is aimed towards unraveling the outsize obstacle of scaling up biomass dewatering from mixed microalgae consortia using microfiltration (MF) and ultrafiltration (UF) ceramic membranes incorporated cross-flow filtration. The MF membrane was constituted of Kaolin clay and alumina with cellulose as binder whereas the UF membrane was constituted of a nano alumina layer on alumina support. The recirculation parameters were optimized to increase the overall efficiency of the harvesting process. The fouling behaviors of the membranes were further analyzed by Resistance in series model followed by characterization in terms of MIP, FESEM and FTIR to analogize the results with that of the model data. The study revealed that the harvesting efficiency at optimized condition was higher for the indigenously prepared MF membrane than the UF counterpart in terms of Productivity (124.41), Concentration factor (2.01) and Volume reduction factor (2.04). Further the permeate flux of the MF membrane at optimized condition was found to be 315.29 LMH with a recovery of 97.71% for when the backpulsing interval was 5 min. Permeate was characterized in terms of BOD, COD, pH, turbidity and TSS and the outcome indicated a higher degree of remediation by the UF membrane.

Keywords: Biomass harvesting; Ceramic membrane; Cross-flow filtration; Mixed-microalgae consortia; Resistance in series (RIS) model

Abstract ID: ACE-OP169

Development of belt drives for Annular Centrifugal Extractors used in nuclear fuel reprocessing

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Abstract
Annular centrifugal extractors (ACE) are extensively used in solvent extraction process for the separation of uranium and plutonium from spent nuclear fast fuel reprocessing facilities due to the advantage of compact size and short residence time. Custom made electrical motor drives are used to rotate the individual stages at the speed of 3000 to 4000 rpm and are likely to fail in highly radioactive and acidic environment after some time. This increases the remote maintenance and their complete failure leads to generation of radioactive solid waste. It is proposed to develop air operated drive with endless belt for the rotation of ACE bowl to minimize the maintenance issues and to reduce the quantity of solid waste generation. This paper discusses the development of the drive and custom made multi-ribbed polymer belt for highly radioactive hot cell environment. The pulley mounted bearing housing was designed, fabricated and assembled with the rotors of individual stages, additional tensioners and idlers were provided for the remote hot cell installation and adjustment of belt. The belt drive operation was validated with single stage 25mm ID ACE prototype for rated speed and load with the EPDM based single side multi ribbed endless belt reinforced with aramid cord.

Keywords: Annular centrifugal extractors; Belt drives; Nuclear fuel reprocessing

Abstract ID: ACE-OP171

A machine learning approach to identify operational points and process bottlenecks for biopharmaceuticals

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Abstract
The biopharmaceutical sector and the creation of new biologics have received top importance, particularly in the healthcare industry. The biopharmaceutical business has always been on edge about how to reach out to patients who are in need as quickly as possible and yet preserve sustainability goals at the same time because it requires extensive research, manufacture, and deployment along with meeting unmet medical requirements. The identification of important operational points will assist current operations in maximizing product output and cost and minimizing footprint. In this research, an attempt has been made by applying machine learning approaches to identify these key operational points and process bottlenecks that are causing delay and redundancy that indirectly account for the reduction in process time and therefore faster production and deployment of biologics.

Keywords: Biopharmaceuticals; Machine learning; Process modeling; Simulation

Abstract ID: ACE-OP173

Optimization of Natural gas pipeline networks

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Abstract
Transportation of natural gas over interstate pipes presents an intriguing optimization challenge due to the need for periodic re-pressurization using compressors that utilize a portion of the same gas as an energy source. The study focuses on a 18-node gas pipeline network with a single origin and destination. The dynamics of the gas flow, the properties of the compressor, and the mass balance equations have all been included in a steady-state model. Minimizing fuel consumption while maintaining a constant throughput has been accomplished with the use of Simulated Annealing Optimization. Compared to another optimization tool, a solver of a generic algebraic modelling system that extracts the concept of a generalized reduced gradient algorithm, this one provides a better answer in terms of minimizing fuel usage. The proposed model and the technique implemented is expected to provide a blueprint to the researchers and gas pipeline operators to propose the most lucrative conditions to enhance pipeline profitability.

Keywords: Natural gas; Gas pipeline; Optimization; Simulated annealing; Generalized reduced gradient technique; Compressors

Abstract ID: ACE-OP176

Experimental Investigation and Process Development for Carbon Dioxide Capture in Aqueous Media for Global Neutralisation of Carbon

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Abstract
Recent investigations and statistics indicate that fossil fuels are the biggest contributors of carbon dioxide emissions. The Carbon Capture, Utilization, and Storage (CCUS) framework is subject to comprehensive investigation as a supply chain model, encompassing a systematic assessment of the processes associated with capturing, utilizing, converting, and storing carbon dioxide. This study presents the utilization of an aqueous amino acid, specifically L-Histidine, as an environmentally friendly and sustainable approach for capturing carbon dioxide (CO2) at ambient temperature (298.15 K) and pressure not exceeding 30 bars. The investigation focused on examining the CO2 capture process within a high-pressure triple injection setup that was equipped with a comprehensive data gathering system. This system allowed for the continuous monitoring and recording of pressure and temperature parameters in real-time. The saturation, or carbon dioxide uptake capacity, was determined by three repetitions of each experiment. This was done to assess the possibility of developing a continuous process with minimal percentage error. The experimental procedure involved agitating a reactor under different concentration conditions of SDS and water. In order to analyze the influence of mass transfer on the absorption of carbon dioxide (CO2), an experiment was conducted using sodium dodecyl sulfate (SDS), a commonly used surfactant, along with water. The results obtained from the present investigation have been presented in this report.

Keywords: Climate change; Global warming; Carbon capture and utilisation; Sodium dodecylsulphate; Emissions; Storage; Histidine

Abstract ID: ACE-OP177

Process intensification in distillation using rotating packed beds: A comprehensive review and analysis

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Abstract
The idea of enhancing the gas side mass transfer coefficient in rotating packed beds has been challenging over few decades. Distillation being the gas side controlling resistant process needs significant efforts in achieving greater gas side mass transfer coefficients. Rotating packed beds are advantageous when compared with the conventional columns due to the micro-mixing in the fluid channels which results in high mass transfer between phases and the quick attainment of steady state. Several attempts have been made in designing the rotor to increase the tangential slip velocity between the gas and liquid. Few such designs including Split packing, Zig-zag packing, counter flow concentric ring packing, cross flow concentric baffles packing, Couette flow HiGee and 3D structured packing are described here. Working principle of HiGee, typical flow pattern, modeling equations and practical limitations are discussed. The effects of rotational speed, gas-liquid flow rates and radial thickness of the packing on mass transfer performance were also investigated. This study contributes significantly to advancing the industrial applications of rotating packed beds.

Keywords: Process intensification; HiGee Distillation; Gas liquid mass transfer; Rotating packed beds

Abstract ID: ACE-OP178

Design and simulate the mtbe production by reactive distillation process using aspen plus

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Abstract
The objectives of the process is to study the profiles of distillation column at different stages in the production of MTBE, the effect of MTBE production by varying the different parameters and the process optimization of the production of MTBE. Simulation studies were carried out on the production of Methyl Tertiary Butyl Ether (MTBE) in Reactive Distillation by using Aspen Plus. Process optimization is the manipulation of process variables, so as to optimize some of the parameters without violating the constraints. In this studies the temperature profile, pressure profile and the molar flow rate of the entire is distillation column in the production of MTBE were established. And also found that the optimal points of production of MTBE by varying the temperature, pressure and molar flow rate at each stage of reactive distillation column. The reactor system on being optimized by an kinetic data ,we gave the operating temperature as temperature 320 K , pressure 1 atm and methanol to isobutene feed ratio is 3:1 in feed and the catalyst flow rate is 204.1 (kg catalyst/stage). The reflux ratio values were found to be 7 (mole basis) for the column.

Keywords: Simulation; Aspen plus; MTBE; Reactive distillation

Abstract ID: ACE-OP179

Modelling and Optimization of Methylene Blue Dye Removal using Eucalyptus Bark Biomass in a Packed Bed Column: A Comparative Analysis of ANN and ANFIS Predictive Models

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Abstract:
Eucalyptus bark biomass exhibits a prominent adsorption capacity for the removal of MB dye from aqueous solutions in a column system and can be effectually employed for treating effluents containing dyes. In this study, a packed bed up-flow column experimental data obtained from literature was used and an Artificial Neural Network (ANN) and an Adaptive Neuro-Fuzzy Inference System (ANFIS) model was applied and compared to predict the adsorptive performance of biomass-based adsorbent. Breakthrough curves were generated under varying conditions, including different flow rates of MB dye intake (10–15 mL/min), initial MB dye concentrations (50–100 mg/L), and adsorbent bed heights (10–15 cm), using raw eucalyptus bark in a series of column experiments. The optimal conditions for achieving maximum dye adsorption were identified as a high bed height, low flow rate, and high initial dye concentration. To plot the breakthrough curves using linear regression, the experimental data were fitted to the Thomas and Yoon-Nelson models. Employing the Levenberg-Marquardt (LM) technique, the ANN and ANFIS based model successfully predicted the column's performance. A strong correlation was observed when comparing the experimental data to the model's predictions, indicating excellent agreement between the experimental and anticipated data generated by the machine learning models.

Keywords: Machine learning; Wastewater treatment; Dye adsorption; Biomass

Abstract ID: ACE-OP180

Predictive Modelling of Organic and Inorganic Pollutants Adsorption with Metal-Organic Frameworks: A Comparative Computational Study

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Abstract:
The aim of the work is comparison of efficiency of computation intelligence models, including Artificial Neural Networks (ANNs), Adaptive Neuro-Fuzzy Inference System (ANFIS), Support Vector Machines (SVMs) and Response Surface Methodology (RSM) to model the dynamic adsorption of dyes onto numerous available metal organic frameworks (MOFs) as adsorbent. ANNs were implemented with standard transfer functions; SVMs utilized a fine Gaussian kernel function,

while ANFIS and RSM adopted the Box-Behnken design. The dataset used for this study was sourced from literature containing adsorption kinetics data related to dyes and ions using MOFs. Specific parameters tailored to the literature were selected for the adsorption kinetics analysis. To evaluate the efficacy of these computational models, a comparison was conducted by employing various metrics to assess the alignment between experimental and predicted data through breakthrough curve analysis. The study results were compiled and presented in tabular form, allowing for the identification of the most suitable model for specific combination of dye and adsorbent based on the regression coefficients R^2.

Keywords: ANN; ANFIS; SVM, RSM; Dynamic Adsorption; MOFs

Abstract ID: ACE-OP181

Microwave Assisted Xylose/Furfural Upgradation to 5- Hydroxymethylfurfural and Levulinic Acid

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Abstract
The utilization of the entire carbohydrate part (cellulose and hemicellulose) of lignocellulosic biomass to produce valuable chemicals is an economically viable and technologically challenging endeavor. In this presentation, I am going to discuss a novel route that is developed in our research group to convert xylose/furfural to 5-hydroxymethylfurfural (HMF) and levulinic acid (LA) using microwave reactor. Up to 50% furfural (FF) concentration were tested. The highest selectivity to LA of 60% was achieved at a FF conversion of 74% within a reaction time of 5 min at 160℃. A preliminary techno-economic analysis (TEA) was conducted to calculate the minimum selling price of levulinic acid. The TEA suggested that the MSP of one metric ton of LA is $1349, considering the FF (feedstock) market price as $1000 per metric ton and a discount rate of 10%. While the MSP of LA from lignocellulosic biomass was $1011 per metric ton. The MSP is highly sensitive to FF price and LA yield. The integration of this route with already developed C6 routes for the LA production allows one to utilize the entire carbohydrate part of the lignocellulosic biomass and makes the overall process more economical.

Keywords: Xylose to levulinic acid; Microwave reactor; Techno-economics

Abstract ID: ACE-OP182

Evolutionary Computation for estimation of UNIFAC group interaction parameters for VLE of methanol (1) + water (2)

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Abstract
Evolutionary Computation (EC) is a subfield of artificial intelligence that has been extensively applied to many research areas. EC techniques are stochastic algorithms whose search methods model natural phenomena, such as genetic inheritance and Darwinian strive for survival. The best-known algorithms in this category are evolutionary programming, evolution strategies, genetic algorithms, differential evolution, and genetic programming. In 2023, a new method called the opposite point-based differential evolution (OPDE) algorithm has been introduced by Yadav and Angira, which is an improved version of the classical differential evolution (DE) algorithm. The objective of this work is to evaluate the efficacy of the opposite point-based differential evolution (OPDE) algorithms using the experimental and synthetic VLE data of the methanol (1) + water (2) system at three different temperatures. The OPDE algorithm has been tested using the classical least-squares and error-in-variable approaches. The interaction parameters of UNIFAC activity coefficient model were estimated and found to be same as those reported in literature for synthetic data set at 100°C. But different interaction parameters are obtained for experimental dataset at all three temperatures. At 100°C, the deviation between experimental and calculated value of pressure and vapor mole fraction was found to be more as compared to that at 25°C and 50°C. The OPDE algorithm for each dataset was run 100 times for testing the performance and robustness. Convergence rate of the OPDE algorithm has been found to be 100%. The overall acceleration rate using the synthetic VLE data set is found to be

approx. 13% more in comparison to the experimental VLE data set. Our results indicate that OPDE is a robust procedure for nonlinear parameter estimation in thermodynamic models.

Keywords: Evolutionary computation; VLE modeling; OPDE; Parameter estimation

Abstract ID: ACE-OP183

Adsorption studies on the removal of toxic dye over natural eco-friendly biochar-based adsorbent

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Abstract
With the increase of industrialization and urbanization, the requirement of removal of small amounts of toxic pollutants, dye effluents in particular, in the ppm or ppb level from industrial waste water is increasingly becoming significant. Because of potential toxicity of the dyes and their visibility in surface waters, removal and degradation of organic dyes have been a matter of considerable interest. In this study, the potential of biochar generated from pumpkin peels to remove Malachite green from aqueous solution was evaluated in a batch process. Experiments were carried out as function of contact time, initial concentration, dosage, pH and temperature. Adsorption isotherms were modelled with the Langmuir and Freundlich isotherms. The data fitted well with the Freundlich isotherm. The absorption spectrum of the treated and untreated sample was analyzed by UV-Vis spectrophotometer. The surface functional groups of adsorbent before and after adsorption was analyzed by FTIR. The pore size of the biochar after adsorption was analyzed using SEM analysis technique. The results indicate that the biochar generated from food waste could be an alternative for more costly adsorbents used for dye removal and could be employed as an alternative for wastewater treatments besides it is not only to minimize the cost, but also to reduce waste material.

Keywords: Adsorption; pumpkin peels; Biochar; Malachite green; Isotherm

Abstract ID: ACE-OP184

Adsorption studies on the removal of toxic dye over natural eco-friendly adsorbent- garlic peels

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Abstract
With the increase of industrialization and urbanization, the requirement of removal of small amounts of toxic pollutants, dye effluents in particular, in the ppm or ppb level from industrial waste water is increasingly becoming significant. Because of potential toxicity of the dyes and their visibility in surface waters, removal and degradation of organic dyes have been a matter of considerable interest.. In this study, the potential of garlic peel (GP), agricultural waste, to remove Malachite green from aqueous solution was evaluated in a batch process. Experiments were carried out as function of contact time, initial concentration, dosage, pH and temperature. Adsorption isotherms were modelled with the Langmuir and Freundlich isotherms. The data fitted well with the Freundlich isotherm. The absorption spectrum of the treated and untreated sample was analyzed by UV-Vis spectrophotometer. The surface functional groups and pore size of the adsorbent before and after adsorption was analyzed by FTIR and SEM analysis techniques. The results indicate that the garlic peel could be an alternative for more costly adsorbents used for dye removal and could be employed as an alternative for wastewater treatments besides it is not only to minimize the cost, but also to reduce waste materials.

Keywords: Adsorption; Garlic; Malachite green; Isotherm

Abstract ID: ACE-OP185

Study on ultrasonic cleaning of annular centrifugal extractor using X-ray tomography

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Abstract
Annular centrifugal extractors (ACE) used in Indian fast reactor spent fuel reprocessing facilities are prone to choking due to the deposition of undissolved particles from dissolver solution near their aqueous outlet during solvent extraction cycle. An ultrasonic cleaning method was developed for cleaning deposited radioactive fine particles in ACE rotating bowls. This paper discusses the study carried out on ultrasonically cleaned ACE rotating bowls using X-ray tomography.
Three ACE rotating bowls were initially choked with simulated zirconium molybdate slurry in a single-stage ACE unit at a rotating speed of 3000 rpm and flow rate of 5L/h to 15 L/h. The choking experiments were conducted up to the flooding limit. The choked rotating bowls along with a motor drive assembly were mounted in an indigenously designed and fabricated ultrasonic bath and cleaning was carried out using an ultrasonic resonator of 40 kHz frequency. The X-ray computed tomography was employed for analyzing the de-choking pattern. The de-choking behavior was studied by analyzing reconstructed cross-sectional images of empty, fully choked and stage-wise de-choked ACE rotating bowls.

Keywords: Annular centrifugal extractors; Ultrasonic cleaning; X-ray computed tomography

Abstract ID: ACE-OP186

Process Development for Refining of Crude Sodium Di-Uranate conc. using EDTA. 4Na salt as a Complexing Agent

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Abstract
Refining of Crude Uranyl Nitrate (CUN) solution, obtained after dissolving Sodium Di-Uranate conc. in Nitric Acid, is carried out in a counter-current Solvent Extraction operation to produce nuclear grade 'U'. There is third phase formation during Solvent Extraction operation while contacting CUN sol. with organic sol. (33% Tributyl Phosphate). This third phase is creating many operational problems including poor mass transfer, chocking of pipeline and system, loss of Uranium etc. The issue of third phase formation was successfully resolved by treating the CUN sol. with tetra-Sodium salt of EDTA as a complexing agent. Extensive lab scale experimental trials at different process conditions like free acidity, molar ratio of EDAT.4Na to 'U', digestion time of treatment etc. were carried out to optimize the process conditions. It was found that EDTA.4Na as a complexing agent works well when CUN have 'U' in the range of 220 to 240 g/l, 1.6 to 1.8 N free acidity and 0.0683 molar ratio of EDTA.4Na to 'U'. Also, it requires min. 5 hrs. of digestion time of treatment. Based on the finding, a process flow sheet has been developed and successfully demonstrated at the plant scale with more than 99.75% 'U' recovery.

Keywords: Sodium Di-Uranate conc.; Solvent Extraction; tetra-Sodium salt of EDTA

Abstract ID: ACE-OP187

Graph Auto-encoder Based Fault Detection Approach for Chemical Process Systems

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Abstract
Integration of Machine Learning, Internet of Things, and Digital Twins with the traditional unit operations, have boosted the performance of chemical process industries. Data-driven approaches bring with them the flexibility of tackling non-linear, non-Gaussian processes better as compared to the First-Principle models. Fault detection is one such exercise which can be carried out using data-driven modeling. In recent years, Graph Machine Learning has been of greater use to detect faults in the system. One such approach is proposed in this work, where Graph Auto-encoders (GAE) are being utilized for detecting faults for the Tennessee Eastman Process, which is a benchmark dataset for validating various fault detection

methodologies. GAE consists of an encoder-decoder network, where the encoder takes a graph and its features as an input and learns the latent representation of the input data and the decoder then expands the latent representation of the data. The SPE and T2 statistics are calculated for the methodology and is compared with the state-of-the-art fault detection methodologies in PCA, DPCA, Graph Convolutional Networks, and Auto-encoders. The proposed methodology yielded superior results when compared to the traditional approaches.

Keywords: Industry 4.0; Fault detection; Graph machine learning; Graph auto-encoder

Abstract ID: ACE-OP188

Approach Leveraging Deep Learning to Enhance Time Series Forecasting in Bioreactor Operations via LSTM Networks

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Abstract
Accurate forecasting of time series data is crucial for optimizing and controlling bioreactor processes. Monoclonal antibodies(mAbs) are a cornerstone of biopharmaceuticals, offering targeted and effective treatments for a wide range of diseases. Their role in personalized medicine and the development of biosimilars are key trends shaping the future of mAb-based therapies in biopharma. It is produced through culturing Chinese hamster ovary (CHO) mammalian cells. In this work, we propose a novel approach to enhance the performance of time series forecasting in bioreactor operations through the application of Long Short-Term Memory (LSTM) networks. It is a type of recurrent neural network widely used in sequential data analysis. Traditional forecasting methods often struggle with capturing the complex temporal dependencies and nonlinear patterns inherent in bioprocess data. Our proposed LSTM-based approach employs a deep learning architecture capable of capturing intricate patterns within the bioreactor time series data. We preprocess the data and normalize the input features to improve convergence during training. The LSTM network is designed to learn from historical data, including process variables in bioprocessing such as inlet flow rate, sample removal flow rate, bulk removal flow rates, and volume of reactor mixture, enabling it to effectively capture the dynamic behavior of the bioreactor system such as viable cell density, viability, glucose consumption, lactate production, and product titer. Our model presents a promising solution for enhancing the accuracy of time series forecasting in bioreactor operations. By leveraging the strengths of LSTM networks in capturing complex temporal patterns, this approach contributes to improved process control, increased efficiency, and enhanced decision-making in bioprocess engineering.

Keywords: Time series; Forecasting; Monoclonal antibodies; Biopharmaceuticals; Biosimilars; CHO cell culture; LSTM network; Bioreactor

Abstract ID: ACE-OP189

Deep Eutectic Solvents and the Study of their Physical and Thermodynamic Properties

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Abstract
Deep eutectic solvents have intriguing physical properties that correspond to the needs of a sustainable and ecologically acceptable solvent. They can be fine-tuned during synthesis for various applications such as metal extraction, gas sorption, liquid-liquid extraction, electrochemistry, catalyst for biodiesel, and nanotechnology. This study used reported deep eutectic solvents in the literature for the property's estimation. Various physical properties such as surface tension, density, and viscosity, as well as thermodynamic properties such as critical pressure, were calculated in this work. The DNLDIP technique was used to estimate density, the Vogel-Fulcher-Tammann method was utilized to assess viscosity, and the IK-Cape approach was used to calculate surface tension of deep eutectic solvents. The Lee Kessler approach and the modified Lydersen-Joback-Reid (LJR) method were used to determine the critical properties of each DES. These calculations will

assist the scientific community in inheriting these values and using them for numerous research objectives such as thermodynamic modelling of gas sorption.

Keywords: Deep eutectic solvents; Green solvent; Property estimation; Thermodynamic modeling

Abstract ID: ACE-OP192

Computational fluid dynamics simulation of flow in Blood Vessels

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Abstract

Blood flow in vessels is complex due to factors like vessels geometry, including curves and branches, and crucial pulsatile nature of blood. Computational Fluid Simulation (CFS) is an advanced numerical method widely used to solve and analyze problems that involve fluid flows. This study aims to utilize CFD to simulate and analyze blood flow within vessels, by creating detailed, three-dimensional models of blood vessels to simulate blood flow patterns. The simulation takes into account the impact of vascular diseases and abnormalities, such as atherosclerosis and aneurysms, on blood flow dynamics by considering blood as a Newtonian, incompressible fluid and flow as laminar. Blood vessels walls are considered as rigid with no slip boundary condition. CFS provide critical insights into the mechanical factors contributing to the progression and onset of vascular diseases. They potentially aid in the predictive assessment of disease progression, and the planning and optimization of treatment strategies. In conclusion, this study underlines the potential of CFS as a powerful tool in understanding hemodynamics, and in the design and evaluation of medical devices and surgical procedures.

Keywords: Computational Fluid Simulation; Blood Flow; Hemodynamics.

Abstract ID: ACE-OP193

Development of kinetic model for the esterification of n-propionic acid and n-propyl alcohol

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Abstract

An experiment was conducted in a simple isothermal batch reactor to produce n-Propyl Propionate and water through the Esterification of n-Propyl alcohol with n-Propionic acid. The reaction employed solid catalyst Indion 140. The temperature of the reaction mixture was maintained between 333.15K and 353.15K. The catalyst loading varied from 0.01 g/cc to 0.03 g/cc based on the volume of the reaction mixture. The mole ratio of n-Propionic acid to n-Propyl alcohol ranged from 1:1 to 1:6. Several factors were investigated for their impact on the conversion of n-Propionic acid, including reaction temperature, catalyst loading, initial reactant mole ratio, catalyst particle size, and agitation speed. Experimental results indicated that the reaction was primarily controlled by kinetics rather than mass transfer. A second order kinetic rate equation was successfully employed to fit the experimental data. The forward reaction rate constants and activation energies were determined through the Arrhenius plot. Simulations were conducted to assess the effectiveness of a pseudo homogeneous kinetic model, which showed excellent agreement with the experimental data. A comparison was made between the experimental data and model predictions at different temperatures, catalyst loading, catalyst size, and agitation speed. The developed kinetic model proved useful for the design, control, and optimization of the reactive distillation column involved in the esterification process.

Keywords: Kinetics; Resin catalyst; Modeling; Simulation; Energy; Reactive distillation

Abstract ID: ACE-OP196

Lattice Boltzmann Method for Drying of Capillary Porous Media under Convection-Diffusion Boundary Conditions

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Abstract
The integration of transport phenomena within a porous material during drying is a major challenge faced during the mathematical modeling of the process. Due to its innate ability to incorporate realistic pore-scale geometry and mass transport at the pore level, Lattice Boltzmann Method (LBM) based modeling approach has gained favor for modeling the drying process in recent times. Due to the intricate nature of the porous material, the invasion pattern and the associated mass transport within the medium during the drying process plays an important role in the determination of the macroscopic drying kinetics. In addition, the presence of a convective airflow over the porous medium also plays a critical role in the invasion patterns and also the macroscopic drying kinetics for a porous medium. Thus, in this work, the Lattice Boltzmann Method is used to investigate the pore-scale phenomena and their effects on the macroscopic drying kinetics for the drying of a capillary porous medium.

Keywords: Lattice Boltzmann Method; Drying Kinetics; Haines Jumps; Convection;

Abstract ID: ACE-OP197

A Mesoscale Approach for Modeling the Anodic Layer of PEM Fuel Cells and Electrolyzers

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Abstract
The performance of PEM Electrolyzers and PEM fuel cells are both dependent on the mass transport of the generated oxygen and water out of the Anodic Layer of the PEM Electrolyzer and Fuel Cell respectively, with the restriction to flow within the porous medium being the major cause of losses in overall efficiency. The intricate geometry of the porous medium within the Anodic Layer precludes experimental study, thereby making mathematical modeling an ideal tool for the study of multiphase flows within the Anodic Layer. Of the different types of mathematical modeling, the Lattice Boltzmann Method is gaining dominance due to its ability to handle intricate geometries and multiphase interactions. The current work aims to use a Shan-Chen Lattice Boltzmann Method to model the generation of Oxygen and water and the associated mass transport within the Anodic Layer of PEM Electrolyzers and Fuel Cells respectively.

Keywords: Lattice Boltzmann Method; Porous Transport Layer; Shan-Chen; Multiphase

Abstract ID: ACE-OP198

Kalman filter based data-driven modeling for urban and municipal wastewater treatment processes

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Abstract
Industry 4.0 in wastewater treatment, facilitates higher operational efficiency, reduced costs, minimum environmental impact, and enhanced overall sustainability. Advanced data driven modelling is a key ingredient for industry 4.0. In this paper data-driven models based on neural state space (NSSM) is developed for wastewater treatment processes. The Multi-layer perceptrons (MLP) serve as the neural network component of the model. The quasi-linear nature of neural state space model qualifies it as a good candidate for linear system controller design. The models are identified for both urban and municipal wastewater treatment data. Urban wastewater treatment plant data is obtained from UC Irvine Machine Learning Repository. For municipal wastewater treatment, the synthetic data for activated sludge process, simulated from Benchmark Simulation Model No.1(BSM1) is used. Since the process involved are highly complex in nature and many of variables are hard to measure, observers can be designed to generate state estimates This is essential for various applications including fault detection, soft-sensing, process optimization, process intensification and model-based control. Both Extended Kalman filter (EKF) and Ensemble Kalman Filter (EnKF) are designed and implemented for identified NSSMs. The outputs for EKF based NSSM and EnKF based NSSM are compared and assessed.

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Keywords: Extended Kalman filter; Ensemble Kalman filter; multi-layer perceptrons; Neural state space model

Abstract ID: ACE-OP204

CO2 Capturing using sorbent base methods in a laboratory Fabricated set-up

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Abstract
Temperature Swing Adsorption (TSA) is a carbon capture technology that leverages the adsorption and desorption properties of certain materials. For CO2 capture, various sorbents are used. Their behavior while adsorption and desorption processes at different parameters are investigated. This cyclic process of adsorption and desorption process is behind TSA. The reactor columns are fabricated in Laboratory. Present work examines the role of TSA for CO2 capture with operational findings, including methodology. It also discusses aspects such as the choice of adsorbents under various trials and the same is correlated with CO_2 capture capacity.

Keywords: TSA; Sorbent; Carbon capture

Abstract ID: ACE-OP205

A Review on Flow, Mixing and Segregation of Granular Materials in Heap flow

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Abstract

Granular materials are collections of individual solid particles that are large enough to be seen and handled individually. Granular materials are largely available in industry (second largest materials handled in industry after water) as well as in nature. Collective behavior of granular materials is complex which makes it interesting to study for researcher all over the world. Due to differences in properties like size, shape, and density they segregate during surface flow (e.g. heap, rotating cylinder and chute). In this paper, we have review the flow, mixing, and segregation of granular materials during heap flow. The effect of various parameters on mixing and segregation is reported along with methodology adopted. Experimental as well numerical investigation (DEM simulation) during heap flow is review/explained with appropriate results. In the end, recommendations are suggested as compared to the traditional ways to handled operation of granular materials.

Keywords: Granular materials; Heap flow; Mixing; Segregation

Abstract ID: ACE-OP207

A study on solvation characteristics of active ingredients on deep eutectic solvents

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Abstract
Active ingredients are the essentially found in pharmaceutical drugs, cosmetic products, or pesticides, due to their specific therapeutic or biological effect. These ingredients are carefully selected and formulated to deliver the desired outcome when used as intended. The separation or extraction of these active ingredients is a thrust area of study today. Since a decade, deep eutectic solvents (DES) are gaining widespread application in the field of green chemistry as a valuable alternate to ionic liquids, due to their unique physicochemical properties. DES are eutectic mixtures of hydrogen bond acceptors and hydrogen bond donors. This work focuses on the thermodynamic properties of choline chloride- and menthol- based DES and

investigates how different active ingredients interact with these DES. This study further provides the quantum chemistry insights into how the different DES affect the properties and reactivity of the active ingredients. A solvation study using the Polarizable Continuum Model in Gaussian 16 software was executed to compute the solvation energy. The electrostatic potential (ESP) analysis around the solute was done to understand how the DES affects the charge distribution during interactions within the solvated system.

Keywords: Solvation characteristics, Active ingredients, Deep eutectic solvents, Interactions

Abstract ID: ACE-OP211

Hybrid machine learning-based modelling Andand optimization strategy for photoreactor

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Abstract
This research presents an artificial intelligence-based process modeling and optimization strategy, for a poorly understood photoreactor. Experimental data from a photo reactor (Pareek et al., 2002) is considered in the present study in which photodegradation of sodium oxalate salt in spent Bayer liquor occurred. After data preprocessing, various machine learning (ML)models were tried to predict the reaction rate from input parameters like initial solution pH, power of the lamp, total organic carbon, catalyst loading, etc. Multiple data-driven advanced machine learning methods like Decision Trees, ANN, support vector regression, Gaussian Process Regression, etc. were tried to predict the reaction rate. Out of 26 ML models tried GPR model emerged to be the most accurate model with an R squared value of 0.983 and an average error percentage of 0.265. A partial dependency plot evaluates how the reaction rate is affected by various input parameters to gain insights into reaction phenomenology. Once the accurate model is generated for the reaction rate, the differential evolution algorithm is used to find out the optimum value of 4 input parameters which will lead to the maximization of the reaction rate. Through this hybrid approach, a 90% increase in reaction rate is achieved by optimization. The developed hybrid modeling and optimization approach used in this research is generic and can be applied to any reactor where process phenomenology is poorly understood.

Keywords: Photoreactor; Machine learning models; Simulation &; Optimization

Abstract ID: ACE-OP212

Unlocking Electrolyte Performance: Absorption Intermediates in Simultaneous Carbon Capture and Electrochemical Conversion

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Abstract
Excessive CO_2 emissions from human activities have led to extensive research on global warming mitigation strategies. Reactive Carbon Capture (RCC), a subset of Carbon Capture and Utilization (CCU), is a promising approach. RCC allows the use of intermediates as feedstocks, bypassing traditional CCU regeneration. This study focuses on producing carbamates and/or [bi]carbonates as potential electrolytes after CO_2 capture from flue gas. Our goal is to optimize the absorption process to maximize intermediate formation, enhancing electrolyte quality. This will help us fine-tune electrolyte composition and concentration for better electrochemical system performance, ensuring seamless integration with absorption for efficient carbon capture and conversion. The present study includes a literature review and process modelling to optimize the electrolyte composition and concentration. An economic feasibility assessment will also be performed to evaluate the process model's viability. These efforts provide insights into the practicality and commercial potential of RCC. We examine CO_2 absorption mechanisms to identify key parameters influencing product selectivity. We also explore the use of absorption intermediates in electrochemical processes for various chemical production. This leads to a preliminary process model derived from literature review, forming the foundation for assessing RCC's commercial viability and implementation.The integration of carbon capture with direct electrochemical conversion represents a pioneering approach

that not only promises substantial emissions reduction but also paves the way for economically viable and environmentally responsible industrial practices.

Keywords: CO_2 Absorption; Integrated CO_2 Capture and Electrochemical Conversion; Reactive Carbon Capture

Abstract ID: ACE-OP213

Optimization of Synthesis Methods for High-Purity Magnesium Titanate from Different Precursor Materials and Processing Parameters

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Abstract
Magnesium titanate is a versatile ceramic material with remarkable dielectric properties that make it indispensable in various chemical engineering applications, particularly in high-frequency electronics, GPS technology, defense industry components, and microwave dielectric materials. Its unique combination of properties ensures efficient energy storage, precise frequency stabilization, and effective signal transmission in a wide range of technological applications. In this paper, numerous magnesium titanate production techniques have been reviewed under various working conditions, as well as their characterization. Magnesium titanate is being studied for its efficient method of synthesis due to its numerous uses. Different researchers employ different synthesis procedures for magnesium titanate depending on the qualities needed for the final product. The manner in which magnesium titanate is produced with the appropriate stoichiometry fraction largely determines its properties. We highly suggest use wet chemical processes like sol-gel and co-precipitation methods in order to maintain the stoichiometry %, even though there are several solid-state synthesis methodologies available. One of the main advantages of this strategy is the capacity to alter the composition with remarkable precision. The researchers have also shown how the structure varies at different pressure and temperature settings using XRD and SEM images.

Keywords: Magnesium Titanate; Precipitation; Calcination; Dielectric material.

Abstract ID: ACE-OP214

Chemicals and Fertilizers

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Abstract
The production of chemicals and fertilizers is undergoing significant transformations with a strong focus on innovation and sustainability. This abstract provides an overview of key developments in these crucial sectors. In the realm of chemicals, there is a growing emphasis on green chemistry and sustainable practices. Fertilizers, essential for global food production, are also evolving. Advanced formulations are being developed to enhance nutrient efficiency and reduce environmental impact. Precision agriculture technologies are aiding in the precise application of fertilizers, reducing excess usage, and minimizing runoff into water bodies, which can cause pollution. Furthermore, sustainable agriculture practices and organic fertilizers are gaining traction, aligning with the global shift towards more environmentally responsible and health-conscious farming methods.
In conclusion, advancements in chemicals and fertilizers are fostering sustainability, resource efficiency, and responsible production. These innovations are essential not only for industrial progress but also for the well-being of our planet and its inhabitants.

Keywords: Sustainability; Agriculture Technologies; Green Chemistry

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Paper-based Colorimetric Detection using Machine Learning Techniques

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Abstract

We propose a method for quantitative chemical analysis using a blend of color-based analysis, machine learning algorithms, and artificial intelligence (AI). This approach harnesses the chemical reactivity of a specific substance with the paper's coating, inducing a distinctive color change. Through smart-phone photography, our system captures these color changes and employs machine learning and AI to accurately quantify the substance within the original material. The research aims to automate substance detection and quantification, offering broad applications in fields such as environmental monitoring, food safety, and industrial quality control. By integrating advanced image processing with machine learning, we precisely analyze the smart-phone-captured color changes and correlate them with substance concentration. The proposed method stands out for its simplicity, affordability, and accessibility. The synergy of smart-phone technology and AI empowers users from various backgrounds to engage in substance quantification without specialized equipment or expertise. This system has the potential to impact diverse domains, reducing analysis time, human error, costs, while enhancing efficiency and reliability.

Keywords: Color-Based Analysis; Machine Learning Algorithms; Artificial Intelligence

Abstract ID: ACE-OP216

Development of a novel method of preparing Propellant grade Crystal Specific Iron Oxides and studying their influence on Thermal Decomposition of Ammonium Perchlorate

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Abstract

The objective of this paper is two-fold, 1) to prepare two propellant grade oxides of iron, viz. predominantly inverse spinel magnetite and predominantly acicular geothite-hematite using hydrothermal process from the same precursors 2) find their role in the combustion of ammonium perchlorate (AP) using TG-DSC studies. From the method prescribed by David and Welch for magnetite preparation (Iron Oxide-1, M1), three important changes were carried out while preparation, i.e., a) the reaction temperature was brought down to room temperature @30^{0}C against 90^{0}C, b) the pH of the intermediate product is kept alkaline (pH>10 against neutral pH) and drying is carried out for one sample at ambient temperature, @30^{0}C (Iron Oxide-3, M3) and c) another sample at 105^{0}C in hot air oven (Iron Oxide-2, M2) against specified vacuum drying at 40^{0}C. The morphology and composition were studied using SEM, EDS, HR-TEM and PXRD. In addition, laser scattering method was used for particle size analysis and BET isotherm method was used for estimating specific surface area. All the samples yielded near same particle size and specific surface area in the order of 3 μm and 5 m^2/g respectively. The XRD revealed that M1 yielded magnetite (100%), on the other hand, M2 resulted in geothite (α-FeOOH) and hematite (α-Fe_2O_3) mixture and M3 resulted in 50:50 wt. /wt. Fe_4O_5 and α-FeOOH. Decomposition studies were carried out using TG-DSC, with AP and catalyst samples M1, M2, M3. Pure AP showed three distinguishable decomposition zones; LTD (300±10^{0}C), ITD (370±10^{0}C) and HTD (438^{0}C). There is no observable change in the Low Temperature Decomposition (LTD) of AP between magnetite and acicular goethite-hematite catalysts. However, when magnetite is present, ITD was absent. The geothite-hematite sample could not eliminate the ITD zone. Similarly, the TG indicates that about 47% of the combustion by mass occurred in LTD & ITD zones together and the remaining 53% in HTD zone. The presence of catalyst increased the quantity of combustion in HTD zone to 76%, 71% and 68% respectively for M1, M2 and M3. The HTD temperature is reduced to 415^{0}C when magnetite is used whereas there is no change in case of goethite-hematite combination. This study finds importance for a propellant designer to choose between low and highly sensitive burn rate modifiers, which have their own merits and demerits.

Keywords: Magnetite, Geothite; Hematite; Ammonium Perchlorate; Thermal decomposition

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Identification and resolution of weak chemical Process equipment design variable combinations using Monte-Carlo Simulation- A case study of drying rocket grade alumina using continuous rotary drier

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Abstract

Design of the process equipment is an art although majority of the times the set of governing equations or relations pre-exist. It is because, it is not easy to weigh the contribution of each variable and assign a judicious value especially when the number of independent variables is so high and all variables can vary simultaneously. This is the case with uncertainties in the values of constants (like material properties) too. A practicing designer attends this issue by making assumptions and intelligent guesses, which generally are idiosyncratic even though certain guidelines, precedence and experience are available. However, there is a flip side of the coin. The idiosyncratic design decisions on selection of variable values may not lead to optimal design, in fact, the designer may be in dark on the right search space that leads to optimal design.

In the present study we tried to resolve this haziness using the application of monte carlo simulation technique. Consider a design expressed as the equation Y (m)=f_i (X(n)), where Y is the set of output or response variables and X is the set of independent or stimulus variables. f_i is the way they are related to Y. In Monte Carlo simulation, a statistical method, assumes that each stimulus variable randomly varies within an upper and lower limits over the mean or nominal value due to a gaussian random error within, since every variable is a natural system. When the iteration (simulation) is repeated very large in number, the output becomes many combinations of values, both low and high leading to scenarios of strong and weak combinations as well as scenarios of good or favorable search space of combinations. This is a more informed and calculative assertion on the design values.

In this paper, we show how this simulation is carried out for a design of a continuous rotary dryer; applied for a case study of rocket grade alumina drying for a given feed rate and reduction in moisture content using air. Since the objective of the paper is to establish the use of monte carlo simulation rather than exhaustive design of the dryer, we assumed the following conditions viz., 1) drying is to remove surface moisture, 2) it is primarily heat transfer controlled, 3) there are no heat leaks, 4) there are no gradients across solid-gas interface, 5) there are no mass transfer constraints etc., thus making the drier design a simplified version. We ended up with the hot air duty in terms of flowrate required, input and output temperatures and humidity. Finally, we arrived at the length, diameter of the rotary dryer. This design is iterated for 100-1000 times leading to exhaustive scenarios. Later we sorted the data with respect to l/d ratio, least air flow rate, and ΔT of the air and solids and identified the design space, worst scenarios not required to be considered. The effect of increase in number of iterations is established after repeating the simulations 10 times, 100 times and 1000 times. The performance indicator assumed was the l/d ratio of the drier which ultimately describes the floor area, support structure required, and civil building, electric motor capacity, input and output collection subsystem costs including civil works and handling. We understand that although the design under consideration is simple, the results showed that the monte-carlo simulation is a powerful method applicable for designers to reduce the risk of design assumptions. The concept can be extended to more severe technical constraints such as mass transfer constraints, leaks, mass and heat gradients etc as well as project constraints like cost of equipment, supports, handling, human resources and civil structures. In fact, the need for monte-carlo technique is visible as the number of constraints are very large and factorial variation-based simulations are of little use because of the combinatorically increasing iterations.

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Heterometallic Co^{III}-Ln^{III} Single Molecule Magnets

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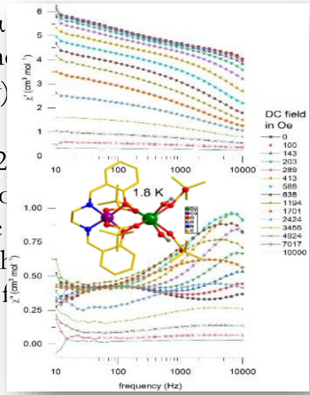
Abstract

The reaction of Schiff base ligand, *N,N'*-Bis(salicylidene)ethylenediamine (LH_2) with [Co^{II} (μ)(O CCMe) (HO CCMe)] (*Co^II -Piv*) (*Piv* =pivalate) and $Ln(NO_3)_3{\cdot}xH_2O$ salts in the presen triethylamine afforded [Co^{III}Dy(L)(*μ*-Piv)$_2$(η^1-Piv)$_2$(η^1- OHMe)2] (**1**) [Co^{III}Tb(L)(*μ*-Piv) Piv)2(η^1-OHMe)$_2$] (**2**) [Co^{III}Ho(L)(*μ*-Piv)$_2$(η^1-Piv)$_2$(η^1-OHMe)2] (**3**), and [Co^{III}Er(L)(*μ*-Piv)2(η^1-Piv)2(η^1-OHMe)2 complexes. The heterometallic dinuclear ensemble is built *via* the bridging coordination actic [L]$^{2-}$ and four [Piv]$^-$ ligands. Shape analysis of all the Ln(III) centers reveals the existence distorted triangular dodecahedron geometry. Magnetic studies revealed that compound **1** sł slow magnetic relaxation under zero-field at low temperatures whereas compound **4** displays f induced slow magnetic relaxation.



Keywords: 3d-4f complexes; magnetic susceptibility; slow magnetic relaxation

Abstract ID: ACE-PP1

Mixing efficiency and residence time distribution studies in a pulsed sieve plate extraction column using radiotracer

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Abstract

The pulsed sieve plate columns (PSPC) are widely used for solvent extraction process in chemical, petroleum, biochemical, metallurgical and nuclear industries due to their compact design, ease of operation, absence of moving parts. Mixing of the fluids in the PSPC is a critical parameter for its optimal design and efficient operation, as it decides fluid mixing, reactor performance and product quality. The ideal design and operation of the PSPC requires narrow residence time distribution (RTD) and high mixing of process fluid. The present study describes, the RTD measurements carried out in continuous phase of a pilot-scale PSPC using ^{99m}Tc as radiotracer. The water and dodecane were used as dispersed and continuous phase respectively. The continuous phase mixing in the PSPC was quantified using axial dispersion and continuous stirred tank with feedback modes at different pulsing velocity, dispersed phase and continuous phase flow rates. The liquid mixing was found to be significantly affected by continuous phase flow rate and pulsing velocity, whereas marginally affected by dispersed phase flow rate. Moreover, the results of the study will be used to validate the computational fluid dynamics codes and scale-up of the PSPC.

Keywords: Axial dispersion; Residence time distribution; Radiotracer

Abstract ID: ACE-PP2

Towards Sustainable Extraction of Polyphenols from Agro-food Waste

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Abstract

The rising volumes of agro-food waste as a result of the world's expanding human population are frequently linked to problems with environmental contamination and a lack of natural resources. Nutrient-rich agro-food wastes are frequently the most alluring substrates for the important bioproducts such as industrial enzymes, biofuel, and phenolic compounds (polyphenols). Phenolic compounds are secondary metabolites that are mostly found in structurally diverse plant species. Due to their strong antioxidant capacities and notable contributions to the reduction of oxidative stress-related disorders like cancer, polyphenols are gaining more and more attention. However, polyphenol extraction from agro-food waste is hampered by low yield and high production costs. The lengthy and labor-intensive extraction process has been the barrier

in the use of natural materials in drug development. Moreover, there is a need for the extraction process to be green and sustainable. With that motivation, the goal of our work is to optimise various laboratory scale extraction technologies, specifically with microwave and ultrasound, based on techno-economic and life cycle assessments to determine the optimal choice for the extraction of phenolic compounds.

Keywords: Agro-food waste; Polyphenols; Optimization; Sustainability

Abstract ID: ACE-PP3

Design of ammonia production plant and production of acrylonitrile using ASPEN PLUS

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Abstract
The present study addresses the methods and means to safely create a preliminary design for ammonia production plant on a small scale. The study aims to optimize the process parameters and assess the feasibility of the proposed plant design for efficient and sustainable ammonia production, along with acrylonitrile as product. The analysis state that Haber Bosch process can be used to produce ammonia at small-scale because of the ease in availability of raw materials, optimum working conditions, increased efficiency. Also, acrylonitrile which is widely used as monomer, comonomer, intermediate for fibres, thermoplastics and elastomers can be produced using ammonia. This investigation includes the thermodynamics aspect of nitrogen liquefaction under certain operating condition. The liquefaction temperature of nitrogen being -200°C is taken into consideration. Moreover, the simulation study is also conducted for the separation of N2 from air and the purity is found to be 92.3 %.

Keywords: Ammonia; Haber-Bosch; Acrylonitrile; Ammoxidation; ASPEN; Simulation

Abstract ID: ACE-PP4

Hydrodynamics of a rotating solid-liquid feed clarification system

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Abstract
Tubular Bowl Centrifuges (TBC) are widely used for the efficient separation of solids from liquids in chemical processing plants, especially in fast reactor nuclear fuel reprocessing plants where fissile and fertile materials are recovered from the nuclear spent fuel through a series of chemical operations. One of the operation being clarification, which involves the separation of fine solid particles from dissolver solution, obtained after chopping of nuclear spent fuel. These solid particles, if not removed, will lead to choking of the liquid transfer lines and degradation of solvent due to accumulation in the interfaces during solvent extraction step.
TBCs are mostly preferred for solid-liquid clarification process because of its unique feature of high settling velocity by attaining high G-Force for large feed rates due to which shorter residence times are achieved. This leads to ease of separation of very fine solid particles ranging from 0.5- 500 μm and reduces complexity in processing of unstable materials due to short residence times.
The separation efficiency of particles is strongly influenced by the hydrodynamics in the high speed rotating bowl.The flow pattern, stationary phase retention and the interfacial area for effective mass transfer are strongly dependent on the physical properties of solvent system and its operating parameters. In order to measure these parameters, the hydrodynamic behaviour inside the rotating bowl need to be visualized w.r.to bowl speed, liquid level, diameter and height of the bowl.
In this study, the free surface profile of liquid inside centrifuge rotating bowl is traced from the initial condition of stationary fluid to final state of paraboloid shape due to forced vortex phenomenon, corresponding which the parameters like cut-off speed, residence time, pressure distribution and velocity distribution are estimated by developing a numerical model using CFD tools. The results obtained for the model are validated with the experimental results. Further, parametric studies are performed with the developed model.

Keywords: Cut-off speed; residence time; pressure distribution; velocity distribution; centrifuge bowl

Abstract ID: ACE-PP9

Fabrication and study of Pebax/PVA blend membrane for CO_2 Separation

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Abstract
CO_2 being a greenhouse gas is responsible for global warming. For the separation of CO_2 from the CO_2/N_2 gaseous mixture, Pebax and the Pebax/PVA blend membrane have been fabricated. Characterizations such as FTIR, XRD, TGA, FESEM, TEM, EDX, and XPS have been done on the prepared material. FTIR and XRD of the Pebax/PVA blend are indicating that there havehas been interaction between Pebax and PVA. Peaks shifted towards higher wavenumber with increasing content of PVA indicating an increase in crystallinity of the membrane. Also, the XRD peak for PVA appeared in the XRD pattern of the blend membrane. Further, a gas separation study was performed on the pure Pebax membrane and Pebax/PVA blend membrane. For pure Pebax membrane CO_2/N_2 selectivity was lower than 1 but for the Pebax/PVA blend membrane CO_2/N_2 selectivity increased to around 3. This suggests that Pebax/PVA blend membrane can give better gas separation results than the pure Pebax membrane. It is also envisaged that with the incorporation of an amine carrier and MOF, the gas separation performance will increase to a higher value.

Keywords: Flue gas; CO_2 separation; Polymeric blend membrane

Abstract ID: ACE-PP10

Micronization of Explosives by Expansion of CO_2-Expanded Liquid Solutions

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Abstract
High-energy compounds (HECs) play a critical role in military munitions and solid propellants due to their high energy density, but their sensitivity to accidental stimuli raises serious concerns. To address this issue, crystal engineering has emerged as a promising strategy for reducing sensitivity by modifying their physical characteristics, such as crystal size, shape, and morphology. The correlation between explosive particle size and impact sensitivity[1] has sparked interest in producing micrometer or sub-micrometer solid particles. Various methods have been proposed for preparing sub-micron sized HECs, including SAS, sol-gel, RESS[2], and mechanical milling. However, these methods have limitations, such as the need for high pressures (200-400 bar) and complex nozzle geometries. To overcome these limitations, Precipitation by Pressure Reduction over the Gas-Expanded Liquids (PPRGEL) was introduced[3], which achieves effective micronization by drastically reducing the solution temperature (30-80K in 0.5-1.5 min), resulting in rapid, high, and uniform supersaturation. In this study, we employed the PPRGEL method to micronize HMX (1,3,5,7-tetranitro-1,3,5,7-tetrazocane) and investigated the influence of various process parameters, such as pressure, solvent type and volume, saturation, solvent-to-antisolvent ratio, antisolvent temperature, and surfactant concentration. Our findings revealed that GBL (Gamma Butyro-Lactone) produced the smallest average particle size among the tested solvents (Acetone, DMF, and GBL). The optimal conditions for achieving the smallest particle size were identified as 64 bar pressure, 0.5 saturation, and a solvent-to-antisolvent ratio of 1:10. The addition of surfactants, specifically Tween-80 at a concentration of 400 ppm, effectively prevented particle agglomeration. FTIR analysis confirmed the presence of the Beta polymorphic phase. Ultimately, the PPRGEL technique enabled a significant reduction in particle size, from 180μm (for raw HMX) to 5.51 μm (D50), corresponding to an approximate reduction of 97%.

Keywords: Explosives; PPRGEL; Micronization

Abstract ID: ACE-PP11

Selective Separation of CO_2, CH_4, and N_2 Gases over Polyols-modified Zeolite

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Abstract
The adsorptive separation process for CO_2/CH_4 and CH_4/N_2 gas separation has commercial potential, in biogas, CBM, etc. although it remains to strive due to the absence of effective adsorbents. Zeolite NaY was used in this study due to its uniform pore structures, surface properties, and potential gas separation adsorbents. Zeolite NaY was modified by polyols to get a high-selective adsorbent for CO_2/CH_4 and CH_4/N_2 gas separation. Various structure-sensitive techniques such as TEM, PXRD, FT-IR, GPC, ^{1}H NMR, adsorption-desorption isotherm, and surface area analysis were used to characterize the polyol and polyol-modified zeolite. The adsorption isotherm for CO_2, CH_4 and N_2 was measured at 298K, 313K and 328K up to 5 bar pressure. The surface area and hydroxyl groups in polyol-modified NaY enhanced selectivity for CO_2/CH_4 and CH_4/N_2 gas separation. The selectivity was calculated by the IAST method. The selectivity of 0.5% polyol-NaY was 108 % higher than the commercial zeolite NaY for CO_2/CH_4 at 5 bar pressure whereas, 2% polyol-NaY was selective for CH_4/N_2 gas separation which is 110 % higher than the commercial zeolite NaY. It may be suggested that the 0.5% polyol-NaY is suitable for CO_2/CH_4 gas separation and 2% polyol-NaY for CH_4/N_2 gas separation.

Keywords: Adsorption; Carbon dioxide; Methane; Nitrogen; Polyols; Separation; Zeolite NaY

Abstract ID: ACE-PP14

Activation of Dry Reforming of Methane by Molten In-Ni and In-Sn Alloy

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Abstract
With the escalating energy demand and the pressing need for sustainable and eco-friendly energy sources, hydrogen fuel has emerged as a promising option. This clean energy carrier can be efficiently produced through the dry reforming of methane, a potent greenhouse gas (GHG). Molten metal catalysts have drawn attention due to their remarkable advantages, such as no catalytic deactivation issues and more efficient heat transfer capabilities. Among various molten metal catalysts, pure indium (In) demonstrates superior CH_4 and CO_2 conversion rates compared to other molten metals like Ag, Cu, Sn, Ga, and Bi. Interestingly, the catalytic activity of In and many other molten metals can be further enhanced by alloying with other metals. In-based alloys particularly exhibit the highest CO_2 conversion efficiency compared to Sn-based and Ge-based alloys. This computational study aims to elucidate the underlying reasons for the distinct performance of In-Ni and In-Sn molten metal catalysts in terms of methane and carbon dioxide conversions. The methodology used in this work involves constant temperature a*b initio* molecular dynamics simulations with energies calculated using density functional theory. The activation energy, a critical factor impacting the conversion efficiency, was evaluated using the nudge elastic band (NEB) method. A higher activation energy is expected to result in lower conversion rates. Our simulation results revealed that the molten systems showed distinct atom segregation patterns, with In metal preferentially occupying the surface in both In-Ni and In-Sn systems. The simulations predict a higher activation energy for methane dissociation in the In-Ni system compared to the In-Sn system, suggesting a lower methane conversion efficiency for the former. Conversely, the In-Ni system exhibits lower activation energy for carbon dioxide dissociation than the In-Sn system, indicating enhanced CO_2 conversion. The implications of our findings are substantial, as the In-Ni catalyst offers the potential for efficient carbon dioxide utilization while curbing methane emissions.

Keywords: Dry Reforming of Methane; Molten Metal Catalyst; Syngas; Hydrogen

Abstract ID: ACE-PP15

Efficient Metal Catalyst for CO2 Methanation Supported on Alumina

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Abstract
Methanation plays a crucial role in mitigating greenhouse gas and advancing the development of renewable energy system.

$CO_2 + 4\,H_2 \rightarrow CH_4 + 2H_2O\ \Delta H^0_{rx}\,(25\,°C) = -165\ kJ/mol$

It is known that rhodium(Rh)-based catalysts have excellent catalytic performance for methanation reaction. However, nickel(Ni)-based catalyst are commercially used. We will conduct a comparative analysis of the supported rhodium- and nickel-based catalyst using a commercially available Al2O3 support to determine the effect of loading and reaction temperature on conversion and selectivity. The catalysts will be synthesized by incipient wetness impregnation and finally calcined at 500°C. The catalysts will be characterized by: H2-TPR, H2-TPD, UV-Vis, and XRD, with an aim to assist us in understanding the difference in catalytic behavior of the two supported metals. Initial H2-TPR studies reveals that the supported rhodium catalyst are reduced at lower temperature (300oC) compared to nickel (600oC). Thus, all the reactions will be performed in a downward flow quartz tube packed bed reactor using catalysts reduced at 300oC (for supported Rh) and 600oC (for supported Ni) at atmospheric pressure and reaction temperature 230-300 °C. Based on these studies the optimum loading of supported Rh and Ni will be determined, and effect of metal loading compared.

Keywords: Renewable energy; Methanation; Nickel; Rhodium

Abstract ID: ACE-PP16

Thermo-catalytic conversion of CO_2 into ethanol over Na-Co/ZnO &NaCo/SiO_2 catalyst.

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Abstract

Ethanol is a significantly useful chemical in both industry and our daily life as it has been widely used as a clean fuel additive, solvent, and disinfectant. Developing new routes for ethanol production is of great importance other than fermentation process. As CO_2 is a major contributor of greenhouse gases, conversion of CO_2 into value-added products such as ethanol will not only result in the production of alternative fuel but it will also help in the reduction of CO_2 emission. Thermo-catalytic conversion of CO_2 into ethanol can offer an attractive solution for continuous and large-scale ethanol production. In this current work, Na-promoted cobalt-based catalysts supported on different support i.e ZnO, and SiO_2 have been investigated. For this purpose 2%Na- 20%Co/ZnO Catalyst is prepared by incipient wetness impregnation method using 0.37 gm Na_2CO_3, 3.96 gm of $Co(NO_3)_2.6H_2O$, and rest 3.12 gm of ZnO. The Catalyst prepared was calcined at 350°C for 3h and then activated at 350°C and 5 bar conditions with a flow of 31.1 ml/min hydrogen gas. H_2 and CO_2 ratio is maintained as 3:1. Activity test of the prepared catalyst was performed at 250°C and 15 bar pressure condition and feed flow of 62.2 ml/min. Figure 1 shows the preliminary investigation for Na-Co/ZnO catalyst. It was found that CO_2 conversion was lying between 30-45%. However, no ethanol production was observed. To further investigate the effect of support, promoter, and different catalyst composition, activity test of Na-Co/SiO_2 will also be performed.

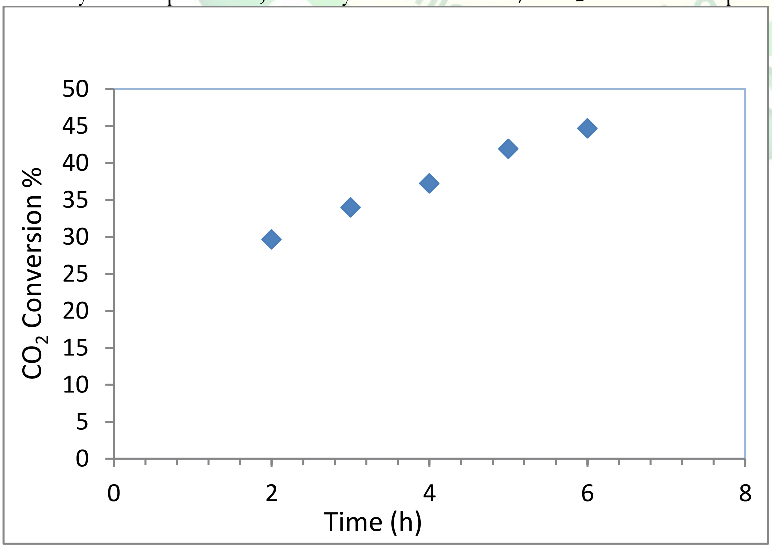

Figure1- CO_2 conversion percentage with time on stream for Na-Co/ZnO (T-250°C, P-15 bar, CO_2:H_2= 3:1)

Thermodynamics calculations and study of CO_2 hydrogenation to higher alcohols were done using SRK(Soave- Redlich-Kwong) equation of state model in DWSIM was used for simulation under different conditions i.e Temperature, Pressure,

CO_2&H_2 ratios. Thermodynamically, methane is the most favorable product in a reaction system containing CO, CO_2, and H_2, as well as C_{1-4} alkanes, alkenes, and alcohols.

Keywords: Ethanol; CO_2 hydrogenation; Cobalt catalyst; Carbon utilization

Abstract ID: ACE-PP17

Prediction and Optimization of Syngas Yield from Biomass using Multivariate LSTM

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Abstract
Biomass gasification offers a promising pathway to produce syngas, a versatile fuel precursor, from renewable feedstocks. However, the inherent complexity and uncertainty in the gasification process hinder its efficient optimization. This study proposes a novel approach to enhance syngas yield from rice husk and coconut shell through the integration of Gaussian Process Regression (GPR) and Shapley Additive Explanation (SHAP) techniques. The research utilizes GP regression to construct a surrogate model of the gasification process, capturing the intricate relationships between key process variables and syngas yield. By emulating the gasification process, the surrogate model efficiently explores a vast parameter space, enabling faster and cost-effective optimization. To further comprehend the surrogate model's predictions and gain insights into the process, SHAP is employed to elucidate the relative importance of process variables. Finally, the proposed methodology is validated using real-time biomass gasification data in a two stage updraft fixed bed gasifier, demonstrating its capability to accurately predict syngas yield and pinpoint influential factors. The experimental conditions like reaction temperature, air flow rate, equivalence ratio, biomass ratio were maintained in the range of 550-1000oC, 0.01-0.03 L/min, 0.2-0.4 and 0 - 1:1, respectively. The results showcase a significant improvement in syngas yield compared to conventional optimization techniques.

Keywords: Biomass; Gasification; GPR; SHAP; Syngas Optimizationoptimization

Abstract ID: ACE-PP20

Study on cement slurry formulation with dbm and silica fume for horizontal wells at low temperature

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Abstract
Cementing plays a crucial role in the oil and gas industry in horizontal well operations as well as vertical wells but we discussed the horizontal wells in this paper. It is the process of placing cement slurry into the wellbore to provide zonal isolation, structural support, and protection of the casing. To enhance the performance of cement slurries in challenging horizontal well conditions, engineers have turned to novel additives and we were discussed about the properties change in cement slurry due to these additives.

In this paper we were to make a combination of dead burnt magnesite and silica fume in the cement slurry that represents a significant step forward in horizontal well cementing technology. The expanding properties of dead burnt magnesite and the strengthening effects of silica fume work synergistically to create a robust and reliable wellbore barrier. As the industry continues to push the boundaries of oil and gas extraction, this innovative cement slurry promises to deliver enhanced performance, greater operational efficiency, and improved wellbore integrity.

Keywords: Speciality Cements; Oil Well Cement; Horizontal Well Technologies

Abstract ID: ACE-PP22

Carbon Dioxide Capturing and Utilization for Sustainable Development: A Review

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Abstract
Global climate change has enforced to study innovative ways to lower carbon dioxide (CO_2) emissions from combustion of fossil fuels. 'Carbon capture and utilization' (CCU) has evolved as a promising concept that not only reduces CO_2 emissions but also converts them into useful products, for both environmental sustainability and economic development. This paper offers a thorough examination of advancements and breakthroughs in the field and includes CO_2 capture, and its utilization. Various techniques for carbon capture, such as chemical absorption, membrane separation etc. have been assessed for their effectiveness and affordability. Various ways have been examined for use of CO_2 including its transformation into fuels, chemicals, construction materials etc. The review offers insights into the practical applicability of CCU technologies and their integration into current industrial infrastructure by examining case studies. CCU stands out as a multidimensional strategy with the potential to revolutionize carbon management systems as efforts to reduce impact on climate change and for sustainable development.

Keywords: Carbon Capture; Sustainable Development; CO_2 Utilization.

Abstract ID: ACE-PP26

Application of PID Tuning in Chemical Engineering Processes

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Abstract
In controller design, there is generally a trade-off between robustness and performance of system. In some cases, we require the system to respond quickly and in some other cases there might be no need for quick response but small overshoot desired. In the study, performance of various PID tuning methods were analyzed and compared for First Order Plus Dead Time (FOPDT) system, Second Order Plus Dead Time (SOPDT) system and Heat Exchanger (SISO Model) based on Error Analysis. It was observed that Wang Juang Chan and IMC-PID methods produced better response for FOPDT System and SOPDT System. It was also observed that IMC PID method produced satisfactory response for all the above systems indicating high robustness of the method.

Keywords: Performance; FOPDT; SOPDT; Heat Exchanger

Abstract ID: ACE-PP28

Predicting Adsorption Kinetics in a Dehydration Unit for Gas Treating Applications

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Abstract
Adsorption technology has been widely used due to its low cost and high efficiency. Adsorption dynamics of a fixed bed is crucial for a well-designed adsorption process. The presence of water vapour as a polar component in natural gas causes corrosion and hydrate deposition on pipeline walls, and it must be removed from the gas system early on. Adsorption kinetics in gas treatment reactors significantly impact the "Mass Transfer Zone Length" (MTZL), with slower kinetics leading to larger reactors and increased fixed costs. The durability and performance of dehydration units (DHUs), commonly positioned downstream of acid gas removal units (AGRUs), are vital over their anticipated 4-year lifespan. However, as operational cycles progress, the adsorbent degrades, reducing DHU lifespans and increasing reactor sizes. Water breakthrough during DHU operation can halt LNG plant operations or necessitate shorter cycles, incurring substantial costs.

This study introduces a comprehensive mathematical model, employing MATLAB and COMSOL Multiphysics software, to predict gas dehydration unit performance. Parametric analysis elucidates the influence of operational parameters on breakthrough curves and improves MTZL predictions. Data from pilot plant reactor experiments enhances understanding of adsorbent saturation under varying conditions. These findings promise to optimize gas dehydration processes, ensuring their long-term viability and economic sustainability.

Keywords: Water adsorption; Breakthrough curve; Mass transfer zone length; Fixed bed column; COMSOL modeling

Abstract ID: ACE-PP30

Fractional Order PID Controller Design for Mixing Tank (MIMO) Process

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Abstract

Multi Input Multi Output (MIMO) processes are inherently harder to control because of the presence of interactions between the process loops. Thus, implementing standard PID do not give satisfactory results. To overcome this issue, an advanced controller design scheme based on fractional-order control has been proposed for a two-input, two-output mixing tank process. The fractional PID controller was implemented by designing the controller for individual loops using advanced algorithms present in the FOMCON (Fractional Order Modelling and Control) toolbox of MATLAB. Relative gain array analysis was done to obtain favorable pairing that provides least extent of interaction in the control loop. Further, a simplified decoupler was designed to remove any interaction present in the system. The proposed decoupled controller performance was compared with Ziegler-Nichols (ZN) and Internal Model Controller (IMC). The simulation results show that control achieved by the proposed controllers is significantly better than conventional PID and IMC PID.

Keywords: Multivariable Process, Fractional Calculus, IPD Controller, Relative Gain Array, Simplified Decoupler

Abstract ID: ACE-PP32

Implementation of Carbon Capture Utilization and Sequestration in India and the road ahead: a review

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Abstract
Notwithstanding the well-established fact that civilizations flourish due to fossil fuels, their exhaustible nature and their negative consequences on climate change rendered us to resort to alternative sources of energy. This contribution is an eclectic investigation of how the mitigation technology of the integrated Carbon Capture Utilization and Sequestration fared thus far in India and the prospects that it bestows the country from an engineering standpoint. It describes the challenges faced by an emerging nation such as India, where coal remains to be a predominant source of electricity, to fulfill the impact-scale deployment and retrofitting of the state-of-the art CCUS technology into a new or an existing plant, bearing in mind the social, economic, technological, political and legal factors in accordance with the Paris Agreement on climate change. It sheds some light on whether it is indispensable to deploy CCUS in India as opposed to the otherwise reduced energy penalties and the current technological trends in CCUS. To cite that it is imperative to have a collaborative movement between policy makers and academia on this front is an understatement.

Keywords: CCUS in India; CCUS energy requirements; Carbon dioxide; Energy penalty

Abstract ID: ACE-PP34

Fuzzy Logic Controller for Non-Linear Systems

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Abstract
Fuzzy logic has proven to be a powerful tool when dealing with nonlinear systems, providing a flexible and intuitive approach to modeling and control. This overview examines the application of fuzzy logic in addressing the challenges posed by nonlinear systems in various fields such as engineering, finance, and artificial intelligence. Nonlinear systems are characterized by complex and often unpredictable relationships between inputs and outputs. Traditional linear methods have difficulty capturing this complexity, making fuzzy logic an attractive alternative. Fuzzy logic introduces the concepts of linguistic variables and fuzzy sets, allowing for a more natural expression of uncertainty and ambiguity.
Applications ranging from self-driving cars to industrial automation, where accurate control is crucial despite nonlinear dynamics, have shown the value of fuzzy control systems. Fuzzy logic is also essential to artificial intelligence because it allow systems to think and decide in complex, unpredictable contexts. Fuzzy logic models in finance can be used to evaluate risks and optimize portfolios while taking into consideration the inherent volatility of the financial markets. In conclusion, fuzzy logic presents a potentially effective method for addressing the complicated nature of nonlinear systems.

Keywords: Fuzzy logic; Non-linear systems; Automation

Abstract ID: ACE-PP35

Sorption enhanced steam reforming of biomass fast pyrolysis volatiles: analysis of operating conditions

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Abstract
The biomass fast pyrolysis and in line sorption enhanced steam reforming is a promising process for hydrogen production, since it allows capturing the CO_2, obtaining higher H_2 yields, and a purity near to 100 % in the product stream.
This work deals with the evaluation of different operating conditions for the process from a thermodynamic point of view. Pro II v.2021 software was used for the simulation, which was based on the Gibbs free energy minimization method.
A wide range of operating conditions has been studied (temperature between 300 and 800 °C, and steam/biomass (S/B) ratio between 0 and 4). A hydrogen yield (wt% by mass unit of the biomass in the feed) near to 12.4 % and a hydrogen purity ≥ 98 % were obtained working between 400-600 °C, and within a S/B ratio between 1.5-4. The sorption enhanced process allows widening the operating window while maintaining best results, compared to the traditional steam reforming. Besides, it makes it possible to work at lower temperatures and S/B ratios, thus, reducing energy requirements, and at the same time, to obtain better results than the conventional SR in terms of H_2 yield and purity.

Keywords: biomass pyrolysis; hydrogen energy; carbon dioxide capture

Abstract ID: ACE-PP36

Synergistic Enhancement of CO_2/N_2 separation performance via Ce-MOF infused Chitosan Mixed Matrix Membrane

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Abstract
Reticular chemistry, exemplified by metal-organic frameworks (MOFs), has proven invaluable in creating porous materials with finely tuned structures to address critical global energy and environmental challenges. In this context, the need for efficient carbon dioxide (CO_2) capture and utilization has taken center stage. One promising approach involves the integration of MOFs into polymer matrix to develop Mixed Matrix Membranes (MMMs). Cerium-based MOFs (Ce-MOF)

were selected due to their robust CO_2 capture capabilities, while Chitosan (CS) was chosen as the polymer matrix due to its reasonably good selectivity and balanced CO_2 permeability for the development of MMMs for CO_2/N_2 (20/80 vol%) separation. A comprehensive suite of analytical techniques, including FTIR, XRD, FESEM, XPS, TGA, EDX, AFM, and BET, was applied for precise characterization of both the MOF and the membranes. Various operational parameters, such as Ce-MOF content, temperature, pressure, and humidity, were systematically explored in our CO_2 capture investigations. The results revealed that the optimized Ce-MOF-embedded CS mixed matrix membranes (MMMs) consistently outperformed the bare CS membranes

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Advanced Polymer & Composite (APC)

Polymer composites in electronic mobility; Polymer composites in aviation and aerospace applications; Multifunctional polymer composites in artificial intelligence; Sustainable green composites; Fire-retardant lightweight composites for battery applications; Biomimicked polymers and their applications; Processing, Modeling, and Properties of advanced polymer and composites

Abstract ID: APC-OP1

Developments of Self-Driven Auto-sensors derived from PENGs for Multifunctional Applications & Machine Learning

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Abstract
In todays' world, the advent of the Internet of Things (IoT) era, there has aroused a dire need of multi-sensored systems in different applicative uses. For large scale networks, parameters like remote controlled, self-sustaining & independent operations are becoming of primeval importance. For these purposes, a self-driven sensory system which can utilize the self-

harvested energy extracted from its surroundings to run the sensors and directly response to the external stimuli has attracted great attention worldwide. The discovery & developments of Piezoelectric Nanogenerators (PENG) which basically takes Maxwell's Displacement Currents as the driving force, has invariably led to the research & development of self-powered active mechanical sensors, electronic skins, and humanoid verbal and physical interactions. The present review introduces us the concepts of piezoelectric materials and fabrication processes along with the energy harvesters used for self- powered systems along with the applications of PENGs. Moreover, some challenges and industrial obstacles for the self-powered multifunctional sensors are also put forward here. The perennial investigations into PENGs- based active sensors will eventually use in Touch screens, environment monitoring & intelligence learning.

Keywords: IoT; PENGs; Displacement currents; Piezoelectric materials; Intelligence learning

Abstract ID: APC-OP4

Effect of Nano-filler Size and Concentration on Solvent Transport Through Ethylene Propylene Diene Monomer Based Elastomer Composite

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Abstract
Ethylene propylene diene monomer (EPDM) is a cost effective, synthetic rubber with a variety of applications such as sealant, cable insulators, hoses, liners, gaskets etc. It shows excellent resistance to weather, chemicals, high temperature and environment making it a popular choice for various industries. In order to enhance the properties such as mechanical, thermal and electrical of EPDM components they are primarily loaded with microfillers. Hence, it is crucial that it does not allow solvent transportation to a high extent when in use. In this work we evaluate the solvent (toluene) transportation of EPDM elastomer and its composites loaded with micro-fillers and the effect of size and concentration of nano-fillers on solvent transport. We found that the addition of microfiller increases the rate of solvent sorption. However, the addition of nanofillers reduces this solvent transport drastically. The effect of concentration and particle size also shows the decrease in solvent sorption in the composite. Additionally, we used different solvent transport models to analyse the mode of transport. Finally, this study aims to help the polymer engineers to select the suitable formulation for applications involving various solvents.

Keywords: Ethylene propylene diene monomer; Solvent transport; Nanofillers

Abstract ID: APC-OP5

Study the Role of Different Nanomaterials in Biodegradable Polymer Film for Food Packaging Industry

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Abstract
Flexible polymer films are very much useful for the packaging purpose in food industry, but excess use of synthetic polymers creating serious issues when it's disposed to environment. Biodegradable polymeric films can be an alternative solution to address these issues. Herein biodegradable film was prepared using aqueous polyvinyl alcohol (PVA), starch (ST) and glycerol (GL) solution by solution casting method. The film made of this composite polymer have limited application because of its low tensile strength, high moisture permeability. The application of this film can be enhanced by incorporating nanomaterials within the film which can increase the strength as well as other properties. We studied the relative effect of different nanomaterials; TiO_2 and g-carbon nitride (g-C_3N_4) on the physical properties of this biodegradable film. The obtained films were characterized by FTIR, SEM, TGA, contact angle, swelling behaviour, and soil-degradation to check the efficacy of the

nanomaterials. The study reports that there is a change in morphology of the film after adding both different nanomaterials in it. The tensile strength and soil degradation study shows there is different trend in the presence of different nanomaterials.

Keywords: Polymer composites; Biodegradable film; Nanomaterials; Food packaging

Abstract ID: APC-OP7

Mixing of polymer blends via reversible dynamic crosslinks

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Abstract
Most of the industrially used polymers are immiscible and incompatible and do not form a homogeneous mixture. Stabilizing these immiscible mixed plastics could increase their lifespan and enable previously unrecoverable mixed plastic wastes to be reprocessed and reused. Thus, developing new methods for increasing blend compatibility is of increasing demand for sustainable polymer development. Here we study how dynamics covalent bond can reactivate mixed plastic "dead" chains into compatibilized multiblock copolymers. We develop a bead-spring model and carry out molecular dynamics (MD) simulation of an incompatible homopolymer blend, whose constituents are termed A and B. Dynamic crosslinks are created only between pairs of dissimilar (AB) monomers within a predefined cut-off distance. Figure 1A and 1C are with 5% and 15% of AB crosslinked monomers, respectively. The corresponding radial distribution functions for AA, BB and AB pairs are shown in Fig. 1B and 1D. These results illustrate the clear transition from an immiscible blend to a progressively more miscible one. Detailed analysis of the static structure factor shows that the 5% AB crosslinked system is likely microphase separated while the 15% system is completely miscible. Consistent with this conclusion, there is clear evidence of decreased sizes of the Arich and B-rich domains with increased AB crosslinking. The creation of a "living" gMBCPs, is found to be the underpinning driver for the increased miscibility. In contrast, static crosslinking creates a much less miscible system. We establish correlations between miscibility, lifetime of dynamic crosslinks, the fraction of crosslinks. We show that the universal dynamic crosslinking improves the mechanical properties, and thus the reusability of the blend. Our theoretical prediction is validated by recent experimental studies.

Keywords: Dynamics bonds; Polymer recycling; Molecular simulation

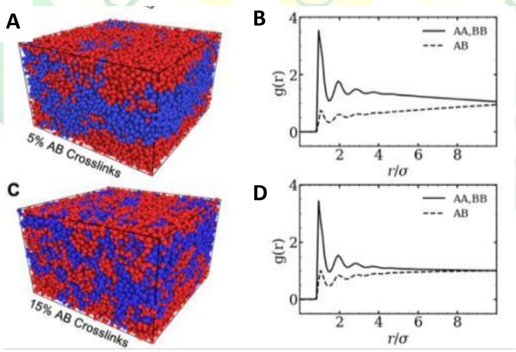

Figure 1: Coarse-Grained MD Simulations of a BinaryPolymer Blend. MD snapshots of 5% AB dynamically crosslinked (A), 15% AB dynamically crosslinked blends (C). The corresponding radial distribution functions are shown in (B), and (D), respectively

Abstract ID: APC-OP10

Synthesize of Nanosilica from Rice Husk and its application on the Structure, Property and Biodegradability of LDPE/Starch Biodegradable Film

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Abstract
This work emphasizes the extraction of nanosilica from agricultural waste (rice husk) for its application as a property enhancing filler for producing high quality packaging material. Nanosilca (200 nm) is obtained by chemical treatment followed by further reduction of size through cryo mill. The nanosilica having surface area and pore volume of 189.64 m^2/g and 0.462 cc/g respectively used as a filler. The SEM and TEM analysis indicates the uniformity in particle size of the produced nanomaterial with an agglomerating tendency. The XRD and FTIR analysis reveals that the obtained material is amorphous in nature and is obtained as SiO_2. The nanosilica is dispersed in various proportions in LDPE/Starch matrix and it is observed that the highest tensile strength (9.62 MPa) can be obtained at 1.5% of nanosilica content in the matrix. There is a continuous increase in Young's modulus and stiffness from 372.3 to 440.12 MPa and 20243.2 to 28559.42 N/m respectively when 1.5% of nanosilica is dispersed in the biodegradable matrix. The hybridised film produced showed promising results in terms of biodegradability. The weight loss percentage in garden soil is found to be 10.32%, indicating that it could effectively substitute low-quality biodegradable packaging films.

Keywords: Starch blended low density poly ethylene; Biodegradable films; Nanosilica; Agricultural waste; Rice husk

Abstract ID: APC-OP12

A Sustainable Approach to Enhance Biodegradable Plastics with Starch Biofillers Derived from Potato Peels and Rice Husk Ash

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Abstract
The demand for environmental protection has led to the development of biodegradable polymers and nanomaterials. These materials can be used in eco-friendly applications and help address public health and ecological issues. Nanofillers, such as natural fibers, can improve the properties of biodegradable polymers, such as mechanical strength and thermal properties. This study investigates the potential of using starch derived from potato peels and rice husk as biofillers for the production of biodegradable plastics. The aim is to explore a sustainable approach to producing eco-friendly plastics that can reduce the negative impact of traditional plastics on the environment. Starch was extracted from potato peels and modified using phthalic anhydride, formamide, and potassium acetate to ensure its homogeneous dispersion into the polymer matrix. The modified potato peel starch and rice husk ash were characterized using various techniques such as Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD) and blended with recycled low-density polyethylene (LDPE) to produce biodegradable biofilms.

Keywords: Biodegradable plastics; Starch; Potato peels; Rice husk; Biofillers; Environmental protection; Biodegradable polymers; Nanomaterials; Eco-friendly applications; Public health; Ecological issues; Nanofillers; Natural fibers

Abstract ID: APC-OP13

Recent trends in amine-functionalized porous polymer adsorbents for CO_2 capture

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Abstract

In this review, we are presenting the development of amine-functionalized porous polymeric adsorbents for the CO_2 capture from the point source. Moreover, amine leaching and evaporation are common in the adsorbents through physical deposition of polymeric amines on porous supports. An effective way to address such problem is the epoxide-functionalization of primary amines to reduce the adsorption heat and facilitate CO_2 desorption, because the secondary amines have relatively weak interaction with CO_2 molecules to avoid dehydrative condensation. Further to improve the loading of inert amines, we propose to prepare the porous polypropylene/polyolefin elastomer (PP/POE) as the support with low density and high porosity using supercritical CO_2. Based on the phase inversion mechanism, the pore sizes of the porous polymer can be effectively controlled at the micron-scale, which is crucial for improving the adsorption efficiency of loaded amines. The porous polymers have a robust compression-resilience performance thus being an ideal support to host and protect the functionalized amines. The high porosity and low density of porous polymer can be impregnated with a high content of the modified amines and simultaneously provide enough passageways for CO_2 diffusion, promising a high adsorption capacity even after in-depth functionalization.

Keywords: CO_2 capture; Flue gas; Porous polymer; Adsorption; Amine functionalization

Abstract ID: APC-OP15

Synthesis of β-nitrostyrene derived chitosan derivative: characterisation and biological applications

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Abstract
Michael addition of chitosan to β-nitrostyrene followed by elimination via retero aza-Henry type process was used to synthesize a β-nitrostyrene derived chitosan conjugate (β-NS-CS). It was characterised by FTIR, ^{1}H NMR, XRD and SEM analyses, which successfully confirmed the formation of the conjugate. The FTIR spectrum showed a peak at 1617 cm^{-1} which confirmed the presence of imine (C=N) group. In ^{1}H NMR spectrum, the new signals in the aromatic region along with chitosan proton signals also confirmed the successful incorporation of the β-nitrostyrene into chitosan framework. The XRD pattern was found to be different from chitosan with more peaks indicating that the conjugate is more crystalline than chitosan. The SEM analysis confirmed the porous morphology of the conjugate. β-NS-CS also showed good response in biological applications like antibacterial activity and antioxidant activity, further finding approach in drug delivery. The antibacterial activity against gram negative bacteria (*E. coli*) was found to be enhanced after conjugation of β-nitrostyrene with chitosan. The antioxidant activity of conjugate was evaluated using DPPH radical scavenging method which exhibited about 24% antioxidant radical activity.

Keywords: Chitosan; β-Nitrostyrene; Michael addition; Antibacterial activity; Antioxidant radical activity

Abstract ID: APC-OP18

Enhancing mechanical and thermal properties of plasticized starch via temperature optimization: A melt processing approach

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Abstract
This work proposes a cost-effective sustainable technology as an alternative to conventional polymers. For this purpose, the starch-based formulation containing glycerin (15%, 20%, and 25%) and water as a plasticizing system was considered. The temperature during the melt processing was optimized to improve the properties of the formulation. The polymer developed through the optimized settings was subjected to mechanical (tensile experiments) and thermal (thermo gravimetric analysis, differential scanning calorimetry) studies. Also, the wettability, morphological, and Fourier transform infrared characterizations were carried out. From the results, it was identified that the starch-based system containing 15% glycerin processed at 120 °C showed better properties than the other composition. The obtained tensile strength, Young's modulus,

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and the elongation in break were 21 MPa, 392 MPa, and 9%, respectively. The properties of the optimized polymer blend were in agreement with the blended starch, cross-linked starch, modified starch, and starch with added fillers reported in earlier studies. Another observation was that the increased plasticizer concentration decreased thermal stability. However, the optimized formulation was more stable than native starch up to 270 °C, indicating the enhanced starch-plasticizer interaction. Due to this reason, the hydrophobicity of the optimized blend was found to be superior. The results obtained from this investigation showed that the optimization of process parameters could help to enhance the properties of the starch formulation without the need for costly additives.

Keywords: Melt processing; Temperature optimization; Mechanical and thermal properties

Abstract ID: APC-OP19

Kinetic Study on the Curing Reaction of 4- (Dimethylsilyl) Butyl Ferrocene Grafted HTPB with IPDI by Differential Scanning Calorimetry

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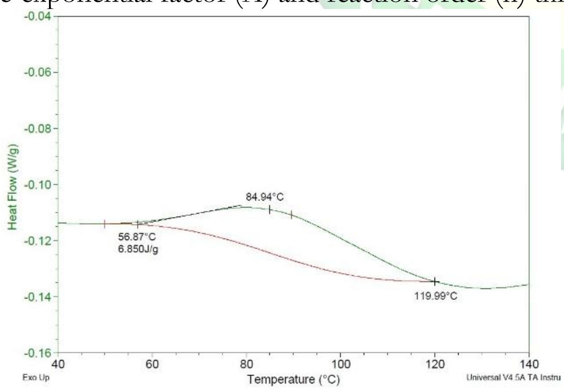
Abstract
Composite propellant which is a highly filled viscoelastic material with a filler phase of oxidizer, metal powder and high explosives, has contributed immensely in the domain of space and defence. On suitable initiation energy, composite propellant produces high temperature gases, which were expanded through a nozzle to generate thrust for rockets and missiles.
The burn rate of composite propellant is one of the most important parameters owing to its ability to change the ballistic of the projectile. Different stages of missile system demand for different burn rates based on the thrust requirements, and it is an active filed of research to deduce ingenious pathways to obtain high burn rates for composite propellant. The ever-growing need of higher burn rate has necessitated exploration of novel polymeric binder system; 4-(Dimethylsilyl) Butyl Ferrocene grafted Hydroxyl terminated polybutadiene, where ferrocene-based burn rate modifier has been grafted to the back bone of workhorse binder Hydroxyl terminated polybutadiene (HTPB). Although, a higher burn rate of 40 mm s^{-1} at 7 MPa was achieved, it exhibits processibility issues pertaining to viscosity management and higher rate of curing reaction with isocyanate curators such as Toluene diisocyanate (TDI), Isophorone di isocyanate (IPDI) etc.
In this work, attempts were made to examine the kinetic parameters of 4- (Dimethylsilyl) Butyl Ferrocene grafted HTPB with curator IPDI (P01), and a comparative study was performed against the curing kinetics of HTPB/ IPDI (P02) system. The curing reaction of HTPB based binder system with isocyantes is a continuous exothermic process. Therefore, application of differential scanning calorimetry has been attempted in evaluation of kinetic parameters such as activation energy (E_a), pre-exponential factor (A) and reaction order (n) through the Kissinger, Ozawa and Crane methods.



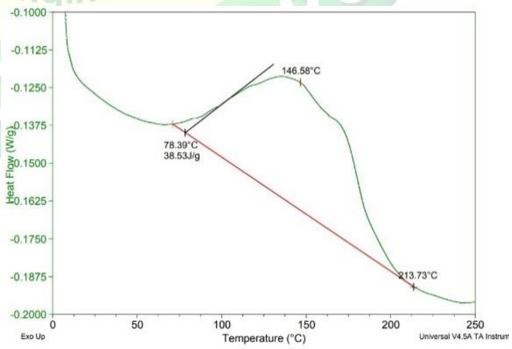


Fig 1. DSC curve exotherm of 4-(Dimethylsilyl) butyl ferrocene grafted HTPB/IPDI (P01) & HTPB/IPDI (P02) systems

The Kissinger and Ozawa plots for both the systems P01 and P02 were utilized to compute the Arrhenius action energy, pre-exponential factor and rate constant of the curing reaction as described in Table 1.

System	Method	Activation energy (kJ mol^{-1})	Pre exponential factor (min^{-1})	Rate constant at 50 °C (min^{-1})

4-(Dimethylsilyl) butyl ferrocene grafted HTPB/IPDI (P01)	Kissinger	43.4	4.25×10^5	0.04
	Ozawa	44.2	5.77×10^5	0.04
HTPB/IPDI (P02)	Kissinger	33.7	1.8×10^3	0.007
	Ozawa	35.4	3.16×10^3	0.006

Table 1. Kinetic parameters of curing reaction of P4-(Dimethylsilyl) butyl ferrocene grafted HTPB/IPDI (P01) & HTPB/IPDI (P02) system

The activation energy obtained from Kissinger and Ozawa method are very close and the data suggested that the 4-(Dimethylsilyl) Butyl Ferrocene grafted HTPB/IPDI (P01) has a higher activation energy as compared to that of HTPB/IPDI (P02) system. However, the rate constant values showed that P01 system exhibits a faster rate of curing reaction as compared to P02. The Crane model was explored to determine the reaction order of the curing reaction, and both the systems; P01 and P02 follow a nth order reaction kinetics with order of 0.93 and 0.88.

Keywords: Curing kinetics; DSC; Activation Energy (E_a); Rate constant; Reaction order (n)

Abstract ID: APC-OP20

Melt processing of Sawdust reinforced Polylactic acid/Polycaprolactone biocomposites with ensured scalability

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Abstract
The major drawback associated with petroleum-based polymer products is pollution, leading to environmental hazards. So, it is essential to replace conventional polymers with biodegradable polymers. However, biodegradable polymers express low thermal stability, low gas permeability, and high cost when compared with conventional polymers. These issues can be effectively addressed with biodegradable polymer composites. In this work, sawdust reinforced PLA/PCL biocomposites were developed using the melt extrusion technique. At first, the collected sawdust was processed through shaking, grinding, sieving, meshing, and washing. Then the obtained fine sawdust was blended with PLA/PCL in a mini twin screw extruder. For this purpose, different weight fractions (10%, 20%, 30%, and 40%) of sawdust were considered. The developed biocomposites were subjected to tensile testing, and observed that the increased weight % of sawdust reduced the tensile strength. For instance, a 56% reduction in the tensile strength was witnessed with PLA/PCL/30 wt% sawdust compared with pristine PLA. The materials were investigated through regular laboratory experiments followed by assessment of scaling-up efficiency, which led to the production of, biodegradable disposable plates, successfully fabricated using the vacuum forming machine.

Keywords: Melt processing; Biocomposite; Degradation

Abstract ID: APC-OP21

Development of porous polyimide film for next generation electronic devices

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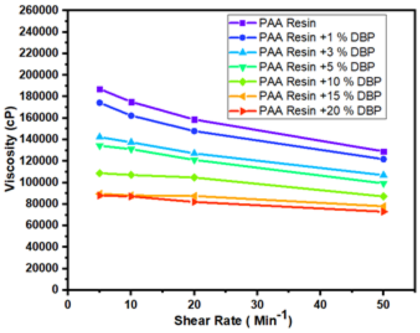
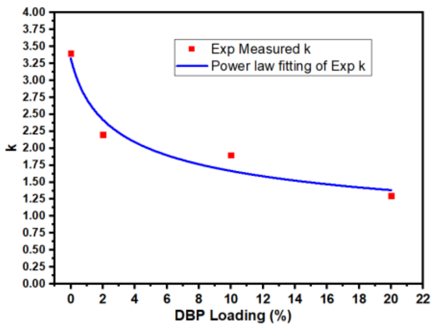
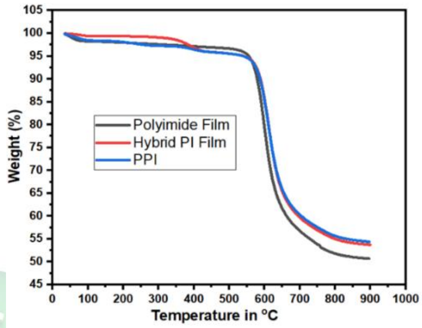
Abstract
Porous polyimide is an advanced engineering material due to its excellent insulating and outstanding dielectric properties. These properties enable porous PI films for its potential application as interlevel insulation materials in next generation micro electronic devices. Development of Porous PI film(PPI) was initiated for use in sensing layer of RH space sensor. In this study, a novel method was developed to achieve uniform pore size and the process is also scalable to produce the films in large scale. To achieve desirable porous film forming properties rheological studies of Polyamic acid and Mixed resins (with

porogen) is carried out followed by experimental trials to validate the film forming properties. Suitable Porogen is used in the synthesis of PPI which can be easily dispersed in the Polyamic Acid (PA) resin.
Optimization of process parameters for synthesis of porous polyimide film (PPI) is carried out w.r.t mixing time, curing cycle, chemical etching time of porogen followed by heating of PPI to remove any traces of volatile impurity present in the pores. Developed porous polyimide film had uniform pore distribution with a pore size of 0.5 to 8.0 μm, the dielectric constant is measured as 1.35 and the film is thermally stable up to 500°C meeting all the requirements for space grade RH sensor.







Viscosity of PAA resin & Mixed Resin variation with shear rate

us p

Dielectric Constant of PPI variation with porogen concentration

size;

Thermal stability of polyimide film, hybrid PI film and PPI

Abstract ID: APC-OP23

Cultural studies and biochemical characterization of high yielding exopolysaccharides producing cyanobacterial regimes: a comparative case study

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Abstract
Cyanobacteria are the most efficient microbial community platform to naturally synthesize biopolymer constituent i.e., exopolysaccharides. In this study, four different naive cyanobacterial strains had been investigated towards exopolysaccharides production. *Anabaena* sp CCC748 and *Nostoc* sp. CCC757 was the best producer of exopolysaccharides: around 1.29(±0.04) and 1.58(±0.06) μg.ml^{-1}, respectively. EPS has been produced especially in the stationary phase. At 15°C, pH 6, NaCl (10 g.L^{-1}), glucose as a carbon source (100 g.L^{-1}), yeast extract as a source of nitrogen (10 g.L^{-1}), and a glucose/yeast extract ratio (10/1) optimum EPS synthesis has been obtained. The EPS production has been enhanced by elevated NaCl concentration i.e. 40 g.L^{-1} and low light intensity (10 μmol photons.m^{-2}.s^{-1}). The soluble fraction of protein content and carbohydrates are estimated towards ameliorating exopolysaccharide generation in near future following genetic engineering and biosynthetic biology approaches. Due to their various physicochemical and biological features, EPSs have piqued the curiosity of researchers all over the world.

Keywords: Exopolysaccharide; Cyanobacteria; Microalgae; Soluble protein; Bioflocculants

Abstract ID: APC-OP24

Characterisation of *Ovis Aries* Horn and *Cocos Nucifera* Shell Particles for Hybridisation in Polymeric Composites

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Abstract
The potential of *ovis aries* (ram) horn and *cocos nucifera* (coconut) shell particles as hybrid reinforcement in polymeric composites was investigated in this work. *Ovis aries* horn and *cocos nucifera* shell particles were characterised using TGA, XRF, FTIR and XRD analyses. Both samples exhibited appreciable thermal stability as revealed by the TGA curves, while XRF analysis featured varied proportions of similar elemental and oxides constituents known to possess good reinforcement characteristics. XRD patterns of the NaOH treated *cocos nucifera* shell particles featured minor peak around $2\theta = 35^{o}$, suggesting a little alteration in crystallinity of the material. FTIR analysis established the presence of amine groups and disulphide bond in the *ovis aries* horn, and potentially reactive carbonyl, carboxyl, and hydroxyl groups in the *cocos nucifera* shell. Removal of waxy materials, part of lignin and hemicellulose, and reduction in hydroxyl groups of *cocos nucifera* shell particles after NaOH treatment were confirmed by FTIR. Hence, the potential of hybridising *ovis aries* horn and *cocos nucifera* shell particles as reinforcement in polymeric composites intended for impact resistance applications such as automobile bumper fascia is high.

Keywords: Hybridisation; *ovis aries* (ram) horn; *cocos nucifera* (coconut) shell; polymeric composites

Abstract ID: APC-OP25

Development of reinforced Polymeric Composite material using thermosetting polymers

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Abstract
Recently a numerous researches have been carried out on the development of different promising polymeric reinforced composites owing to have high strength, high durability, toughness, corrosion/ fire resistance, high strength-to-weight ratio or suitable features for construction and manufacturing industrial applications, or as a feasible alternative to single metal or alloys. The present study aims to develop polyester resin-epoxy resin composite material reinforced with nano-filler and to identify the best composite system of highest attribute. Here, resin composites were developed of five different compositions i.e., 25%, 50%, 75% of epoxy resin including pure epoxy resin and pure polyester resin. Tensile test and Izod impact test were conducted for all five composites to compare the qualitative features of five composite matrices without filler. Izod test showed the ductile property in terms of impact energy per unit thickness of each type of test specimen. It decreases in order of 50% epoxy> 75% epoxy> 25% epoxy> pure polyester> pure epoxy as the corresponding results of 78.34, 77.39, 64.79, 7.40 and 2.34 Jm^{-1} respectively. Again, tensile test confirmed the similar trend as shown in izod test. Best performing 50% and 75% epoxy compositions were further modified by incorporating Talc nanoparticles at different percentage of 0.5%, 1%, 2%, 3.5% & 5% by weight. 75% epoxy composition with 3.5% nano talc reinforcement showed the highest tensile stress and impact energy of 5.92 MPa and 6.34 Jm^{-1} respectively.

Keywords: Polymer composite; Yield stress; Ultimate tensile stress; Ductility; Elongation

Abstract ID: APC-OP26

Mechanical behavior of hybrid metal matrix of aluminium-fly ash-granite composite

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Abstract
Metal matrix composites (MMCs) of Al-6067, Fly ash and specimen are developed by different casting processes. Specimen 1 has a composition of 100% Aluminium (Al 6061). Specimen 2 combines 90% Al-6067, 5% fly ash, and 5% granite.

Specimen 3 combines 80% Al-6067, 10% fly ash, and 10% granite. All three composite specimens are compared in terms of tensile, compression and impact test. It is observed that the yield strength of specimens 1, 2, and 3 are 353.01MPa, 108.11MPa and 68.59MPa, respectively. Similarly, the ultimate strength of specimens 1, 2, and 3 are 382.76MPa, 117.59MPa and 99.48MPa, respectively. Similarly, the percentage elongation in specimen 1, 2, and 3 are 15.64%, 2.24%, and 2.42%, respectively. The tensile property of the metal matrix (specimens 2 and 3) is lower than the specimen 1. Similarly, the energy absorbed values observed after impact in specimens 1, 2, and 3 are 34J, 4J, and 2J, respectively. The energy absorbed in the specimen 1 is significantly more than the specimen 2 and specimen 3. The compression strength of specimens 1, 2, and 3 are 270.31kN, 280.12kN, and 284.31kN, respectively. The compression strength of the specimen 1 and 2 are more than the Al-6061.

Keywords: Metal Matrix composites; Aluminium alloy Al-6061; Fly ash; Granite

Abstract ID: APC-OP28

Development of polymeric hydrogels for separation of antibiotics as drug delivery carrier

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Abstract
Polymeric hydrogels are increasingly being investigated as local drug delivery system due to their tunable properties, controllable degradability, and capability to protect labile drugs from degradation. Hydrogel serves as a platform in which various physiochemical interactions with the encapsulated drugs control their release. In this work we used polyvinyl alcohol (PVA) and sodium alginate (ALG) as bio-compatible polymers and synthesized hydrogels by crosslinking with a common crosslinker glutaraldehyde in the form of Full Inter-Penetrating Network (FIPN) from their solutions. Accordingly, three such fully cross-linked IPNs i.e., FIPN25, FIPN50 and FIPN75 have been synthesized with different mass ratios of PVA: ALG i.e., 1:0.25 (FIPN25), 1:0.50 (FIPN50) and 1:0.75 (FIPN75). These three full IPN hydrogels along with pure PVA and pure ALG hydrogels were used for adsorptive separation of Amoxicillin, a common strong antibiotic belonging to the penicillin group, from its solution of five different concentrations from 2 ppm to 20 ppm and at four different pH ranging from acidic to basic conditions. All these FIPN hydrogels along with pure PVA and, pure ALG hydrogels were characterized with FTIR and SEM studies. The performances of the hydrogels were evaluated in terms of % separation for amoxicillin from feed solutions. Optimum separation was observed by the FIPN75 hydrogel from 15 ppm feed solution at the pH of 8.1. Controlled desorption studies were also performed.

Keywords: Amoxicilin; FIPN hydrogel; Sodium alginate; Polyvinyl alcohol; Adsorptive separation

Abstract ID: APC-OP29

Quinoxaline-Probe Embedded Injectable Fluorogenic Hydrogels: Comparative Detection of Mesitylene in Guar Gum and i-Carrageenan Hydrogels

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Abstract
The innovation of novel chemosensor probes for the recognition of trace volatile organic compounds is critical due to their hazardous effect on the environment and human health. A nitro-group integrated quinoxaline probe with a profound discriminative fluorescence 'turn-on' response to mesitylene was fabricated into guar gum and i-carrageenan, two biopolymer-based hydrogel matrices, to develop compact, portable fluorogenic hydrogel sensors and assess their fluorescence properties. A comparative characterization-based analysis was investigated to ascertain the overall compatibility of the hydrogel-based sensors for use as a smart rapid detection tool. Fluorescence spectroscopic investigations yielded promising results of 0.15 ppm limit of detection (LOD) in guar gum and 0.29 ppm LOD in i-carrageenan hydrogels respectively. The practical feasibility of the chemosensor in hydrogel form for mesitylene detection in the vapor phase was also explored. This approach of incorporating chemosensors into biobased hydrogel networks has the potential to broaden its opportunities in the field of chemical, biomedical, and environmental sensing sectors.

Keywords: Guar gum; Carrageenan; Hydrogel; Quinoxaline; Mesitylene

Abstract ID: APC-OP31

The Effect of Alkali Treatment on Coir Reinforced Polyvinyl Alcohol/Polyethylene Glycol Blend Biocomposite Films

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Abstract
Natural fibers are increasingly used in polymer biocomposite due to their easy availability, low density, superior mechanical stability, and sustainability. In this study, the biodegradable composite films were synthesized using untreated coir fiber and treated coir fiber as a reinforcing agent with polyvinyl alcohol and polyethylene glycol blend as a matrix, along with various polyethylene glycol loading using the solution casting method. The effect of alkaline treatment on the structure and properties of the synthesized films was investigated. Our study suggests that the alkaline treatment of coir fiber improves its compatibility with polyvinyl alcohol and polyethylene glycol blends, enabling the fabrication of biocomposite films with improved mechanical properties for packaging applications.

Keywords: Alkali treatment; Biodegradable composite films; Polymer blends

Abstract ID: APC-OP32

An Insight into self-healing polymer microcapsule for composite structures

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Abstract
Self-healing polymers that can regain their original structure are getting increasing interest globally to deal with the impacts of damage in composite materials automatically. Self-healing materials are equivalent to the defensive system of a living object that develops a scab for healing after a minor wound or bruise. Numerous attempts have been made to replicate this self-healing property into polymers and composites of polymers that are beneficial for applications in engineering such as high-tech, chemical, domestic plastic goods, and energy industries that are well reported in this paper. Cracks cause failure and are identified using specialized tools before being manually fixed, which is ineffective because it requires meticulous labor performance. A potential treatment for this is incorporating capsule-based polymer into the composites. This review paper gives insights particularly into self-healing microcapsules that can intrinsically repair the damage brought on by regular use. The types of capsule embedment, chemistries associated with it, encapsulation mechanism, and their production techniques are extensively discussed. Since the capsule-embedded composites decrease inefficiency over time brought on by degradation, the fabrication and characterization methods are also reviewed, preventing material failure costs.

Keywords: Self-healing Polymer; Microcapsule embedment; In-situ polymerisation; Encapsulation

Abstract ID: APC-OP33

A study of novel starch-based self-healing two-phase elastomer

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Abstract
Environment friendly, degradable, bio-compatible, non-toxic, inexpensive yet flexible material having high mechanical strength is required for innumerable practical applications. Currently available materials hardly meet all these requirements. For example, bio-sourced material like cellulose and starch are inexpensive and abundantly available but are susceptible to water/moisture; on the contrary, silicone is hydrophobic and environmentally benign but is expensive. To make two ends meet, we have synthesized a two-phase composite material by dispersing a starch/PVA based hydrogel as tiny droplets in silicone oligomer mixed with crosslinking agent. Hydrogel phase is physically crosslinked by reversible boronic ester bonds which contains multi-valent Borate ions, whereas the silicone is thermally crosslinked at @70 oC. We show that it is possible to disperse as much as 50%w/w starch into the silicone, without altering most of its physical properties. Importantly, the

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two-phase material could be incised and rejoined at cut surfaces over several cycles, thereby opening up the possibility of making a self-healable elastomer useful for several engineering applications.

Keywords: Silicone; Hydrogel; Self-healing; Fracture

Abstract ID: APC-OP34

Effect of Cellulose Nanofiller on Gas Transport in PLA-PBAT Blends Using Molecular Simulations

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Abstract
Nanofillers in polymer blends have attracted considerable attention due to their potential for enhancing mechanical, thermal, and barrier properties. In this study, we focus on incorporating cellulose nanocrystals (CNCs) as a sustainable and economically viable nanofiller in blends of polylactic acid (PLA) and polybutylene adipate-co-terephthalate (PBAT). We employed molecular simulations to investigate the influence of CNCs on the overall properties of the polymers. First, we generated realistic molecular models of pure PLA, pure PBAT, and their blends loaded with CNC as filler by utilizing the Materials Studio 7.0 software package for modeling the amorphous polymer structures and the LAMMPS software package with CVFF force field for equilibrating the structures. Next, we conducted molecular dynamics simulations to examine the transport of oxygen, water, and carbon dioxide within the modeled polymers and blends. The simulations demonstrate that increasing the CNC content in the blends leads to a decrease in the mean-square displacements and self-diffusion coefficients of the gases. Furthermore, the radial distribution function (RDF) and trajectories of different gases in the polymer matrix provide insights into the interactions between the polymeric components and the CNC filler in blends. These findings enhance our understanding of gas transport behavior in PLA-PBAT blends and aid in optimizing the design and performance of polymer nanocomposite materials for various applications.

Keywords: Simulation; Filler; PLA-PBAT blends

Abstract ID: APC-OP36

Fabrication of porous polydimethylsiloxane (PDMS) using camphor substitutes.

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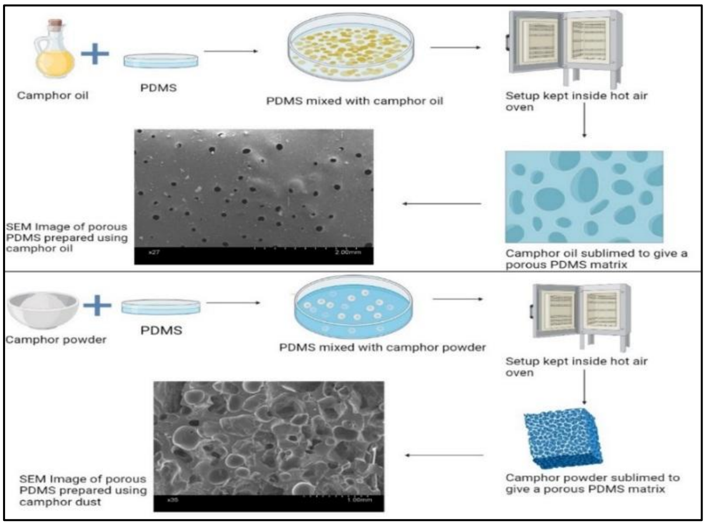
Abstract
Porous polydimethylsiloxane plays an important role in portable microfluidic devices. These polymeric membranes are preferred to its solid counterparts due to its low cost and superior mechanical strength. Of the various preparation methods studied so far, the most common method is soft lithography using emulsion templating. In this paper we have employed emulsion templating to fabricate our porous polydimethylsiloxane using various substitutes of camphor such as camphor oil and camphor powder. Camphor is a sublimatory material which sublimes on heating this property of camphor has been exploited to prepare the sacrificial template of the porous structure. The preparation techniques are reported and compared based on their physical properties. The produced membranes resulted in having a hierarchical pore structure within a composite polymeric matrix.



Keywords: Polydimethylsiloxane; Porous; Camphor; Microfluidics

Abstract ID: APC-OP37

Study of Phase Equilibria for a specific a Solvent–Polymer–Coagulant System

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Abstract
Solvent–Polymer–Coagulant (SPC) systems play a crucial role in various fields, including polymer science, material engineering, textile industries, etc. Comprehending and generating phase diagram of such systems is a critical input for design & optimization of processes involving solvent–polymer interactions. This study presents an approach for generation of ternary phase diagram for a SPC system at a specified temperature. Cloud point titration method has been used to obtain the ternary phase diagram for low concentration of polymer in solvent (0.5 wt%-5 wt%). This has been extrapolated for high concentration of polymer using a Linearized Cloud-Point (LCP) curve model. It is observed that less coagulant is required to coagulate polymer–solvent mixture at higher concentration of polymer. The generated ternary phase diagram would significantly contribute towards understanding the complex phase separation of SPC system and enable identification of phase separation region.

Keywords: Ternary phase diagram; Cloud-Point; Phase separation; Polymer; Coagulant; solvent-polymer interaction

Abstract ID: APC-OP38

Fabrication of polymer-based electrodes for Microbial Fuel Cell applications

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Abstract
The exponential increase in global energy demand is overwhelming the capacity of energy generation from non-renewable sources, leading to depletion of fossil fuels while giving rise to greenhouse gas emissions. Requirement for renewable and cost-efficient technologies led the research towards bio-electrochemical systems (BES) that are significant sources for treatment of wastewater, energy generation and clean fuel production, incorporating Microbial fuel cells (MFCs) for electricity. In the present work, polymer based electrode was developed for BES using dip coating technique. The substrate material used was ITO glass slide over which the polymer composite is coated with a blend of polyaniline as a conductive

polymer and polystyrene as a base material. This polymerbased electrode was operated as working electrode in a single chamber MFC with Ag/AgCl2 as reference and titanium wire as counter electrode. A maximum electric current of 15µA was obtained through this process with Shewanella oneidensis as the model electrochemically active bacterium. Surface interaction between the bacteria and the developed electrode surface was characterized using FESEM. Due to its cost effectiveness, the energy generated through this system can be used as power sources in bio-batteries, biosensors and other applications.

Keywords: Polyaniline; Microbial fuel cell; Shewanella oneidensis; Renewable energy

Abstract ID: APC-OP39

Development of novel composite material from waste packaging plastic: An environmentally sustainable approach towards Waste to Wealth generation

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Abstract
Waste plastics form widespread littering on the landscape due to the lack of proper management techniques which produces harmful environmental consequences. The waste packaging plastics are the main cause of choking sewer lines. The production of useful products (such as paver blocks, floor tiles, trackway, helipads etc.) using waste plastic has good potential to mitigate the global issue of waste plastic. In the present study, a light weight, fire-resistant, durable, unbreakable and low-cost composite material has been prepared using waste packaging plastics. The products (paver blocks and trackway) developed from this composite material has been tested at lab scale for their compressing strength, softening point, density and water absorption, while field trials of these products have been performed over multiple movements of heavy vehicles. The results of both lab scale and field trial have shown good performance of products. Further, the life cycle assessment of present technology has shown less environmental emissions than the conventional concrete and metal-based products. Therefore, making useful products from waste packing plastic has good potential to become an environmentally friendly and economically sustainable option to manage the waste.

Keywords: Waste plastic recycling; Waste to wealth; Life cycle assessment

Abstract ID: APC-OP40

Fabrication and optimization of durability and fire-retardancy of rice straw-based roofing material by free radical copolymerization of methymethacrylate

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Abstract
The burning of huts roofed with rice straws has evolved as a major concern affecting the living village community and environment, causing a huge disaster for mankind and making the villagers life helpless riskful life. This work emphasizes on the treatment of rice straws by graft copolymerization by using *methymethacrylate*. The characteristics study shows grafted rice straw have significant flame retardancy with Limiting Oxygen Index (LOI) of 26.12% for grafted rice straw have compared to 18.4% for raw rice straw. Other characterization like SEM, FTIR and Proximate analysis was done to determine the effect of grafting on the quality of the fabricated roofing material. The durability of the grafted rice straw was further investigated by calculating the specific growth rate of *Klebsiella Oxytoca (KF303807)* on the grafted/raw rice straw. The values of BOD and COD were obtained to be 3.72 mg/L and 375 mg/L indicating the ratio of BOD/COD (0.009) < 0.01 representing non-degradability behaivour of the fabricated grafted rice straw. Analysis has been also done to optimize the monomer concentration of the grafted rice straw in basis of achieving highest flame retardancy and lowest degradability. Thus, the produced grafted rice straw can be effectively utilized a roofing substitute.

Keywords: Graft copolymerization; Flame retardancy; Biodegradability; BOD

Abstract ID: APC-OP41

Mechanical Behavior of hybrid fiber reinforced epoxy/polyester

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Abstract
Nowadays, polymer matrix composite performs a vital function in industries namely automotive, aerospace and marine. This paper describes the fabrication of epoxy and polyester resin composites by combining glass fiber and carbon fiber in varying proportions. The mechanical properties of the mixture of Epoxy and Polyester resin with different ratio are investigated first and unidirectional hybrid laminates made of glass and carbon fiber are explored. The static response of the hybrid laminates has been studied using Finite Element technique. The modal analysis also be presented next. The result of mechanical properties shows that composites with more epoxy resin in the resin mixture shows higher tensile modulus as compared to composites with more polyester resin in the resin mixture. The presence of carbon fiber in the hybrid laminate shows higher mechanical properties.

Keywords: Polymer matrix composite; Epoxy and Polyester resin; Hybrid laminate; Finite Element technique

Abstract ID: APC-OP42

Biocompatible Approaches in Synthesis of Polymeric Nanoparticles

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Abstract
Polymeric nanoparticles have shown immense potential in different applications due to their biocompatibility, tuneable properties, and versatile functionalities. As the demand for safe and effective nanoparticles continues to rise, researchers have been exploring innovative synthesis techniques to develop biocompatible polymeric nanoparticles with enhanced therapeutic efficacy and reduced toxicity. This article aims to present an overview of the latest emerging trends in the synthesis of biocompatible polymeric nanoparticles. Each trend is explored in terms of its potential advantages, challenges, and applications in different nanofields. Furthermore, the article highlights the importance of considering biocompatibility, toxicity, and regulatory considerations in the development of these advanced polymeric nanoparticles. The article concludes with future prospects and potential directions for research in the field of biocompatible polymeric nanoparticles synthesis.

Keywords: Biocompatible; Characterization; Polymer; Polymeric nanoparticles; Synthesis

Abstract ID: APC-OP43

Study of Acrylic Emulsion based Coating with inclusion of MgO for Antimicrobial Application

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Abstract
In order to improve the antimicrobial properties of acrylic emulsion, acrylic emulsion was prepared by emulsion polymerization technique with methyl meth acrylate (MMA) and butyl acrylate (BA) monomers. In-situ polymerisation of acrylic emulsion containing 1.5% (with respect to the monomers) Magnesium Oxide MgO nanoparticles was carried out. It was characterized for structural properties by Fourier-Transform Infra-Red (FTIR) spectroscopy, thermal properties by

Differential Scanning Calorimetry (DSC), viscosity by Brookfield viscometer and antimicrobial property against *E-coli* bacteria. The coating of acrylic emulsions was applied on mild steel (MS) panel and tested for drying time, flexibility, adhesion, and gloss. The results showed inclusion of MgO particles provided high gloss coating films with excellent antimicrobial property, good adhesion, and flexibility.

Keywords: Acrylic Emulsion; Antimicrobial; Butyl acrylate; Coating; Methyl methacrylate

Abstract ID: APC-OP44

Polyaniline, MWCNTs and Araucaria Columnaris Composite for H_2O_2 Detection

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Abstract

A biocompatible composite comprising Polyaniline, MWCNTs, and latex (Araucaria Columnaris) was developed and used as a matrix for haemoglobin immobilization. The Christmas tree (Araucaria Columnaris) was used to extract latex, a polysaccharide emulsion. Along with MWCNTs, naturally occurring polysaccharides were integrated into the Polyaniline matrix. MWCNTs improve the materials' bulk conductivity, whereas latex gives biocompatibility (due to the presence of a significant number of hydroxyl groups). Fourier Transform Infrared Spectroscopy, Ultraviolet Visible Spectroscopy, Raman Spectroscopy, X-ray Diffraction, Scanning Electron Microscopy, Transmission Electron Microscopy, Thermogravimetric Analysis, Cyclic Voltammetry, and Amperometry are used to analyze the composite material. A carbon paste capillary electrode was made, and hydrogen peroxide was detected using haemoglobin. The redox behavior of the composites is investigated by comparing cyclic voltammograms at various scan rates (200, 100, 50, 10 mV/s) and pH (PBS buffer solution at 1, 2, 3, 4, 5, 6, 7). Hydrogen peroxide detection is useful in many domains, including industrial, environmental protection, and clinical control. We immobilized haemoglobin within the composite material and utilized it to make an H_2O_2 sensor.

Keywords: Araucaria Columnaris: Polyaniline; MWCNTs; H_2O_2

Abstract ID: APC-OP46

A Review: Polyaniline based Composite Materials for Electrochemical Sensor/Biosensor Applications

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Abstract

Several nanomaterials have been investigated in recent decades for diverse technological uses. A single material could not possibly contain all of the needed properties for a certain application. Fabrication of composite material systems is an easy way to obtain superior, tailored and valuable properties. Polyaniline (PANI) is the most studied conducting polymer due to its ease of synthesis, low-cost monomer, environmental stability, highly reversible redox behaviour, diverse oxidation states, non-toxicity, easy to control structure, interesting doping chemistry, and wide range of conductivity. Its electronic structure and electrical properties could be easily modified by varying the degree of oxidation and protonation. However, it has several intrinsic limitations, such as a less controlled reaction, insolubility in common solvents, conductivity loss at higher pH, and poor processability. Nature of acid and associated dopant greatly affect the kinetics of polymerization and morphology. A variety of PANI based materials has been used to fabricate electrochemical sensor systems. Electrochemical detection using enzymatic biosensors represents a reliable and feasible technique due to their simplicity, good sensitivity, high selectivity and low fabrication cost. The present review summarizes recent developments in the preparation of different PANI based composite materials (Polysaccharides, Metal nano particles) with a special focus on electrochemical sensors/ biosensors.

Keywords: Polyaniline; Composite materials; Biosensor; Electrochemical sensors; Nanomaterials; Polysaccharide; Metal nano particles

Abstract ID: APC-OP47

Synthesis and Characterization of Noble Bio-Polymeric Conducting Hydrogels

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Abstract
Hydrogels, due to their defined porous structures and being filled with aqueous solution, offer the ability to increase the amount of immobilized chemical, biological or biochemical molecules. With the objective of developing electrically conducting hydrogels, in this work, we used Polyvinyl alcohol (PVOH), Gelatine (GELTN), Sodium Alginate (SALGT), Chitosan (CHITN), Carboxy methyl Cellulose (CMC) like poler bio-polymers for hydrogel synthesis using a common crosslinker Glutaraldehyde. Accordingly, we synthesized four sets of hydrogels taking Polyvinyl alcohol as base material and Carboxy-methyl Cellulose, Gelatine, Sodium alginate and Chitosan as composite constituents by solution blending with the composition of 25%, 50% & 75% by solid polymer basis with respect to PVOH followed by crosslinking with Glutaraldehyde in the form of Full Inter-Penetrating Network (FIPN) Hydrogels. Pure (100%) gels of all five polymers (PVOH, GELTN, SALGT, CHITN & CMC) were also prepared for comparative study with other composite gels. All hydrogels were characterized by XRD, DSC & FTIR studies. Di-electric strength & volume resistivity of all the hydrogel samples were studied for comparing conducting characteristics and thus, the optimum composition of the hydrogel has been identified.

Keywords: FIPN hydrogel; Conducting hydrogel; Polyvinyl alcohol; Chitosan; Gelatin; Di-Electric strength; Volume resistivity

Abstract ID: APC-OP48

Studies on Adsorptive Dehydration of Pasteurized Milk by Filled Polymeric IPN Hydrogel

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Abstract
Adsorptive dehydration using polymeric hydrogel may be one of the effective techniques for eliminating excess water from pasteurized milk. Three IPN hydrogels of Polyvinyl Alcohol (PVOH) and Hydroxyethyl Cellulose (HEC) at mass ratios of 90:10, 70:30 and 50:50 respectively using Maleic Anhydride (MAn) as a common cross-linker of 2%, 4%, and 8% based on total polymer weight were studied for the same. Increasing rate of dehydration was observed with increasing HEC% in the hydrogels. But, stability decreased due to change in structural alignment of polymer chains and weak cross-linking. With each milk sample, the hydrogel with the best extent of adsorption with minimum change in the pH and conductivity observed for the hydrogel of polymer composition of 70:30 for PVOH and HEC respectively duly cross-linked with 8% MAn and it has been selected for further study. The said composition of hydrogel has been modified further by incorporating hydrophilic nano filler (Bentonite) at the proportion of 2%, 4% and 6% based on total polymer weight during hydrogel synthesis. The best result obtained in terms of swelling and the stability was with 4% nano filler though 6% filled hydrogel showed better swelling but lower stability. Finally, the dehydration of milk is optimized by fuzzy logic which shows the R^2 value 95.13%.

Keywords: Polymeric hydrogel; IPN; Adsorptive dehydration; Pasteurized milk

Abstract ID: APC-OP50

Fabrication of Open and Closed Cell Porous Sulfonated Poly ether ether ketone Membranes by Phase Inversion Technique

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Abstract
Porous sulfonated poly ether ether ketone (SPEEK) membranes are fabricated by using different porogens via phase inversion technique. Different types of pore formers with varied concentration are used to study the effect on the morphology and characteristics of the porous membranes. SPEEK is synthesized by direct sulfonation using concentrated sulfuric acid at 50±5°C for around 4 hours. The membranes are characterized for structural and morphological characteristics using advanced instrumental techniques. Nuclear magnetic resonance spectroscopy (NMR) study reveals that the degree of sulfonation of SPEEK is about 83%. The morphology and pore structure of membranes are analyzed by field emission scanning electron microscopy (FESEM) and the mechanism of formation of pore structure has been proposed. A uniform honeycomb like porous SPEEK membrane with closed cell morphology is evidenced in case of 5 and 10 wt. % of dibutyl phthalate pore forming agent. At 20 wt. % of sodium dodecyl sulfate pores former, the polymeric membrane has shown open cell morphology after phase inversion process. The surface roughness of the membranes is analyzed by atomic force microscopy (AFM). The water up takes, thermal stability, water retention behavior, proton conductivity, etc. are studied to investigate the suitability of these porous membranes as base materials for polymer electrolyte membranes in low temperature fuel cells.

Keywords: Phase inversion; Porous membrane; Sulfonated poly ether ether ketone; Thermal properties

Abstract ID: APC-OP51

Rheological and morphological properties of Bentonite dispersions for drilling mud

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Abstract
Bentonite has many industrial applications, in particular, as a binding agent, plasticizer, and suspending agent but can also be used as a filter or barrier. Rheological characteristics of drilling mud made from these clays, and drilling mud's suitability for drilling operations were all taken into consideration. In this work, an experimental study on the rheology of bentonite aqueous dispersions has been evaluated. The experiments were carried out in the modular compact rheometer of Anton Paar (MCR 102). The objective of this research is to explore the influences of various factors such as concentration, temperature, time, frequency, shear rates and shear stresses on the rheological properties of bentonite suspensions. Different experiments were performed with different bentonite concentrations (2,4,5,10,15 % w/v), temperature range (30-50°C) with 5°C gap, time sweep (0-300s), frequency sweep (1-100 rads^{-1}), storage and loss modulus (G´and G´´) and shear rates (1, 10, 100, 1000 s^{-1}). It has been found that on increases the shear rate from 1 to 1000s^{-1}, the viscosity of the mixtures goes on decreasing. For the concentration variation, sharp changes in viscosity have been seen. It was examined that at the constant temperature, the viscosity goes on increasing with the concentration of bentonite in an aqueous solution with varying shear rates. Nevertheless, no significant changes have been observed for the temperature variations. Finally, a comparative study of bentonite morphological properties using SEM, XRD, and TEM analysis.

Keywords: Bentonite; Drilling mud; Rheology; Viscosity; Storage modulus

Abstract ID: ACE-OP52

Value Added Cellulose Nanofiber Production from Agro wastes for Edible Food Packaging Application

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Abstract
The design and development of agro-waste derived biopolymers have gained attention for several environmental issues caused by fossil-based polymers. The residues obtained from agricultural sources are found in abundance and are a great alternative to produce value-added products. The agro-wastes are a potential source for the fabrication of cellulose nanofibers (CNF) using pre-treatment and acid hydrolysis methods. Further, the bamboo (*B. balcoaa*) dust derived CNF reinforced chitosan film facilitated with tea tree essential oil for meat packaging application is a remarkable way for improved

shelf life of meat. The tensile strengths of the films increased from 7.54 MPa to 18.09 MPa, whereas WVTR decreased from 7.5×10^{-3} to 3.42×10^{-3} g/(s.m^2) with addition of CNF and tea tree essential oils. The addition of tea tree essential oils to chitosan nanocomposite films is advantageous to deliver active functional property. Further, CNF reinforced chitosan based functionalized nanocomposites are also used as edible nanocoating on cut pineapple, and kiwifruits. The iron fortification to CNF using single step co-precipitation method is prepared to develop functionalized biocomposites for enhanced shelf life of produces and maintained quality. The various properties of the functionalized nanocomposites such as mechanical property, optical property, thermal property, and texture properties are tailored-made using various proportion of nanofillers and bioactive components for packaging application.

Keywords: Agro-waste; Cellulose nanofibers; Nanocomposite; Edible packaging

Abstract ID: APC-OP53

Anticorrosive Behavior of PU in Acidic Environment

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Abstract
Corrosion has become a major concern at local and industrial level, which affects their manufacturing process. In the last few decades, many corrosion inhibiting approaches have been used to protect the metallic surface from corrosion, such as cathodic or anodic protection, use of inhibitors, and application of barrier coatings; among these strategies, the application of the coating is economically feasible. Polyurethane (PU) coating has been prepared using in-situ polymerization process to protect mild steel (MS) from acid corrosion. The structural and morphological characterizations were performed using Fourier-transform infrared spectroscopy (FTIR) and Field emission scanning electron microscopy (FESEM). Anticorrosive properties of polyurethane-coated and uncoated MS coupons were investigated using electrochemical technique (PDP). Outcomes from Tafel analysis revealed that the value of corrosion current density (i_{corr}) significantly decreased for PU coated coupons. PU coating showed excellent anticorrosion behavior with inhibition efficiency of 99.90 % as compared to without coating.

Keywords: Corrosion; Electrochemical studies; Inhibition; Mild steel; Polyurethane coating

Abstract ID: APC-PP1

Novel polyester amide resin development from a sustainable resource

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Abstract
Soya-acid oil (SAO) is a fatty acid-rich by-product that is generated during vegetable oil refining. In this investigation, SAO was first converted to its fatty acid, followed by aminolysis and esterification to produce an SAO-based polyester amide resin (PEA). Structural confirmation of PEA was performed by FTIR-ATR and H^1NMR spectroscopy. The PEA resin was characterized and compared with conventional soybean oil-based PEA resins. Films were produced by curing the resin with melamine-formaldehyde. The performance of the resin-based coating was evaluated in terms of physical properties, mechanical, and chemical resistance tests. To study the corrosion resistance properties, a paint primer was formulated with PEA resin and 5% zinc phosphate. The metal content of the cured primer film was analyzed by Inductive coupled plasma-optical emission spectroscopy (ICP-OES). The results exhibited that the SAO can be utilized as a sustainable resource for low-cost PEA resin synthesis.

Keywords: Soya acid oil; Polyester amide resin; Resin-based coating

Abstract ID: APC-PP2

Composite Polymer Electrolyte: Influence of Fillers on Solvent Sorption Capacity & Structure Property Correlation

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Abstract
Polymer composites are very well known in today's research and practical/industrial application owing to their dimension, easy processability, flexibility, electrochemical stability, safety and long life. Smart polymer hybrids are widely applicable in electrochemical devices, supercapacitors, fuel cells, sensors, etc. Such polymers bear a reinforcement, in which the polymer acts as a matrix resin i. e host that penetrates the and bonds to the reinforcement. Understanding the structure property relation and mechanistic outlay is a constraint due to dual phase existence of numerous polymers in crystalline and amorphous phases. The present research is focused on the film preparation of poly[ethylene oxide] based films using salts and non-reactive fillers followed by their property traits. The influence of ions (from salts) is found to influence the solvent diffusion characteristics of the parent film. A theoretical study has been undertaken to investigate the diffusion phenomena of the films and is also correlated with the experimental findings on conductivity and relaxation tenure. Non fickian nature of the polymer composite system is noted with possible mechanism of interaction. Such behaviour enables application of such polymer systems as electrolyte material for solid state devices and membrane applications.

Keywords: Polymer composite; Solid state devices; Polymer electrolytes

Abstract ID: APC-PP3

Synthesis and Characterization of Environment-Friendly Composite Film Using ramie fiber and Polyvinyl Alcohol

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Abstract
The widespread dependency on synthetic polymers has led to concerns regarding their non-degradability and environmental pollution. This study explores the disadvantages of synthetic plastics, such as their slow degradation, harmful compounds, and negative impact on wildlife and human health. To address these issues, the potential of composite materials, specifically biocomposites, is investigated. Biocomposites combine natural fibers as reinforcement with a matrix of resins, offering enhanced properties and biodegradability. The use of ramie fiber, obtained from the ramie plant, is examined as a reinforcement material due to its favorable properties. Chemical pretreatment methods for biomass are analyzed for their effectiveness in improving the properties of natural fibers and further characterized using various analytical techniques including scanning electron microscopy (SEM), thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR) and mechanical stability tests. The research findings indicate that the cross-linked PVA hybrid films exhibit highly enhanced water resistance and oxygen barrier properties, making them suitable for packaging applications. Overall, this research contributes to the development of sustainable alternatives to synthetic plastics by exploring the potential of biocomposites and optimizing their properties through chemical pre-treatment and crosslinking techniques.

Keywords: Biocomposites; Natural fibers; Chemical pretreatment

Abstract ID: APC-PP4

A comparative study between the effect of nano clay treatment and chemical treatment on the performance of jute fiber reinforced epoxy composites

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Abstract

Natural fibers are potential materials as reinforcement in polymer composites because of their easily availability, environment-friendly nature and cost-effectiveness. However there are few issues which are undesirable that is poor compatibility between these cellulosic fibers and polymer matrix. Various surface treatment methodologies of these fibers have been attempted to improve the adhesion and compatibility between these two materials of opposite nature. Nano clay treatment of these natural fibers is one of the promising methods which is used to improve the performance of these fibers when used as a reinforcement in polymer composites
Initially, jute fiber-reinforced epoxy composites have been prepared by simple hand lay-up technique without any treatment of the fibers. After that fiber treatment is done by alkali alone and alkali followed by nano clay and the composites were prepared by these fibers. The various properties of these composites have been evaluated by X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) Thermogravimetric analysis (TGA), and Universal testing machine (UTM)analysis. FWO and Kissinger's method has been applied to calculate the activation energy of these fibers before and after treatment steps. A remarkable improvement in various properties of these composites has been observed by these treatments.

Key words: Composites; XRD; SEM; FTIR; TGA

Abstract ID: APC-PP6

An insight on the plasma treatment in the polymeric membrane and on its recovery of hydrophobicity

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Abstract
Polymeric membranes are widely used in various industries like food, pharmaceutical, and biomedical. Membrane life and efficiency drastically affected due to the fouling in membranes. Fouling and deposition are more severe in polymeric membranes because of strong interactions between hydrophobic surface and solute. Various methods have been adopted for surface modification of polymeric membranes to improve the hydrophilicity of the material and among them plasma treatment is quite effective and efficient to modify the membrane surface selectively. The treatment is generally conducted in a reactor in which there are electrical circuits coupled by inductive coil with magnetic field operating at radio frequency. The plasma treatment of polymeric membranes introduced various functional groups on the topmost layer of the membrane resulting in increase in hydrophilicity. This increase in the wettable behaviour last only for some time due to the aging of the polymer. There is a retrieval of the hydrophobicity of the polymers due to many reasons. This paper discusses about the plasma treatments done with various gases such as about the mechanism of the treatment, the extent to which hydrophilicity increases for different polymers, and the hydrophobic recovery of various polymers.

Keywords: Hydrophilicity; Hydrophobicity; Plasma; Fouling

Abstract ID: APC-PP7

Flow modeling and analysis of structural hydrophobicity of Banana Leaf

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Abstract
This study delves into the fluid flow dynamics on the adaxial and abaxial sides of banana leaves, characterized by conical micropillars resulting in interesting surface properties. The drop dynamics on the leaf surface are investigated using COMSOL multiphysics and finite elemental modeling, and the structural variations leading to the transition from hydrophobic to hydrophilic surface are examined. By analyzing contact angles, flow patterns, pressure distribution, and energy changes, hydrophilic-hydrophobic transitions are identified in both Wenzel and Cassie-Baxter states. The role of nanopillar structures in influencing fluid dynamics is also explored. This study unveils intricate fluid-surface and fluid-microstructure interactions intrinsic to banana leaves, with implications for biomimetic materials, agriculture, and surface engineering. It underscores numerical simulations as vital tools for unraveling complex fluid dynamics, guiding tailored wetting properties, and microstructure designs. In conclusion, this investigation advances further understanding of fluid behavior on banana leaf surfaces, offering insights into wetting phenomena and microstructure influence. The findings

inspire the development of innovative applications by harnessing nature's designs and simulation techniques for effective engineering solutions.

Keywords: Drop dynamics; Wetting behavior; Micropillar structures; Computational flow modeling; Biomimetic materials

Abstract ID: APC-PP10

Enhancing irrigation efficiency through the integration of potassium-based hydrogel in LDPE mulch film for sustainable agriculture

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Abstract
Irrigation plays an important role on our daily basis. All consumable green plants are being irrigated under manual supervision. A proper level of water and sunlight (humid condition) is the basic necessity for proper growth and health of the crops. Mulching is the process being followed in places with extreme climate conditions where scarcity of water is high. On the other hand, on recent growth the hydrogels are being used on large scale for agriculture purpose for their tendency to absorb and preserve water. Thus, using both the concepts, the hydrogels are being incorporated in the mulching film to increase their usage in the field of plasticulture. Mulching film is prepared using Low Density Polyethylene (LDPE) by extrusion process. Potassium based hydrogels are used to improve the production and to maintain the pH of the soil. Thus, mulching film incorporated with potassium-based hydrogels can improvise the production of crops and minimize the usage of surplus water maintaining the nutrition of the soil.

Keywords: Potassium based Hydrogel; Development in irrigation; Improvisation of mulch film; Polymers in agriculture; LDPE with hydrogel; Advancement of polymer in agriculture

Abstract ID: APC-PP11

CARBON REINFORCED EPOXY BASED COMPOSITES FOR STRUCTURAL APPLICATION

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Abstract
Carbon reinforced polymer composites grab a great attention in the recent past due to excellent strength and stiffness properties making them a material of interest for the structural applications. Carbon due to excellent thermal and mechanical properties, corrosion resistivity, dimensional stability has been utilized in various forms such as particles, fibers; both long and short fibers, nanotubes, nanodiamonds, etc. into the polymeric matrices for high strength applications. Epoxy resins have been extensively explored by researchers for the fabrication of carbon reinforced polymeric composites due to stiffness, chemical resistivity, strength properties and minimal shrinkage with excellent dimensional stability. Carbon reinforced eepoxy-basedpolymer composites have been utilized in various fields such as automobiles, defense, sports, aerospace, etc. In this article, we have reviewed the routes of synthesis of biowaste derived carbon from various natural resources and discussed the mechanical and thermal properties of biowaste derived carbon/epoxy composites for structural application.

Keywords: Epoxy; Composites; Carbon; Biowaste

Abstract ID: APC-PP12

Effect of EVA as Flow Improver on Rheology of Indian Waxy Crude Oil

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Abstract

The rheological properties of crude oil play a crucial role in its transportation, processing, and overall economic viability. Indian waxy crude oil, characterized by its high paraffin content, poses significant challenges due to its poor flow behavior at lower temperatures. This study investigates the potential of Ethylene Vinyl Acetate (EVA) as a flow improver for Indian waxy crude oil.

The research methodology involves a comprehensive examination of the rheological behavior of Indian waxy crude oil with varying concentrations of EVA additives at different temperatures and shear rates. Rheological measurements are conducted using advanced techniques such as rotational rheometry and oscillatory rheometry. The study also explores the effect of EVA on the crystallization behavior of paraffins within the crude oil matrix.

The results reveal that the incorporation of EVA as a flow improver significantly enhances the rheological properties of Indian waxy crude oil, reducing its viscosity and improving its pour point, yielding more favorable flow characteristics at low temperatures. Furthermore, the study elucidates the mechanisms underlying the EVA-induced improvements in rheological behavior, including the inhibition of paraffin crystallization and alteration of the crude oil's molecular structure.

This research contributes to a better understanding of flow improvement strategies for Indian waxy crude oil and provides valuable insights into the potential application of EVA as a cost-effective and environmentally friendly flow improver in the petroleum industry. The findings have important implications for optimizing the transportation and processing of Indian waxy crude oil, ultimately enhancing the efficiency and sustainability of crude oil production and refining processes.

Keywords: EVA; Indian waxy crude oil; Rheology; Flow improver

Abstract ID: APC-PP13

Polymer Technology in leading sciences (PT)

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Abstract

One of the fascinating features of the polymer technology has been the way that the manufacturing and the use of these products has pursued in virtually in the industrial nations of the world. Printed circuit boards are used for electronic mobility. PCB'S uses solid mask as composite. CFRP Polymer ceramic composites Polymer matrix composites are widely used in manufacturing of electronic devices. CRPF are known for their high strength to weigh ratio and stiffness. Polymer composites have revolutionized the aerospace industry. Rotor blades, Space craft heat shields, Unmanned Aerial Vehicles are made up of Polymer composites. Kevlar Reinforced Polymers are used in manufacturing UAVs. Kevlar Composites deals with resistance and strength. UAVs is made up HDPE Polymers. Sensor Integration, Structural Health Monitoring, Environmental Sensing are different applications where Polymer composites are used. Sensor Integration is used to collect real time data from their surroundings. Robotic Skins that provide tactile sensing capability to robots by use of flexible polymers. Bioinspired Nanomaterials (BIN) are used to create nanomaterials that mimic the behaviour of viruses for targeted drug delivery. Polyethylene Glycol (PEG) used to improve solubility and stability of drugs. Chitosan found in the shells of crustaceans. Polylactic acid(PLA) is a Biopolymer used to encapsulate and release of drugs at control rate.

To improve energy storage and device efficiency Polymer composites are used. Fire retardant Polymer composites are used to improve the safety of Lithium-Ion batteries. Halogenated flame retardants are used as addictive in Polymer composites to inhabited combustion. They work by created char layer on the material surface-Flame barrier. Graphene oxide used in Polymer composites to improve fire resistance. Electrolytes are made up of Polymer composites are used in Lithium-Ion batteries.

Keywords: Printed Circuit Boards (PCB); Unmanned Aerial Vehicles (UAVS); Extrusion; Sensor Integration (SI)

Biochemical and Bioscience Engineering (BBE)

Biomass, Biofuel, and Bioenergy; Bioresource Technology for Bioenergy; Environmental Biology; Sustainability and Biodiversity; Brewing and food technology; Fermentation; Food safety and its analysis; Food production and engineering;

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environmental biotechnology; biochemical engineering; cell and tissue engineering; protein engineering; biomedical engineering; and bioinformatics; Biosensors; Biosynthesis and production.

Abstract ID: BBE-OP1

Utilization of hemp concreteC as building material

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Abstract
One of the approaches to sustainable construction is look for alternative materials of construction.Natural (plant origin) materials such as hemp have been identified as important raw materials for lightweight composite production in many areas of the world due to their many advantages.However, for utilization of renewable raw materials in building material production is important ensuring of for physical and mechanical properties of composites, the effectiveness of technological processing of raw materials and their availability. This paper focuses about durability of composite materials based on organic filler as hemp shives stored in de-ionized water in definite intervals on evaluation of physico-mechanical properties of hemp composites. The changes in dimensions, bulk density compressive strength, thermal conductivity coefficient of specimens were evaluated. The impact of water on stability of hemp fibres was also evaluated. Natural cellulose fibres can be combined with inorganic matrix to produce environmentally friendly composites with specific strength comparable to glass fibre based polymer composite. FTIR spectra of individual fibres after water storage confirmed partial occurrence of chemically modified fibres. The objective of this study was to compare the influence of water absorption on Physico-Mechanical and Thermal Properties of Hemp Composites and water influence on durability of hemp after different time immersion.

Keywords: Hemp shives; Building material; Thermal conductivity; Water absorption; Compressive strength; FTIR analysis.

Abstract ID: BBE-OP4

Optimization of LC–MS-MS Method for Quantitative Analysis of Vincristine and Vinblastine in Catharanthus roseus

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Abstract
Catharanthus roseus, commonly known as Madagascar periwinkle which belongs to the Apocynaceae family. *Catharanthus roseus* is widely studied due to its pharmaceutical value that comes from its diversity of useful terpenoid indole alkaloids. The most important alkaloids are vincristine and vinblastine, which are mainly present in the aerial parts of the plant and are used for treatment of various human cancer. Several studies have been conducted to identify and quantify these alkaloids using various methods such as High-Performance Liquid Chromatography (HPLC) with UV/PDA detectors, Thin Layer Chromatography (TLC), and capillary electrophoresis. Till date, no study has been reported on the vinblastine and vincristine quantification in *Catharanthus roseus* by Liquid Chromatography tandem Mass Spectrometer (LC-MS/MS). In the present study, we investigated and compared the contents of these two compounds in the leaves from various local varieties of *Catharanthus roseus*. A simple and fast LC-MS/MS method was developed and validated for the separation and determination of vinblastine and vincristine in the methanolic extract. The advantage of this study is to determinate these compounds in a confirmative way by using mass spectrometer as an advanced tool.

Keywords: Vincristine; Vinblastine; Cancer; LC/MS-MS

Abstract ID: BBE-OP7

Biodiesel production using heterogeneous catalyst from waste biomass

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Abstract
The availability of natural fuel supplies is decreasing, and there is a growing desire for a sustainable fuel source. Biodiesel is currently a potential field for producing fuel organically while employing effective procedures to satisfy this demand. In this study, an appropriate plant source (*Milletia pinnata*) was chosen based on its local availability.to ascertain the seeds real moisture content in that area, drying time was optimized upto 6 hours, which implies with ASTM regulations. An extraction of oil from the seed with the aid of probe ultrasonicator set at its optimized conditions. Its result will be compared with the standard Soxhlet extraction and the Solvent recovery was calculated to be 75% in each batch process. Acid value is calculated for both oil and biodiesel as per ASTM standards. Heterogeneous catalyst was prepared from egg shells, it is used to produce fatty acids ethyl esters (FAEE) in order to produce biodiesel. The GC-MS and NMR results for biodiesel were evaluated and interpreted.

Keywords: *Milletia pinnata;* Ultrasonicator; Biodiesel; Catalyst; Extraction

Abstract ID: BBE-OP9

Novel solubilisation of pharmaceutically active drugs using hydrotropy- a review

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Abstract
Developing clinically useful formulations has been difficult when trying to solubilize hydrophobic drugs. Particle size, shape, surface area, physicochemical characteristics, physical forms of drugs, pH of the medium, and temperature are the factors that influence a drug's solubility. To improve the solubility of hydrophobic drugs in aqueous solutions, various solubilization

techniques are used. In a process known as hydrotropy, organic compounds that are only weakly soluble in water become more solubilized; this happens when hydrotropes are present. Hydrotropes are substances that are both water soluble and surface active. They increase the solubility of organic solutes in water by forming complex molecular structures. One of the best options to avoid the use of organic solvent is the hydrotropic solubilization concept. Additionally, this technique is unrivaled by other solubilization methods due to the benefits of certain characteristics like high selectivity, non-toxic, and solvent character that is independent of pH. Hydrotropes like sodium benzoate and sodium citrate can be used to dissolve hydrophobic drugs. The bioavailability of pharmaceutically active drugs can be increased by increasing their solubility. The bioavailability and, ultimately, the solubility of drug molecules determine how well a drug works therapeutically. For the novel solubilization of pharmaceutically active drugs, hydrotropy thus emerges as a promising technique.

Keywords: Hydrotropes; Solubilisation; Pharmaceutically active drugs

Abstract ID: BBE-OP11

Unravelling the Complexities of Fragrances: A Comprehensive Research Review of Extraction Techniques, Analytical Approaches, Chemical Diversity, Psychophysiology Effects, Toxicological Risks, and Environmental Implications

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Abstract
Perfumes have been used throughout human history for a variety of purposes, including enhancing personal hygiene, masking odors, and signaling social status. This paper presents a detailed and thorough summary of perfume compounds and their effects on the human mind and behavior. It covers extraction techniques, chemical diversity, psychophysiological effects, toxicological risks, and environmental implications. It also covers the analytical approaches used for identifying and quantifying fragrance compounds, including HPLC, gas chromatography, and mass spectrometry. In terms of chemical diversity, the paper highlights the wide range of fragrance compounds that exist, including terpenes, phenylpropanoids, and benzenoids. The paper also discusses the psychophysiological effects of fragrances, including their potential to affect mood, memory, and cognitive performance. Perfumes can significantly impact human behavior and cognition, with effects ranging from relaxation to increased alertness and cognitive performance. Specific fragrance compounds, such as linalool and limonene, can induce relaxation and positive mood states, while eugenol has an energizing effect. There are potential risks associated with fragrance use, such as skin irritation, allergies, and respiratory problems. Regulations are in place to ensure safety, but more research is needed to fully understand potential health risks. Sustainable practices are needed to minimize the environmental impact of fragrance production. A comprehensive review also revealed that specific fragrance compounds, such as linalool and limonene, can induce relaxation and positive mood states, while eugenol appears to have an energizing effect. Overall, our findings suggest that perfume compounds have significant psychological and neurological effects on the human mind and behavior.

Keywords: Analysis; Aromatherapy; Chemical compounds; Oil extraction; Psychophysiology

Abstract ID: BBE-OP12

QCM-based Electronic Nose for Detection of (B) (T) (E) (X)

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Abstract
Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) are a group of VOCs released by the ONG industry that harms health. Short-term exposure to this chemical may result in headaches, fatigue, eye, nose, and throat irritation. Hence, development of Electronic Nose for real time detection of these compounds is essential. The developed system consists of Quartz crystal Microbalance (QCM) sensor fabricated with tungsten oxide and Polyvinyl acetate of different thickness to form an array of sensors. The tungsten oxide and polyvinyl acetate sensitizer layer was fabricated using sputtering and spin

coating technique respectively. The frequency changes at 1-1000 ppm were recorded using teensy microcontroller board and principal component analysis (PCA) is used in order to differentiate BTEX in quinary mixing of BTEX gases. The results of this work show promising prospects for the development of a sensitive, reliable, and inexpensive method for the detection of BTEX.

Keywords: Electronic nose; Tungsten Oxide; Polyvinyl Acetate; BTEX; PCA

Abstract ID: BBE-OP13

Sustainable Compounds in Stored Fermented Beverage *Joufinai*

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Abstract
Fermentation is an enzyme induced oxidation of carbohydrates to C_2H_5OH, CO_2 and organic acids. Traditional fermented beverages (TEBs) occupy an important place among the tribal communities of North-East India. *Joufinai* is a stored fermented beverage (storage time varies generally from 1-24 months) used by *Bodo* tribal community (largest plain tribe of Assam); a rice-based fermentation product with a traditional yeast culture, *Amao* containing *Saccharomyces cerevisiae* as dominating enzyme strain. The sustainable compounds catechin, ferulic acid, salicylic acid, quercetin were identified by reverse phase HPLC method; and are responsible for rich anti-oxidant activity in *Joufinai* upto 72.99 % RSE for DPPH. Phenyl ethyl alcohol, butylated hydroxyl toluene, dibutyl terephatalte etc were some identified volatile congeners in *Joufinai*. This beverage contained 41.56 % (v/v) of ethanol when stored up-to 15 months. The starter culture *Amao* used during fermentation is a polyherbal mixture of various plants; acquired good anti-microbial activities against both gram positive and gram negative bacteria.

Keywords: Fermentation; *Joufinai*; Polyherbal mixture

Abstract ID: BBE-OP15

Application of analytical pyrolysis for thermochemical degradation of lignocellulosic biomass using thermogravimetric analyzer (TGA)

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Abstract
In this study, lignocellulosic biomass was subjected to pyrolysis and combustion kinetic characterisation utilising two unique isoconversional model-free approaches, Ozawa-Flynn-Wall (OFW) and Kissinger-Akahira-Sunose (KAS). In a thermogravimetric analyzer (TGA), biomass is heated at different heating rates (5, 10, 15, 20, 25 °C/min) from room temperature to 700 °C in order to undergo pyrolysis and combustion. The atmospheres used are nitrogen and air, respectively. To determine the characteristics of the two processes, pyrolysis and combustion, weight loss (TG), differential thermogram (DTG), differential thermal analysis, and heat flow with regard to temperature and time were recorded. Fourier transform infrared spectroscopy (FTIR) was used to analyse the functional groups of raw biomass powder. Explanation, justification, and application of outcomes will be presented at CHEMCON-23.

Keywords: Analytical pyrolysis; Thermogravimetric analysis (TGA); Combustion

Abstract ID: BBE-OP16

Extraction of bio-ethanol from rice straw

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Abstract
Rice is the main staple food in most of the Asian countries, rice crops generate a huge amount of rice straw as a crop residue in the fields. Unsustainable use of rice straw and open burning of crop not only produces large amount of greenhouse gas (GHG) emission, but also make farmer's loose a very viable by-product. Rice straw can be used in bio-ethanol production and bring additional income and sustainable utilization. It will also provide clean energy solution to ever increasing energy demand in India as it's one of the most abundant renewable resources. Over the past decades, bioethanol has emerged as an important alternative to fossil fuels. Non-edible feedstock such as rice paddy straw and corn straw based lignocellulose biomass has drawn tremendous attention toward the second generation (2G) ethanol production as a sustainable bioenergy source for internal combustion (IC) engine. Cellulose and hemicellulose contents are higher in biomass, which can be used as a source of reducing sugar to produce ethanol. Higher concentration of lignin fibers in the non-edible raw materials makes the sugar extraction challenging. These processes still faces challenges such as low efficiency and high production costs. Optimization of extraction methods and development of cost-effective technologies can improve the feasibility and commercial viability of this process.

Keywords: Bio-ethanol; Greenhouse gas(GHG); Lignocellulose.

Abstract ID: BBE-OP18

Production of bioethanol from potato wastes

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Abstract
Bioethanol is one of the attractive alternative energy sources for transportation. It is produced from sugar and starch containing raw materials like sugarcane, potato, etc. The preparation of bioethanol using yeast Saccharomyces Cerevisiae and waste potatoes. The purpose of the study is to identify the ideal conditions for the production of bioethanol and to assess the viability of using waste potatoes as a feedstock. An analysis of the effects of various parameters, including initial substrate concentration and yeast concentration is done. The findings, in the present investigation is well in line with the reported data. The study further highlights the significance of using the yeast strain Saccharomyces Cerevisiae for effective ethanol production. Overall, the results of this study give important information about producing bioethanol from waste potatoes, and they may have a major impact for the creation of sustainable cost-effective biofuel production systems.

Keywords: Bioethanol; Potato; Saccharomyces Cerevisiae, Lab scale production; Cost estimation

Abstract ID: BBE-OP19

Bioethanol Production from Chemically Pre-treated Residual Plant Biomass

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Abstract

Due to incessant spike in petroleum prices along with increased green house gases, ethanol production from various residual lignocellulosic biomass such as dried defoliated plant leaves, dried weeds and grasses which will not pose the menace food versus fuel has been gaining significant concern in the scientific community. In current study, various types of residual plant biomass were used as a source for bioethanol production. The powdered form of the residual biomass were chemically pre-treated by adopting single stage and multiple stages pre-treatment processes using different acids and alkalis. FTIR study was adopted to characterize the biomass samples before and after pre-treatmemt as well as produced bioethanol samples. The concentration of bioethanol after fermentation was determined by UV-Visible spectroscopy. The FTIR studies of the biomass samples before and after pre-treatment showed significant structural changes in lignocellulosic biomass structure due to pre-treatment. The FTIR pattern of the produced bioethanol showed the characteristic peaks of ethanol.

Keywords: Bioethanol; Chemically pre-treated; Residual plant biomass

Abstract ID: BBE-OP21

Benzylidene-hydrazones as Small Molecule Telomerase Inhibitors: Synthesis, Anticancer Activities, Pharmacokinetic Properties and Molecular Docking Studies

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Abstract

Telomerase, a highly specialized reverse transcriptase (RT) is a potential target for developing anticancer drugs. A series of benzylidene-hydrazones (**3a-o**), which are structurally related to the reported telomerase inhibitors, were synthesized and evaluated for their cytotoxic activities against four human cancer cell lines and for their antioxidant activities. Among the tested compounds **3e**, having two methoxy groups in its benzylidene phenyl ring, was found to be potently cytotoxic to all cancer cell lines tested with IC_{50} values of 0.12 (lung), 0.024 (ovarian), 0.097 (melanoma), and 0.05 μM (colon), and which were comparable to those of the doxorubicin standard (IC_{50} = 0.021, 0.074, 0.001, and 0.872 μM, respectively). DPPH assay showed compounds **3f, 3i**, and **3g** had IC_{50} values of 0.60, 0.99, and 1.30 μM, respectively, which were comparable to that of ascorbic acid (IC_{50} = 0.87 μM). Computational parameters such as, drug-likeness, ADME properties, toxicity effects, and drug scores were evaluated, and none of the fifteen compounds violated Lipiniski's rule of five (ROF) or Veber's rule, and thus they demonstrated good drug-likeness properties. In addition, all fifteen compounds had a higher drug score than the doxorubicin and BIBR1532. *In silico* screening was also conducted by docking of the active compounds on the active site of telomerase reverse transcriptase (TERT) catalytic subunit to determine the probable binding properties. The total binding energies of docked compounds are correlated well with cytotoxic potencies (pIC_{50}) against lung, ovarian, melanoma, and colon cancer cell lines indicating that the benzylidene-hydrazones could use for the development of new anticancer agents as a telomerase inhibitor.

Keywords: Benzylidene-hydrazones; Antitumor agents; Antioxidant; *In silico* screening

Abstract ID: BBE-OP22

Synthesis, antimicrobial, antioxidant and computational study of new transition metal complexes of thiazole-Schiff base derivatives

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Abstract

In the present study we synthesized two thiazole-Schiff base ligands, **2-Hydroxy-2-(5-acetyl-4-methyl-2-thiazolyl)hydrazone benzaldehyde (L_1) & 3-Nitro-2-(5-acetyl-4-methyl-2-thiazolyl)hydrazone benzaldehyde (L_1)** and also its Cu(II), Co(II), Ni(II), Zn(II), Pb(II) and Cr(II) complexes. Antimicrobial activity, antioxidant activity and molecular docking study were also studied. Newly prepared compounds were characterized by elemental analysis, IR, HRMS,

^1H NMR. The elemental analysis data and spectral study indicate octahedral geometry for Cu(II), Co(II) ,Ni(II), Zn(II), Pb(II) and Cr(II) complexes. Excellent antioxidant activity was shown by some of the synthesized ligands and metal complexes. Some of the synthesized compounds showed good activity against antibacterial strains of *S. aureus, E. coli, B. subtilis, P. aeruginosa, S. typhimurium,* and *C. freundii* and antifungal strain *Tricodarma harzianum & Aspergillus niger*. Computational study regarding optimization and docking study was also carried out.

Keywords: Thiazole; Metal complexes; Antimicrobial; Antioxidant; Computational study

Abstract ID: BBE-OP23

Enzymatic starch hydrolysis using immobilized fungal diastase enzyme in a packed bed reactor: performance evaluation

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Abstract
The project is based on the performance evaluation of an immobilized enzyme by passing the starch solution through a Packed Bed Reactor filled with entrapped enzymes within a matrix. Diastase is used as the enzyme in this project. In one set of experiments, Diastase (Carmozyme) is entrapped within calcium alginate beads. In another set, Gelatin is used as a matrix to entrap fungal Diastase (Aristozyme). Then, each concentration of the starch solution is passed through the Packed Bed Reactor at a time and simultaneously the immobilized enzyme activity is checked at a spaced interval. As a result, it is observed that the enzymes immobilized by these methods at the laboratory scale can be repeatedly used for 4-5 days with minimum loss in enzymatic activity. Also, it can be concluded that gelatin as a matrix is found to be more efficient for entrapping the enzyme as compared to calcium alginate beads.

Keywords: Enzyme; Immobilized; Packed bed reactor

Abstract ID: BBE-OP24

Plant-based Proteins for Bioplastic Applications - A Review

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Abstract
Approximately 400 million tons of plastic waste are generated annually worldwide, posing a significant environmental challenge due to their non-degradable nature. A promising alternative is bioplastics, materials that are bio-derived, biodegradable, or both. Proteins have proven to be most suitable for making bioplastics, particularly when formed into films, due to their mechanical strength, gas impermeability, and renewability. Making bioplastics from wasted or unused protein sources is the ideal possibility. Utilising wasted or unused protein sources, such as crop leaves (containing approx. 16-29% protein) presents an ideal opportunity for bioplastic production. Aquatic plant sources can also be utilised. Proteins from the leaves of aquatic plants can also be utilised. Some prolamine proteins like zein (obtained from corn) have poor nutritional value and thus are better suited for applications such as bioplastic production. This work explores the production processes of bioplastics using vegetative proteins, highlighting available protein sources in India such as wheat, pea, zein, soy, water hyacinth, and duckweed. Extraction methods and film processing techniques are discussed, along with the applications,

benefits, and challenges impeding bioplastics' implementation. The paper concludes by discussing future prospects that can lead us towards a clean and sustainable future.

Keywords: Bioplastics; Proteins; Extraction; Biodegradable films; Food packaging

Abstract ID: BBE-OP25

Biodegradation of Textile Synthetic Dyes by New Microbial Isolates

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Abstract
The effluents of textile industries have major percentages of synthetic dyes, which may seriously pollute the environment and societal life. In this study, new microbial isolates have been isolated from textile effluents having potential for decolorization and degradation of synthetic dye like OrangeM2R dyes, fast green, Rose Bengal and yellowM4G. These microbes were isolated from collected effluents and soil samples nearby discharge point of dye from textile industry. Two fungal isolates and two bacterial isolates were screened out after primary screening on nutrient agar media supplemented with specific dye. After sequence analysis, they are recognized as *Bacillus sp. MZ540327, Brevibacillus borstelensis MZ562352, Aspergillus terreus MZ798409, Aspergillus tamarii MZ798407*. Fungal isolates have efficiently degraded 1-2g/l of synthetic dyes of OrangeM2R dyes, fast green, Rose Bengal and yellowM4G with 80-90% decolorization after 8days of incubation period. Bacterial isolates showed decolorization potential upto 60% after 5days incubation period. The efficiency of decolorization could be further improved by immobilization of these microbial isolates and optimization of process parameters.

Keywords: Textile effluents; Microbe isolates; Synthetic dye; Decolorization

Abstract ID: BBE-OP26

Role of LCB as cell immobilizing material for the production of lactic acid

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Abstract
Lignocellulosic Biomass is a cheap, abundant, and renewable resource. A large part comprises cellulose and other cross-linked polymers. The objective was to observe the immobilization efficiency of cellulose polymer compared to calcium alginate. FTIR studies were performed to check the amount of extracted cellulose. Further, 100 ml bacterial suspension were mixed with cellulose material and incubated in a shaker at 37^0C for 72 hrs. After 72 hrs., immobilized cells were washed with PBS. Fresh culture medium (deMann, Rogosa and Sharpe agar) was introduced and lactic acid production was estimated by the Barker-Summerson method. However, the results show the effectiveness of LCB material as compared to calcium alginate.

Keywords: Immobilization; FTIR; PBS; LCB

Abstract ID: BBE-OP27

Nanoliposomal encapsulation of provitamin A carotenoid β cryptoxanthin extracted from *Kocuria marina* DAGII

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Abstract

Provitamin A carotenoid (β cryptoxanthin/ β crx) is found in fruits and vegetables in significantly less amounts. To improve the bioavailability of the carotenoid, encapsulating it in a delivery vehicle is necessary. This study extracted β crx from a novel bacterium *Kocuria marina* DAGII. This bacterium was cultivated on an optimized lactose medium (26°C for 56hrs at 120rpm), and the carotenoid β crx was extracted using the solvent extraction method. The extracted β crx was encapsulated in the liposome using soy-lecithin and tween80 at various concentrations (1:0.5, 1:0.72, 1:1, and 1:1.5). The results showed 1:0.72 β crx encapsulated liposomal solution (64.34±1.06 nm particle size) had higher encapsulation efficiency 96.11%. FESEM analysis revealed the shape of the liposome was a round granule. Storage study showed a satisfactory retention rate of the liposomal membrane for β crx.

Keywords: Provitamin A carotenoid; β cryptoxanthin; Delivery vehicle; Liposome

Abstract ID: BBE-OP28

Comparative study of nutritional component profiles between waste dry and fresh mango leaf extracts

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Abstract
The different parts of mango *(Mangifera indica* L.) tree belong to Anacardiaceae group having lots of potential therapeutic benefits. This is due to the most active biological and nutritional constituent like mangiferin, phytochemicals such as phenolic acids, benzophenones; antioxidants such as flavonoids, ascorbic acid, carotenoids, tocopherols and few more important constituents like vitamins, minerals, alkaloids, saponins, glycosides, terpenes, tannins etc. are present in this plant materials. A limited researches have been conducted to investigate the different nutritional and phytochemical profile with the wastage part of this plant materials specially with waste dry leaves. Hence, the present study focuses on extraction and quantitative evaluation of few selective nutritional constituents such as mangiferin and total phenolic content of the waste dry leaf extract of certain moisture content (9.76% by weight). The experimentally estimated data are then compared with the same of fresh leaf extract obtained from literature. The total mangiferin extracted from waste dried leaves (Size: 0.5-2mm) has been estimated around 9.56 mg/g and the ethanol dissolved solution of this waste dry extract has been analyzed by UV-spectroscopy. The successive Soxhlet extraction yields total phenolic contents of 1.127 mg/g waste dry leaf using hexane, ethyl acetate and methanol as solvent.

Keywords: Dry mango leaves; Mangiferin; Phenolic content; Soxhlet extraction; Health promoting effects

Abstract ID: BBE-OP29

Investigation of Antimicrobial and Antioxidant activity of Bioactive molecules extracted from a novel microorganism *Kocuria marina* DAG II

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Abstract
Postbiotics reflect an array of bioactive molecules produced from probiotic microorganisms, which positively influence their host health. Probiotic microorganisms yield diverse bioactive molecules like pigments, antibiotics, vitamins, amino acids and organic acids, reflecting diverse biological activities like antimicrobial, antioxidant, anti-inflammatory activities. In this study, we have investigated the antimicrobial activities (disk diffusion) and antioxidant activities (ABTS assay) of Intracellular and extracellular metabolites isolated from a novel pro-vitamin A carotenoid producing microorganism *Kocuria marina* DAG II. The intracellular metabolites showed antimicrobial activities against *Staphylococcus aureus* [MTCC 96] and *Pseudomonas aeruginosa* [MTCC 741]. The extracellular metabolites did not show any antimicrobial activity. Cell pellet also showed growth inhibition against *S. aureus* and *P. aeruginosa.* Both intracellular and extracellular metabolites possess antioxidant activity. Extracellular metabolites showed higher antioxidant activity compared to intracellular metabolites.

Keywords: *Kocuria marina* DAG II; Antimicrobial activity; Antioxidant activity

Abstract ID: BBE-OP30

Optimization of Microalgal Cultivation using Genome-Scale Metabolic Model

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Abstract
The use of microalgae has emerged as a sustainable technology to reduce greenhouse gases, bioremediation of waste water, and produce biofuel as well as other high-value products. The green microalga *Chlorella vulgaris* has been widely recognized as a potential candidate for biofuel production due to its high lipid content and flexible metabolism. The maximization of biomass and lipid productivity in microalgae is crucial for commercial production of biofuel, and it can be achieved by analyzing their metabolic activity using genome-scale metabolic model of the microorganisms. This study presents a detailed in silico analysis of *Chlorella vulgaris* cultivation in photobioreactors using dynamic flux balance analysis (FBA) model based on available genome-scale reconstruction of the similar microorganism. The FBA is a constraint-based approach to determine the flux distributions in a given metabolic network which satisfies a given objective function such as maximization of biomass growth while satisfying the reaction stoichiometry and the steady-state mass balance. The dynamic FBA model is thoroughly validated using literature data and the model predicts the microorganism's growth rate and metabolic responses with high accuracy under various environmental conditions. Finally, the validated model is used to optimize microbial metabolic machinery for enhanced production of biomass and lipid content.

Keywords: Microalgae; Genome-Scale metabolic model; Dynamic flux balance analysis; Optimization

Abstract ID: BBE-OP32

Microwave‐ assisted biodiesel production using bio‐ waste catalyst and process optimization using response surface methodology and kinetic study

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Abstract
Providing sufficient energy supply and reducing the effects of global warming are serious challenges in the present decades. In recent years, biodiesel has been viewed as an alternative to exhaustible fossil fuels and can potentially reduce global warming. Here we report for the first time the production of biodiesel from oleic acid (OA) as a test substrate using porous sulfonic acid functionalized banana peel waste as a heterogeneous catalyst under microwave irradiation. The morphology and chemical composition of the catalyst was investigated using Powder X-ray diffraction (PXRD) analysis, Fourier transform infrared (FTIR) spectroscopy, Thermogravimetric analysis (TGA), Transmission electron microscopy (TEM), and Scanning electron microscopy- Energy dispersive X-ray spectroscopy (SEM– EDX). The SEM–EDX analysis of the catalyst revealed the presence of sulfur in 4.62 wt. % amounting to 1.4437 mmol g^{-1} sulfonic acids, which is accorded to the high acidity of the reported catalyst. Using response surface methodology (RSM), through a central composite design (CCD) approach, 97.9 ± 0.7% biodiesel yield was observed under the optimized reaction conditions (methanol to OA molar ratio of 20:1, the temperature of 80 °C, catalyst loading of 8 wt. % for 55 min). The catalyst showed excellent stability on repeated reuse and can be recycled at least 5 times without much activity loss.

Keywords: Heterogenous catalyst; Microwave; Biodiesel; RSM-CCD

Abstract ID: BBE-OP33

Impact of climate change and soil property on plant growth and mitigating effect of osmolyte based hydrogel

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Abstract
Significant environmental problems known as abiotic stresses limit plant growth, productivity, and survival. Proper climatic conditions and soil properties (pH, cation exchange capacity, amount of micro and macro nutrient) effects the quality and growth of plant. Osmolyte based hydrogel can build up abiotic stress tolerance in plant as well as improve water retention properties of soil. Proline is the suitable osmolyte which will bond with biopolymer (alginate, cellulose, agarose) crosslinked hydrogel. The hydrogel holds large amount of water and the retention property is also good. Hydrogels from sugarcane bagasse extracted cellulose and modified with the cross-linker, glutaraldehyde (GA)/ genipin was synthesized. Cellulose was isolated from sugarcane bagasse via pre-treatment with 2.5% w/v sulphuric acid (H_2SO_4) at 150 °C for 30 minutes followed by 1 % w/v sodium hydroxide (NaOH) solution at 100 °C for 60 minutes. The germination index of different seeds in presence and absence of hydrogel in the soil are exhaustively studied.

Keywords: Osmolytes; Hydrogel; Proline; Germination index

Abstract ID: BBE-OP34

Catalytic hydrothermal liquefaction of lignin for quality upgradation of lignin oil

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Abstract
Utilization of cellulose and hemicellulose in 2G ethanol biorefinery generates lignin stream as a by-product. Lignin, most abundant natural aromatic polymer, is capable of producing many industrial products that hold immense potential in replacing fossil-based hydrocarbons and chemicals. The main units present in lignin viz. P-hydroxyphenyl (H), syringyl (S), and guaiacyl (G) are linked by β-O-4 and β-β bonds. Hence, there is an enormous potential for the production of phenolic monomeric compounds by cleavage of specific β-O-4 and β-β bonds through effective depolymerization methods. This work focused on depolymerization of lignin for lignin-oil production via hydrothermal liquefaction (HTL) under N_2 atmosphere. Reaction conditions (temperature, time) were optimized. Lignin: solvent 1:10, 7.5 MPa initial pressure, 10 wt% bimetallic catalyst, and 320 rpm were employed during liquefaction process. Ethyl acetate was used as an extracting solvent to separate the organic phase from the reaction mixture. The yield and HHV of lignin oil ranged from 23-68% and 26-34 MJ kg-1 under different reaction conditions. It was observed that the catalytic HTL of lignin significantly improved the properties of lignin oil. Oil was analyzed with GC-MS, FTIR, NMR, CHNS, etc. to evaluate the properties of lignin oil obtained under different conditions.

Keywords: Hydrothermal liquefaction; Lignin; Lignin-oil

Abstract ID: BBE-OP35

5-Hydroxymethylfurfural Synthesis from Lignocellulosic Biomass Using Hydrothermal Liquefaction

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Abstract
One of the untapped lignocellulosic biomasses is the subject of an extensive investigation to determine its potential for hydrothermal liquefaction to produce 5-HMF. The complete characterization of selected biomass had been done like CHNS, XRD, FTIR, TGA, GCV, FESEM, etc. The study focused on the estimation of 5-HMF in the liquid phase. In this study, tin tetrachloride and chromium nitrate were used as catalysts. Water and Dimethyl sulfoxide (DMSO) were used as the solvent in biphasic mode. The yield varied from 10 to 25 % which was reported by HPLC analysis. In this study, the residence time and temperature ranges were 15 to 30 min. and 120 to 180 °C respectively. Here these catalysts provide the Bronsted and Lewis acid site which is helpful in the production of 5-HMF. 5-HMF reacts in aqueous mixtures with two water molecules in a hydration reaction, forming levulinic acid and formic acid. It's an unwanted reaction but a valuable platform chemical.

Keywords: HTL,5-HMF, Biomass

Abstract ID: BBE-OP36

Production of biochar from areca nut husk: Effect of process parameters on yield and physicochemical properties

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Abstract
Areca nut (*Areca catechu*) is primarily produced and consumed (~ 60%) in India for performing different social and religious rituals. However, a sustainable strategy for handling the large quantity of areca nut husk (AH) generated after the de-husking process is yet to be developed instead of dumping or burning in the open area. In this study, we focus on the production of porous biochar from areca nut husk (AH) via a slow pyrolysis process. The influence of operating parameters (viz., carbonization temperature, holding time, and heating rate) on biochar yield and different physicochemical properties were determined. The biochar yield showed a decreasing trend with carbonization temperature due to the release of the volatile compounds as well as the degradation of the fiber constituents. The biochar pH showed an increasing trend along carbonization temperature. A quadratic polynomial model was discussed to predict the biochar yield as a function of pyrolysis process parameters. The produced biochar was further characterized using proximate and ultimate analysis, FESEM, XRD, Raman, and EDS analysis. Energy value and average pore size obtained through morphological analysis confirmed the application of AH biochar, a sustainable carbon source, and a potential adsorbent.

Keyword: Areca nut husk; Biochar; Slow pyrolysis; Process parameter

Abstract ID: BBE-OP37

Electrochemical Impedance sensing on a microfluidic device for antimicrobial susceptibility testing

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Abstract
Antimicrobial resistance (AMR) is emerging as a global health threat because of which even common infections are becoming harder to treat with empirical antibiotics. Antimicrobial susceptibility testing (AST) ensures the current choice of antibiotics for treating specific infections. We explored the impedance characteristic of the bacterial cells at cell-electrode interface for AST. Impedance changes over time when the bacterial cells grow/die in response to antibiotics. This change in impedance is correlated with the susceptibility profile of bacteria. We employed a microfluidic device with a screen-printed electrode to determine AST without any complex microfabrication technique. Four carbon electrodes of 0.5 mm were screen printed on a glass slide. Two sets of electrode pair, W1-C1 and W2-C2, were used as working (W) and counter (C) electrodes. For microfluidic channels, a mould was designed using 3D printer and made using PDMS. The channel was functionalised with poly-LLysine to enhance bacterial attachment. Before bacterial attachment, impedance of 10% Nutrient Media (NM) was measured and represented as 10%NM_blank using 1mm channel depth. Bacterial suspension of 108CFU/mL was introduced, and unattached bacteria were washed off. EIS was performed with bacteria attached to the electrode of the microfluidic device. The device is then incubated for two hours without antibiotics and used as a PC. For the test device, we introduce an antibiotic (Ampicillin – 20µg/mL) and the 10% NM at t=0 hr. Impedance was measured with respect to time for PC and test (Fig 2b&c). Rct decreased in PC, implying bacterial growth, whereas in the test device, there was no change. In PC, Rct difference can be attributed to the increased electrode coverage due to bacterial growth. The constant Rct after incubation in the test device suggests the inhibition of bacterial growth in the presence of antibiotics. Using a low conductivity medium and selection of Rct as a response signal enables the AST even with simple microfluidic geometry. The change in Rct was related well to the bacterial growth profile. The proposed detection system will enable rapid AST detection and allows front-line healthcare workers to perform AST with minimal training.

Keywords: Antimicrobial susceptibility testing; Microfluidic device; Impedance sensing; Bacteria

Abstract ID: BBE-OP38

The development of a broad-spectrum antibacterial hydrogel by the synergistic action of Fmoc-Phenylalanine and Fmoc-Glutamic acid in a co-assembled state

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Abstract
Self-assembled nanoparticles made of amino acids and their conjugates are developing as a new class of biomaterials with several nanobiotechnological applications. Fmoc-amino acid hydrogelators, particularly Fmoc-Phenylalanine, have been demonstrated to exhibit significant antibacterial properties. However, their antibacterial activity is confined to Gram-positive bacteria and has a modest antibacterial impact on Gram-negative bacteria due to the latter species' inability to penetrate the membrane in the later species. We created a new broad-spectrum antibacterial gel by co-assembling Fmoc-Phenylalanine with negatively charged Fmoc-Glutamic acid. The co-assembled hydrogels inhibited the development of both Gram-negative and Gram-positive bacteria with high efficiency. The composite hydrogel is highly permeable to many kinds of bacteria and compromises membrane integrity. Furthermore, hemolysis and cytotoxicity experiments revealed that the co-assembled hydrogels were biocompatible. As a result, this research may provide a great opportunity for developing innovative biomaterials based on the co-assembly of Fmoc-protected amino acids as valuable alternatives for conventional antibiotics in order to combat the increasing antibacterial-resistant bacteria, an existential threat to public health around the world, while also expanding their other application scopes.

Keywords: Biomaterials; Co-assembly of Fmoc-amino acids; Antibacterial activity

Abstract ID: BBE-OP39

Ultrasound-assisted biohydrogen production from food waste hydrolysate by using metabolic flux analysis

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Abstract
Hydrogen is the cleanest fuel and its production from sustainable resources has been investigated with zest by global scientific community. This study has reported to get insight into ultrasound-assisted enhancement in biohydrogen production from reducing sugar or glucose (food waste hydrolysate) fermentation using metabolic flux analysis (MFA). *Clostridium pasteurianum* is used as microbial culture in fermentation process. A pseudo steady state metabolic flux network model was constructed and analysed using experimentally measured reducing sugar/glucose uptake rate and fluxes of four metabolites, viz. lactate (LA), butyrate (BA), succinate (SA) and Acetate (AA). Total reducing sugar (TRS) consumption and biohydrogen yield increased by application of ultrasound. Acetate and butyrate were major by-products of glucose metabolism. Sonication had major influence on carbon fluxes Acetyl-CoA node.MFA results revealed enhanced flux towards butyrate under sonication, which was manifested in higher butyrate to acetate (B/A) ratio in products and greater hydrogen generation. Biohydrogen production was also a microbial growth associated process. Finally, two theoretical alternatives for further enhancement of biohydrogen were assessed with flux analysis, viz. enhancement of reducing sugar uptake rate and blocking of particular metabolite pathway.

Keywords: Ultrasound; MFA; Biohydrogen; Food waste hydrolysate; Fermentation; Reducing sugar; Clostridium pasteurianum

Abstract ID: BBE-OP40

Effect of Solvent Polarity on Yield Extract, Antibacterial, and Antioxidant Properties of Phytochemicals from Andrographis Paniculata Leaves

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Abstract
Biofilm and microbial corrosion are common global challenges in aqueous environments in various industries. The effect of solvent polarity on the yield extract, antibacterial, and antioxidant properties of the phytochemical compounds in Andrographis paniculata leaves has been studied for antibiofilm. The simplicia of A. paniculata was extracted in a series of organic solvents with increasing polarity (n-Hexane, ethyl acetate, dichloromethane, ethanol, methanol, methanol-water) at room temperature for 24 hours. Preliminary screening showed that the yield extract, phytochemical content, antibacterial, and antioxidant properties were affected by the polarity of the extract solvent. The highest yield extract was obtained using a methanol-water solvent (50:50) of 15.46%. The most active antibacterial activity against biofilm-forming bacteria (P. aeruginosa) was obtained using ethyl acetate and dichloromethane with a minimum inhibition concentration (MIC) value of 312.5 µg mL-1. While the antioxidant properties of A. paniculata leaf extract with all solvents shows a very weak level. The antibacterial activity and antioxidant properties of A. paniculata leaf extracts are related to the phytochemical content in the extract. This is evident in the two extracts with ethyl acetate and dichloromethane solvents with the highest total phenolic and flavonoid values. Therefore, the phytochemical content of the extracts of these two solvents needs to be explored and studied more deeply to obtain antibiofilm phytochemical compounds.

Keywords: Andrographis Paniculata; Antibacterial; Antioxidant; Biofilm; Solvent polarity

Abstract ID: BBE-OP41

Pre-Treatment and Characterization of Water Hyacinth Biomass (WHB) for Enhanced Xylose Production by Alkali Pre-Treatment Method

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Abstract
A monocotyledonous freshwater aquatic plant, water hyacinth grows quickly and adversely affects aquatic life by rapidly utilizing nutrients and oxygen. Lignocellulosic biomass of water hyacinth can be used to produce commercial products such as xylose from which value-added product such as xylitol can be derived. The structure of such biomass is very complex and requires energy extensive processes to allow fermentable sugars to be released. Alkali pre-treatment is an example of chemical pre-treatment that can be used to degrade lignocellulose biomass. In this study, water hyacinth biomass (WHB) was treated with dilute potassium hydroxide (3%) and kept at steam explosion at 121 °C and 15 lb /inch^2 environment to hydrolyze the sample. The total pentose sugar released during this were estimated by UV- Vis spectrophotometer as 0.258 gm/gm of WHB. Field Emission-Scanning Electron Microscope was used to study the changes in the surface morphology of the treated sample with respect to untreated sample. X-Ray Diffraction was used to study the crystallinity of the sample and changes in chemical states of the sample was studied by Fourier Transform Infrared Spectroscopy. The objective of this study is for the enhanced production of xylose from WHB using alkali pre-treatment method.

Keywords: Lignocellulosic biomass; Pre-treatment; Alkali treatment; Surface morphology

Abstract ID: BBE-OP42

Engineering donor corneal endothelial tissue using rapidly internalizing fusogenic liposome-coated nanoparticles to enable prophylaxis before transplantation

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Abstract
Cold stress (hypothermia) during storage and cytokine stress due to acute allograft rejection adversely affects the donor corneal endothelium in the short term. Microtubule stabilizers, cold stress protectants, and antioxidants can be delivered intracellularly to the donor corneal endothelium or cells at controlled rates with one-time administration using nanoparticles before cold storage to tackle damages caused by hypothermia and cytokine stress. However, the death-to-preservation time of donor corneas of more than 6 h significantly decreases endothelial cell density and increases the risk of microbial contamination. Therefore, we have developed fusogenic liposome-coated nanoparticles (FLNPs) for rapid internalization of nanoparticles into cultured corneal endothelial cells and *ex vivo* corneal endothelial tissue. Here, we have shown that the FLNPs have the intrinsic ability to rapidly internalize into cultured corneal endothelial cells and *ex vivo* corneal tissue within 3 h by possibly fusing with the cell membrane and bypassing the endocytic pathway. Lactate dehydrogenase assay showed that the internalized FLNPs did not cause any cytotoxicity to the cells up to 7 days. Thus, fusogenic liposome-coated nanoparticles have great potential as a platform for engineering cells and endothelial tissue of donor corneas to facilitate prophylactic drug delivery during storage and after transplantation.

Keywords: Donor corneal endothelium; Fusogenic liposomes; Nanoparticles; Internalization; Transplantation; Prophylaxis

Abstract ID: BBE-OP43

Potentials of high yielding carotenoids producing cyanobacterial regimes towards industrial sustainability: A comparative case study

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Abstract
Cyanobacteria are most potential microbial cell factories to naturally synthesize diverse therapeutics associated biomolecules including carotenoids. In this study, different naive cyanobacterial strains had been investigated towards carotenoids production. The most potent carotenoid producing cyanobacterial strain was *Nostoc* sp. CCC754 that produced 32.6(±1.30) $\mu g.mg^{-1}$ and 25.5(±2.50) $\mu g.mg^{-1}$ in late stationary and exponential phases, respectively. This higher carotenoid yielding strain *Nostoc* sp. CCC754 has shown 25% bioflocculants activity percentage in late stationary phase. In parallel other physiological parameters like ammonia excretion, chlorophyll-A cognitive quantity, phycobiliproteins quantity, soluble fraction of protein content and carbohydrates are also estimated towards ameliorating carotenoid biogenesis. The case study has clearly been depicted that *Nostoc* sp. CCC754 has enormous potentiality towards large scale production of carotenoids in near future. Moreover, synthetic biology and metabolic engineering approaches can also be applied on *Nostoc* sp. CCC754 strain to balance the metabolic fluxes of carbon and nitrogen flows for higher biosynthesis of carotenoids.

Keywords: Carotenoids; Cyanobacteria; Ammonia excretion; Chlorophyll-A; Phycobiliproteins

Abstract ID: BBE-OP44

Catalytic Production of Butyl Butyrate as a Sustainable Bio-Aviation Fuel using Silicomolybdic Acidic Catalyst

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Abstract
The aviation industry has received a great amount of interest globally due to its strong dependence on traditional petroleum jet fuel and imprudent GHG emissions. As an alternative to conventional jet fuel, biomass fuels have received a great deal of consideration. Butyl Butyrate (BB) obtained from bio-renewable resources is one such probable jet fuel blend that has the potential to lower CO_2 emissions throughout its life, making it an attractive alternative to aviation fuels. The production of butyl butyrate has been investigated by using silicomolybdic acidic catalyst. This catalyst is a promising option for producing sustainable bio-aviation fuel due to its eco-friendliness, high activity, and stability. The optimization of the reaction parameters, like temperature, time, catalyst loading, and reactant concentration, was the primary objective of the experimental investigation. The esterification reaction was promoted by the catalyst, which had remarkable catalytic activity. Characterization of the catalyst has been performed by FTIR, NH_3 TPD, XRD, SEM, and TEM. Based on future biomass feedstock availability, the large-scale use of bio-jet fuels could accomplish enormous potential for both bio-jet fuel production and CO_2 emissions reduction.

Keywords: Bio-Aviation fuel; Butyl Butyrate; Butyric acid; Heteropoly acid

Abstract ID: BBE-OP45

Study of biodegradation of mixed phenolic compounds as co-substrates in presence of toxic Chromium(VI) by an indigenous mixed bacterial culture isolated from East Kolkata Wetlands

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Abstract
Immense growth of population together with industrial revolution has led to an increased discharge of various organic pollutants along with heavy metals in the industrial effluents. The phenolic compounds such as phenol, cresol, resorcinol and heavy metals like chromium(VI), cadmium and lead cannot be degraded simultaneously by soil microbes. Hence, they persist in the ecosystem for an extended period causing various adverse health effects. In the current study, biodegradation of the phenolic compounds in presence of a toxic heavy metal was carried out by a mixed bacterial culture (MBC) isolated from East Calcutta Wetlands. The consortium was acclimatized to 1000 mg/L of mixed phenolic compounds (resorcinol and cresol) and then kinetic study for bacterial growth and substrate degradation was done in presence of 200mg/L, 400mg/L, 600mg/L and 800mg/L phenolic compounds with varying concentrations (5ppm, 10ppm and 20ppm respectively) of chromium(VI). The maximum specific growth rate, μ_{max}, o of MBC was found to be highest for 200 mg/L in presence of 5 mg/L of chromium (VI) in the medium. The value calculated was was 0.0482 h^{-1}. Maximum specific degradation rate of mixed phenolic compounds, q_{max}, of 1.1 h^{-1} was observed in media containing of 200 mg/L of phenolics and 5mg/L of chromium (VI). Operating parameters for the biodegradation process were optimized by Response Surface Methodology using Design Expert Software (version 13.0). For maximum percentage removal efficiency of 62.26% the optimum operating conditions were: 500 mg/L of resorcinol, 100 mg/L of cresol and 5 mg/L of chromium (VI) at 72 h.

Keywords: Phenolic compounds; Biodegradation; Cresol; Resorcinol; Heavy metal; Chromium(VI); Response Surface Methodology (RSM)

Abstract ID: BBE-OP46

Application of nanoemulsions for the quality improvement of meatballs

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Abstract
Nanoemulsions, kinetically stable, isotropic with a mean droplet size of 20-200 nm, have gained much attention in various fields during the last few decades. Meat and meat products are excellent sources of essential nutrients with high-quality proteins, fat, and mineral. Lipid oxidation is a limiting factor in the quality and acceptability of meats and meat products. To overcome these problems in meat and meat products, nanoemulsions are used. This work determined the antioxidant and antimicrobial effect of thyme and lemon essential oil nanoemulsions enrobed on the air-fried meatball. The antioxidant effect was evaluated by peroxide and TBA value. Different frying times were done for the samples, and later the sample was enrobed with the nanoemulsion, and shelf life was studied. Compared with the control, the thyme and lemon NE had the best effect on TBARS, PV, and microbiology at the end of the storage period. The textural parameters like hardness, springiness, cohesiveness, chewiness, gumminess, and resilience decreased in all the samples with the increase in storage time. In control samples, log CFU/gm ranges from 5.823 to 6.760 but in thyme NE meatballs, air fried for 20 minutes showed better control in preventing mesophilic bacteria growth, ranging from 5.778 to 6.221. However, the sensory evaluation indicated that control samples had better colour, flavour, texture, and acceptability.

Keywords: Air-frying; Hydroperoxides; Lipid oxidation; Meatballs; Nanoemulsion; Peroxide value

Abstract ID: BBE-OP47

Optimization of biodegradation of mixed organic pollutant by mixed bacterial culture in batch reactor

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Abstract
Resorcinol and cresol are phenolic compounds that are commonly found in various industries such as petrochemicals, dyes and pharmaceuticals. Both substances are hazardous to living systems if they accumulate in the environment beyond safety limits. Therefore, understanding and implementing effective degradation methods are crucial for mitigating the adverse effects of phenolic compounds and maintaining environmental sustainability. The present study focused on isolating a mixed bacterial culture (MBC) from East Calcutta Wetlands which has been recognized as a Ramsar site. The MBC~~s~~ were subjected to acclimatization upto 1000 ppm of total phenolics concentration (500 ppm resorcinol and 500 ppm cresol) followed by kinetic study of bacterial growth and phenolics degradation. Both the maximum specific growth rate (μ_{max}) and maximum specific degradation rate (q_{max}) were obtained at 800 ppm of total phenolics concentration with a value of 0.045 h^{-1} and 1.37 h^{-1} respectively. Yield-coefficient ($Y_{X/S}$) of 45 mg/mg was found to be maximum in presence of 800 ppm of substrate. It was observed that almost complete degradation of 200 ppm of total phenolics (resorcinol and cresol) took place in 48 h. The maximum percentage removal efficiency (%R.E.) was obtained by optimizing the operating conditions by Response Surface Methodology (RSM) using Design Expert Software (Version 13.0). The (%R.E.) was found out to be 99% within a period of 72 h in presence of 300 mg/L of each of resorcinol and cresol in the growth medium under both aerated and agitated condition.

Keywords: Mixed bacterial culture (MBC); Phenolics; Resorcinol (R); Cresol (C); Response Surface Methodology (RSM); Percentage removal efficiency (%RE); Maximum specific degradation rate (q_{max}); Maximum specific growth rate (μ_{max})

Abstract ID: BBE-OP48

Study of Multi-Stress Factors for Biomass and Lipid Enhancement in Chlorellapyrenoidosa and Scenedesmusabundans using Response Surface Methodology

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Abstract
This study is aimed to identify the sustainable algae species for biofuel production under stress conditions. Algae can stress by supplement or starving the multi-nutrients in different light intensity for *C.pyrenoidosa*and *S. Abundans* growth by Response Surface Methodology. The study shows that the algae have better yield in the nutrient starvation. The resultant dry biomass

of *C. pyrenoidosa*and *S. abundans* were 98.26 and 110 mg/L and the lipid yield were about 22.47 and 29.06 % at optimum conditions respectively. The optimized multi parameters for C. *pyrenoidosa*were 0.805 g/L of $NaNO_3$, 0.052 g/L of K_2HPO_4, 0.099 g/L of KH_2PO_4, 17 days of culture time and 5168.39 lux of illumination whereas *S. abundans*has 1.065 g/L of $NaNO_3$, 0.071 g/L of K_2HPO_4, 0.058 g/L of KH_2PO_4, 22 days of culture time and 2897.76 lux of illumination. Studies have confirmed that both species are considered for sustainable sources for biodiesel production.

Keywords: Microalgae; Lipid; Biomass; Optimization; Response surface methodology

Abstract ID: BBE-OP50

Optimization of alternative low-cost media (Vermiwash and NPK fertilizer) for the cultivation of microalgae to enhance metabolites

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Abstract
Microalgae is a promising cell factory for producing biofuel and other value-added products. The nutrient source is one of the prime things that is required for the proper growth of microalgae. The cost of nutrients present in synthetic media is high and not sustainable in nature which led to the finding of alternative media for the cultivation of microalgae. Thus, the present investigation deals with some low-cost media (vermiwash and NPK fertilizer) for the cultivation of microalgae for extracting various metabolites such as biomass, carbohydrate, protein, chlorophyll, and lipid. The effect of vermiwash and NPK fertilizer on the growth profile and other metabolites was analyzed. Optimization of media, vermiwash and NPK fertilizer (25, 50,75, 100) % v/v and BG11 as control with illumination of light and dark cycle (16:8) hours was carried out for 15 days to analyze the growth and other metabolites. Results indicated that biomass content was increased with an increase in concentrations of vermiwash whereas the opposite trend was followed in the case of NPK fertilizer. Therefore, the combination of different low-cost natural media will be suitable for the higher growth of microalgae.

Keywords: Microalgae; Alternative media; Vermiwash; NPK fertilizer

Abstract ID: BBE-OP53

Anti-bacterial activity of extracted extracellular polysaccharide from isolated *Oscillatoria* sp. from North East (Tripura)

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Abstract
Cyanobacteria are among the oldest photoautotrophic organisms on the earth, and have contributed to shape the planet's biogeochemistry with their significant biomass and key metabolic activities. Extracellular polysaccharide (EPS) extracted from *Oscillatoria* sp. are biopolymers that are defined as extracellular polymeric substances participates in the formation of microbial aggregates. EPS of cyanobacterial strains include different classes of organic macromolecules such as polysaccharides, proteins, nucleic acids, phospholipids etc. A number of molecules present in cyanobacterial EPS have antivirals, antimicrobials, antioxidant activity. The aim of this work was to evaluate composition, structure and bioactivity of EPS (from *Oscillatoria* sp.). Here, crude EPS was extracted from harvested broth of *Oscillatoria* sp. using acetone as extracting solvent. Biochemical analysis has shown carbohydrate composition in crude EPS was 28.32%. However, sulphate and phosphate content of EPS were 0.63% and 0.18% respectively. Analysis of the FTIR spectrum revealed the presence of β-glycosidic linkages at 840 Cm^{-1}. Bioactivity of the extracted EPS was analysed through disk diffusion test against bacterial strains (*E. coli*, *Staphylococcus* sp., *Lactobacillus* sp.). Results had shown extracted EPS effectively kill *E. coli* strains at 2 mg/ml concentration. In the conference, potential and useful application of EPS extracted from *Oscillatoria* sp. would be discussed.

Keywords: Extracellular polysaccharide; Bioactivity; Cyanobacteria

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Abstract ID: BBE-OP54

Edible fruit coating with nanocellulose derivatives to increase the shelf-life periods of fruits

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Abstract
Agricultural products like fruits and vegetables are very prone to spoilage and a significant portion of loss happen during post-harvest periods. An alternative approach to address this spoilage and mitigate the economic and environmental damages is the use of edible coatings to keep fruits fresh for a considerable time after their harvest. The existing petroleum-based coating materials have considerable health threats and causing environmental pollution. The edible coating materials synthesized from waste biomass could be a sustainable alternative. Different biomasses (e.g. banana stem fibers. rice straw, pineapple crown etc.) have been used for the extraction of cellulose and yield was found ~ 26-34%, with 86-90% purity. Extraction of cellulose from waste biomass and synthesis of edible coating formulations for the prevention of spoilage of postharvest agricultural products will be shown in this work. Extracted cellulose was found ~100nm with different size analysis techniques (DLS, SEM and TEM). Extracted cellulose converted into carboxymethylcellulose (degree of substitution ~1.89) and used for the synthesis of edible coating formulation. Edible coating technology comprising nanostructured cellulosic material is efficient to prevent degradation of agricultural products, increasing the shelf-life. Application of this technology would minimize the environmental pollution and maximize the profit from agricultural sector.

Keywords: Food spoilage; Waste bio-mass; Nanocellulose; Edible coating

Abstract ID: BBE-OP55

Comparative Studies on The Effectiveness Of Various Natural Materials Used As Bacterial Carriers In Self-Healing Concrete

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Abstract
The enhancement of sustainability without compromising the affordability of construction materials is a necessity for today's construction industries. Concrete is one of the most widely used construction materials that is vulnerable to cracking. Building resistance to cracking, thereby enhancing the longevity of concrete, is achieved through the concept of 'self-healing' concrete. In bio-concrete (as self-healing concrete is often referred to), microorganisms which are immobilized in suitable carriers, facilitate crack healing through microbially-induced calcite precipitation. The current study was aimed at comparing the effectiveness of various natural materials which could potentially function as bacterial carriers in self-healing concrete. We compared bentonite clay, rice husk ash, mud brick powder and coconut pith, each of which were added separately, at varying proportions from 5% to 25% of the fine aggregate fraction in the concrete mixture. The ureolytic bacterium, Lysini*bacillus sphaericus* AKM01 was used in the present study. Crack healing was studied by 'full-wet' method. Visible crack healing could be achieved within 25 days with concrete containing 20 % mud brick powder. The compressive strength of concrete was also not compromised upon addition of mud brick powder at the aforementioned proportion, as confirmed by tests done on a universal testing machine.

Keywords: Lysinibacillus sphaericus AKM01; Self-healing concrete; Bacterial Carriers

Abstract ID: BBE-OP56

Exploring the Potential of Enzymatic Bio-catalysis in Synthesizing Active Pharmaceutical Ingredients: A Comprehensive and Comparative Study

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Abstract
In recent years, the potential of enzymes to catalyze the synthesis of active pharmaceutical ingredients (APIs) has been studied extensively due to a plethora of reasons. The underlying requirement to alleviate waste generation and low enantiomeric selectivities resulting from chemical processes has attributed to the growth of biocatalysis to synthesize APIs. Enzymes not only afford excellent enantio-, regio- and stereoselectivities, but also enhance efficiency, work under milder conditions and eliminate purification and complex intermediary steps, otherwise involved in chemical synthesis. This highly selective nature, however, limits their range of applications and additional downstream processing may be required. The cost of isolating, purifying, and immobilizing the enzymes could pose both a technical and economical challenge. With the advent of powerful gene-mining technologies, novel gene clusters are being discovered, promising numerous viable enzymes. Molecular modelling tools together with Artificial Intelligence (AI) are also emerging to prematurely determine feasibility of a particular enzyme for synthesis. In this review, we seek to identify and delve into the potential of a few biocatalysts, elucidate their production and application in synthesis of APIs and discuss potential hurdles. A comparative study is also conducted where the merits and demerits of biocatalysts vis-à-vis their chemical counterparts are analyzed.

Keywords: Biocatalysis; Enzymes; Active pharmaceutical ingredients; Stereoselectivity

Abstract ID: BBE-OP57

Enhancing Drug Delivery: A Comprehensive Review of Prodrug Innovations

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Abstract
Prodrugs are a class of drugs on which there is an addition of a pro-moiety thereby making the drug inactive or concealing it under a layer which prevents the drug from activating unless there is need of a specific reaction. The usage of these prodrugs is increasing in recent times for efficient treatment of various diseases. A wide range of prodrugs have already reached the market since a few years. Prodrugs have an edge over regular drugs in that they offer high chemical stability, high solubility, low irritation and pain and limited adverse effects. It also affords oral absorption, which is in high demand these days. Inspite of having the aforementioned advantages, its use is still limited due to the complexity behind the structure of it. It requires a lot of testing as it is quintessential to make sure its effects are not detrimental to humans. These limitations can be overcome by approaching the design strategy and structural analysis. This review article suggests the associated challenges and their resolution during the drug design process of prodrugs. This will also enable us to know the prodrugs' uses in cancer therapy and various other treatments.

Keywords: Prodrugs; Oral absorption; Drug solubility

Abstract ID: BBE-OP58

Experimental validation of a simple unstructured model for respiro-fermentative growth of *Scheffersomyces stipitis*

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Abstract
The yeast *Scheffersomyces stipitis* has been receiving significant research attention by virtue of its high natural capacity for fermenting xylose (a pentose sugar which is present abundantly in plant biomass). Continuous culture studies have shown that at progressively increasing concentrations of feed carbon, *S. stipitis* transitions from respiratory growth to fermentative growth, via a dual-substrate limited (respiro-fermentative) growth regime. Most of the existing mathematical models appear to provide no insights about the kinetics of growth and ethanol production within the dual-substrate limited growth regime.

The current study was therefore aimed at formulating and validating a simple unstructured model for carbon-oxygen (C/O) limited growth of *S. stipitis*. Despite its inability to shed light on the physiology of dual-substrate limited growth, the model could be used to accurately predict the levels of growth and ethanol production at any point within the dual-substrate limited regime, based on relatively simple estimates of volumetric rates. It is further shown that a comparison of parametric sensitivity and relative robustness (for ethanol production) can also be made for different yeast strains, provided the variables of the model are scaled appropriately.

Keywords: *Scheffersomyces stipitis*; Respiro-fermentative growth; Unstructured model; Chemostat

Abstract ID: BBE-OP59

A review on bioethanol production: First generation to third generation

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Abstract
The attraction of alternative energy sources is growing as energy demand grows. A major factor in climate change is usage of fossil fuels. In addition to being compatible with modern internal combustion engines, bioethanol reduce dependency on fossil fuels. Bioethanol generated from renewable feedstock is a practical and environmentally safe replacement for non-renewable fuels as the world's energy demands increase. Concerns over the global food supply's security have fuelled research in lingo cellulosic non-edible feedstock (gen-2 bioethanol) and algal sources (gen-3 bioethanol) as bioethanol feed source. Fleets of internal combustion engines may emit less carbon dioxide. Typically, microbial fermentation is used to produce bioethanol by converting fermentable carbohydrates like glucose to ethanol. Concerns regarding food sustainability have led to research on lingo cellulosic and algal biomass materials. The ethanol from fermentation is influenced by several factors. This report investigates synthesis of bioethanol from a number of feed stocks and goes deeper into multiple methodologies, such as fermentation processes. The importance of yeast nutritional homeostasis is being researched as well. The objective of this analysis is to give industrial producers and policymakers with knowledge on advanced techniques, bioethanol yields attained through present production practises, and future innovation targets. The different sources of eco-friendly feed stocks for the production of bioethanol is presented.

Keywords: Bio ethanol; Pretreatment; Fermentation; Third generation

Abstract ID: BBE-OP61

Natural colorant (Chlorophyll) from isolated microalgae

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Abstract
Use of various toxic and health hazardous materials such as synthetic dyes, as food colorant, are concerned in modern civilization. Synthetic dyes accumulated in human health, consequently causing impairment and dysfunction of various human organs. On the other hand, herbal products, medicinal or food stuffs are becoming popular these days due to their low or no side effects. The natural colorant, chlorophylls is viable alternative to solve this problem. Chlorophylls are essential compounds in sustentation of human life. They are used as additives in pharmaceuticals, cosmetic products and natural food coloring agents. In addition, dietary chlorophylls are antioxidants and anti-mutagenic substances. We have maximized the yield of chlorophylls from isolated microalgal strain by manipulating chemical (e.g. carbon, nitrogen, phosphorus) and physiochemical parameters (pH, temperature and light intensity) and the extraction of chlorophylls in laboratory scale prior to semi-industrial scale demonstration of the operation. We investigated a cost-effective scalable process for producing chlorophylls from isolated high-yielding microalgae that will ultimately reduce the harmful effect of synthetic color. Development of end-to-end process technology for production of chlorophylls from microalgae is the novelty of the present work.

Keywords: Chlorophyll; Natural colorant; Cultivation; Solvent extraction; Purification

Abstract ID: BBE-OP62

Raman Spectroscopic Determination of Pesticide Residues in Foods

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Abstract
Conventional pesticide residue determination in agri-horticultural produce involves cost-intensive, destructive, multistep sample preparation, mass spectrometric/ionization techniques and/or supercritical fluid/solvent extraction. The present work discusses the Raman measurements for the fast quantitative (and imaging) detection of pesticide residues (Imidacloprid, Difenoconazole, Cu-oxychloride, Carbendazim, Azoxystrobin, Mancozeb, Indoxacarb) in fruit and vegetables with the following objectives: a) to develop a standard operating procedure; b) to synthesize, screen, and optimize emerging cost-effective surface enhanced raman (SERS)-active substrates; c) to analyze and establish a spectral library/data of pesticide molecules. The selected seasonal (subtropical and temperate) horticultural products i.e fruits (apple, strawberry) and vegetables (bell pepper, tomato) was collected from the university farm areas, orchard, the local market, and farmer's field. The collected samples were processed and measured through SERS optimizing the procedures as described in the literature.

Keywords: Pesticides; Fruits and vegetables; SERS

Abstract ID: BBE-OP63

"Deciphering the Origins of Protein Thermal Stability and Subsequent Engineering Using Molecular Modeling and Simulation"

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Abstract
Computer aided molecular modeling and simulation have gained a lot of attention of late due to their unique roles in understanding the molecular-level origins of protein functionality. In particular, these techniques can examine the atomistic details of protein structure and action in depth, thus, directly complements traditional drug discovery, protein engineering, and other biochemical approaches. The overall theme of this presentation is to demonstrate how these first-principles based techniques can be utilized to better understand the origins of protein thermal stability and improve it further, which often remains intractable in traditional biochemical methods. Two case studies are going to be discussed in detail: (1) Understanding the differences in thermal stability between a native (wild type) and an engineered cellulase enzyme for improved biomass conversion, and (2) Developing of an effective computational strategy for enhancing membrane proteins thermal stability to facilitate membrane protein crystallization and subsequent structure-guided drug discovery.

Keywords: Thermal stability; Protein engineering; Molecular dynamics; Cellulase; Enzyme; GPCR

Abstract ID: BBE-OP64

CFD Simulation of Arterial Hypotension in a Left Anterior Coronary Artery Section with Potential Clinical Relevance

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Abstract
Atherosclerosis is a complex cardiovascular condition characterized by the buildup of fatty deposits, known as plaques, on the inner walls of arteries. Stenosis occurs when the narrowing of an artery becomes particularly pronounced due to the accumulation of plaque. This narrowed lumen leads to significant pressure drops during blood flow, which may lead to decreased blood flow to the target tissues. The current study focuses on conducting computational fluid dynamic (CFD) simulations of blood flow within a linear segment of the LAD coronary artery, subject to differing degrees of atherosclerotic stenosis. The simulations are performed using COMSOL Multiphysics 5.6. The study has computed pressure drops by considering the laminar flow of blood as a two-phase non-Newtonian fluid. The rheological characteristics have been

modelled using the Carreau Yasuda model. It considers varying stenosis severities ranging from 10% - 90%, coupled with blood velocities spanning from 0.07m/s to 0.2m/s. Additionally, the findings have been compared to results generated using the Power Law model and Casson-Papanastasiou model for blood rheology. The pressure drop within the stenosed section has been correlated with stenosis percentages through power law models.

Keywords: CFD; Atherosclerotic stenosis; LAD coronary artery; Arterial hypotension; Carreau-Yasuda model

Abstract ID: BBE-OP65

Therapeutic biosimilar protein charge variants purification and challenges

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Abstract
Biosimilars are "generic" versions of "innovator" (or "originator") with respect to the amino acid sequence, but they are produced with different cell clones and production processes and parameters. As biosimilars are produced with different production process, they may have different glycosylation and charge variants pattern which may affect quality and safety of the product. Biosimilars provide support to the healthcare system and provide savings in the budget due to their economics. The lower cost of biosimilars is due to less expenditure on research and development, clinical trials and marketing. Monoclonal antibodies (mAbs) are biological macromolecules, used in treatment of various diseases, which includes some types of cancer. Monoclonal antibodies (mAbs) are biological macromolecules with post-translational alterations that can be observed when assessing charge variants. Controlling the charge profile of therapeutic protein is a regulatory requirement to ensure that the macromolecule meets the required levels of quality to ensure patient safety. The advent of biosimilars has constraint the development of more efficient downstream bioprocesses which is esteemed as the bottleneck of manufacturing process. The possible effects of charge heterogeneity in both in-vitro potency and in-vivo kinetics needs to be assessed.

Keywords: Monoclonal antibodies; Chromatography; Biosimilar; Charge variants

Abstract ID: BBE-OP66

Isolation, purification and analysis of charge variants of proposed biosimilar to Omalizumab

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Abstract
Omalizumab (Xolair) is a humanized monoclonal antibody derived by recombinant DNA technology. It has theoretical molecular weight of ~ 149 kilo Dalton (kDa) with N-linked glycosylation sites at asparagine-301 on each Fc region. Omalizumab has two light chains and two heavy chains with 218 and 451 amino acids each respectively. It binds specifically to immunoglobulin E (IgE) which plays a major role in allergic reaction by releasing histamine and other inflammatory factors from mast cells. The composition for originator and biosimilar products quality attribute should be based on cluster of respective variants and not for individual charge variant. This study discussed about the isolation and purification of Xolair biosimilar charge variants purified with preparative chromatography resin. This purification method is robust and developed with aqueous buffer system. The isolated charge variants (acidic, main peak and basic) were highly purified for charge (94.25%, 95.58% and 91.33%) and size (99.58%, 99.98% and 98.64%) distribution determined by cation and size exclusion analytical methods respectively. The study data indicates that isolated charge variants were purified with desired purity and can be further used for process characterization, *in- vitro* potency and *in- vivo* kinetics studies.

Keywords: Xolair; Monoclonal antibodies; Chromatography; Potency; Immunoglobulin E

Abstract ID: BBE-OP68

Polymer coating enables Portable Biomarker Imaging Assay for detection of diabetic retinopathy

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Abstract
Management of diabetic retinopathy (DR), the third most common reason for avoidable blindness (WHO5), is plagued with higher rural burden6 and loss to follow-ups7. Detection of DR biomarker protein (VEGF) in blood serum on droplet test on the glass slide remains challenging because of its very low concentration (70-200 pg/mL in serum10), and poor binding with a glass slide. In this context, we demonstrate the suitability of Poly L lysine (PLL) coating for the improvement of protein binding capacity. Here we show the comparison of various coatings including collagen, and PLL using different methods such as drop cast and dip coating. The proposed methods of polymer coating were validated using immunoassay. Blood samples from patients (DR, Healthy control) were used as a portable low-cost microscope. The result shows a significant reduction in background noises in the case of dip coating with PLL for a single layer. Additionally, we demonstrate a significant difference using the Mann-Whitney test between VEGF levels in serum for DR patients compared to healthy controls. Our data suggests that the PLL coating-based droplet immunoassay has the potential to supplement gold-standard Optical Coherence Tomography (OCT), for DR assessment, especially in low-cost, rural settings.

Keywords: Biomarker; Diabetic retinopathy; Coating

Abstract ID: BBE-OP69

CFD Simulation of Blood-mediated Drug Transport through a Dense Solid Tumor

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Abstract
Advancements in cancer treatment have underscored the importance of understanding the intricate interplay between tumor microenvironments and drug delivery mechanisms. This research delves into the dynamic relationship between blood-mediated drug transport and the density of the tumor matrix within solid tumors. The study seeks to unravel the effects of varying tumor matrix densities on blood flow characteristics, consequently, on the transport efficiency of therapeutic agents. Through computational fluid dynamic simulation, this research elucidates the intricate balance between blood flow dynamics and drug distribution within solid tumors. A simple two dimensional circular geometry has been chosen to represent the tumor and the surrounding microcirculation. Plasma, carrying the drug molecules, diffuses into the interstitial tumor matrix through the microcirculation, and then from the matrix into the tumor cells. The matrix is considered to be a porous medium and the porosity of the media has been varied to simulate the effect of the matrix density on blood perfusion. Preliminary results have shown that the density significantly affects the plasma flux through the tumor matrix.
The outcomes of this research hold potential implications for optimizing drug delivery strategies in cancer therapy possibly by designing drug molecules which can effectively diffuse through dense tumor matrices.

Keywords: Dense tumor; Drug transport; CFD; Blood perfusion

Abstract ID: BBE-OP70

Impact of Exhaust Gas Recirculation on efficiency and pollution characteristics of a diesel engine running on rice bran biodiesel

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Abstract
Augmenting automobiles are inducing escalation in destructive exhalations from the exhaust pipe of diesel engines. It is one of the primary agenda to explore substitute fuel for petroleum. Many researchers and diesel engine experts have concluded that biodiesel can be the suitable alternative for these circumstances. Exhaust gas recirculation (EGR) and biodiesel use have both produced a number of solid results in earlier investigations. In the current investigation, biodiesel made from rice bran was blended with regular diesel to test in a diesel engine. Biodiesel was created by the transestrification process, and B10 and B20 mixes of diesel and biodiesel were created. On a diesel engine with an EGR system fitted, these mixes were evaluated. Compared to conventional diesel, BTE rose when biodiesel was added to fuel. Fuel mix B10 was determined to have the highest BTE. Compared to biodiesel, it decreased once the EGR system was installed. For B10EGR and B20 EGR, BTE was higher than for standard diesel. While the addition of biodiesel causes NOx emissions to increase, the use of EGR causes a decrease in the same. The engine's performance and emission data showed that a diesel engine can run on rice bran biodiesel and diesel blends without requiring any engine modifications, and EGR assisted in reducing exhaust pollutants.

Keywords: Diesel engine; EGR, Emissions; Rice bran biodiesel; Transestrification; Performance; Emission

Abstract ID: BBE-OP71

Exploration of algal biocrusts and their role in the stabilization and rehabilitation of nutrient-depleted surface soils

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Abstract
The sustainability and productivity of terrestrial ecosystems are seriously threatened by erosion-induced soil deterioration and nutrient depletion. The application of biological soil crusts, a complex community of algae, cyanobacteria, lichens and other microorganisms, holds the promise for effective rehabilitation of nutrient-depleted soils. The current study was aimed at understanding the physico-chemical characteristics of algal biocrusts, and their role in stabilization of surface soils. The time-dependent variation in soil pH, total organic carbon (TOC), chlorophyll and EPS (extracellular polysaccharides) were monitored for a period of 50 days post-inoculation. The soil chlorophyll content was found to increase from 0.77 μg/ml to 10.92 μg/ml over a period of 35 days and decline thereafter, indicating a significant link between chlorophyll production and biocrust health. The crusts had accumulated a reasonable amount of EPS (27.51 μg/ml) within the period of study, which evidently contributed to improved soil stability, as confirmed from erosion studies performed using a rainfall simulator. Erosion studies were performed at different flow rates, computed based on local rainfall data. Post-biocrust development, the soil loss was found to decrease by 73.36 % (at a flow rate of 100 ml/min), thereby validating the beneficial role of biological crusts in stabilization of surface soils.

Keywords: Algal biocrusts; Surface soils; Erosion; Soil stabilization
Abstract ID: BBE-OP72

Catalytic oxidation of 5-hydroxymethyl furfural to 2, 5-furandicarboxylic acid over non-noble metal using a microwave reactor

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Abstract
Due to the massive emissions of carbon dioxide brought on by the exponential rise in fuel and chemical consumption, there have been numerous detrimental environmental effects, including climate change, greenhouse gas emissions, and global warming. 5-hydroxymethyl furfural (HMF) is one of the platform chemicals employed for the production of 2,5 furan dicarboxylic acid (FDCA) that acts as a precursor for biobased polymers such as bioplastic which is biodegradable as well as

constitute carbon neutral. In this work, the $CuCo_3O_4$ bimetallic oxide catalyst was prepared via the Co-precipitation method for the catalytic oxidation of HMF to FDCA by applying a microwave reactor as a heating system and t-BuOOH as an oxidant. The bimetallic catalyst showed good catalytic activity, stability, and recyclability. Better performance of the bimetallic catalyst can be due to the synergistic effect of metals as well as the basicity of the catalyst. Various characterizations such as BET surface area, HR-TEM, XRD, H_2-TPR, CO_2 TPD, and XPS have been carried out. Moreover, the effect of various parameters such as temperature, base, oxidant, time, and catalyst amount have been studied.

Keywords: 5-hydroxymethyl furfural; 2,5-furandicarboxylic acid; Bimetallic catalyst; Platform chemicals

Abstract ID: BBE-OP74

Biotransesterification of Rubber seed oil and Kusum oil using lipase from *C. rugosa*

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Abstract
Blending of petroleum products with ethanol and biodiesel has become quintessential in Biofuel Policy-2021. This paper presents biodiesel production with lipase from *Candida rugosa* under optimised parameters using design expert software. The lipase was immobilised with carriers - buffalo milk powder and glutaraldehyde-treated chitosan. Results of FTIIR and SEM for immobilised lipase indicating carrier-lipase bonding have been presented. The maximum yields of biodiesel via Biotransesterification of Rubber-seed oil and Kusum oil using free enzyme were 92.3% and 81.4% respectively in 8 h. The yield increased to 97.3% and 85.4% using immobilised lipase with buffalo milk powder in 16 h. The composition of biodiesel produced from Rubber seed oil and Kusum oil is Linoleic ester - 29.7% and 54.4%, Palmitic ester - 24.7% and 15.7%, Stearic ester - 18.1% and 4.4%, Oleic ester - 12.4% and 23.9%, Myristic ester - 7.4% and 0%, and the Lauric ester - 4.3% and 0% respectively. Immobilised lipase exhibited stability and reusability for five consecutive batches with more than 50% biodiesel yield.

Keywords: Rubber seed oil; Kusum oil; Biotransesterification; Biodiesel

Abstract ID: BBE-OP75

Kinetic Modeling of Reactive Oxygen Species Initiated Amyloid Polymerization

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Abstract
Alzheimer's disease (AD) is the most common form of dementia which is closely related to the interaction between the overproduced reactive oxygen species and the abnormal aggregation of amyloid beta. Amyloid beta (Aβ) protein, commonly found in human brain, is thought to be the major factor of the AD. Aβ protein aggregates to form plaque which deposits across the neurons leading to the neuronal cell death. A kinetic model based on free radical polymerization of Aβ with reactive oxygen species as an initiator is proposed. Kinetic parameters involved in the model have been tuned with the experimental data (obtained from open literature) on aggregates' molecular weight. The tuned model is used to simulate time evolution of aggregate length and polydispersity index. The simulated values are then compared with the reported experimental values of aggregate length and polydispersity index. A good agreement is observed between the model simulated aggregate properties and the reported experimental data. Thus, the simulation results support the hypothesis of reactive oxygen species causing Aβ aggregation using the free radical polymerization. The proposed model also predicts the sigmoidal growth of the aggregate size at different set of parameter values which is commonly reported in the open literature.

Keywords: Kinetic modeling; Aβ aggregation; Reactive oxygen species

Abstract ID: BBE-OP76

Impact of Cellulose based hydrogel derived from peanut shell extract on plant growth

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Abstract
Biomass can be utilized to generate cellulose-based hydrogel from cheap and readily available agricultural waste materials. In this context, isolation of Microcrystalline Cellulose (MCC) from Peanut Shell Powder (PSP) had been carried out using an alkaline treatment, acid treatment, and bleaching. FTIR characterization identifies changes in the cellulose functional group suggesting substantial removal of lignin and hemicellulose. Cellulose-based hydrogel was synthesized through a heterogeneous reaction via polymerization using N,N-methylenebisacrylamide (MBA) as a crosslinking agent. The The swelling measurement showed optimum water uptake at 6.12 wt% cellulose from ten types of hydrogels having MCC concentrations 0.54%, 1.07%, 1.6%, 2.12%, 3.15%,4.16%, 5.15%, 6.12%, 7.07%, and 8% . The water retention property of hydrogel with optimum water uptake also shows substantial improvement at different temperatures. Additionally the growth of Pisum sativum plants cultivated in a soil treated with hydrogel and without hydrogel were observed. Hydrogels presence in the soil reduced water loss during the irrigation process. The seedlings were grown for 28 days and all the plant growth parameters were investigated. It was observed that hydrogel based on cellulose promotes the plant growth more efficiently.

Keywords: Peanut shell powder (PSP); Micro crystalline cellulose (MCC); Swelling ratio,Retention property

Abstract ID: BBE-OP80

Investigation of Atherosclerotic Stenosis Effects on Bifurcated Carotid Artery Hemodynamics with Computational Fluid Dynamics

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Abstract
Atherosclerosis involves plaque buildup in arteries, leading to stenosis and reduced blood flow due to narrowed lumens. This study aims to provide an understanding of transport processes of this complex cardiovascular phenomenon. By employing CFD techniques through COMSOL Multiphysics 5.6, the current study investigates blood flow characteristics within a segment of the human carotid artery featuring bifurcation and subjected to varying degrees of atherosclerotic stenosis, ranging from 0% to 90%. The analysis takes into account the pulsatile nature of arterial blood flow, modeling blood as a two-phase non-Newtonian fluid with careful consideration of its rheological properties. The simulation is conducted over a cardiac cycle time frame of 0.8 seconds. The rheological characteristics have been modelled using the Carreau-Yasuda and Casson models. A mean velocity of 0.35 m/s has been considered within the carotid artery. The pulsatile flow is mathematically represented as a sine wave function, with a damping factor, to closely mimic the dynamics of the cardiac cycle. The wall shear stress at the stenosis is correlated with different stenosis levels, revealing how atherosclerotic stenosis severity affects hemodynamic stresses, yielding clinically valuable insights.

Keywords: CFD; Atherosclerotic stenosis; Bifurcated carotid artery; Hemodynamic stresses; Carreau-Yasuda model

Abstract ID: BBE-OP81

Process for synthesis of in situ Biodiesel from Mahua Oil Seeds

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Abstract
Mahua oil derived from the seeds of the Madhuca indica tree, is an excellent candidate for biodiesel production due to its favorable fatty acid composition and high oil content. In-situ biodiesel synthesis simplifies the process by combining the transesterification reaction within the same reactor, reducing the need for a separate esterification step. Biodiesel has drawn a lot of interest recently as a sustainable and eco-friendly replacement for traditional fossil fuels. In this regard, the manufacturing of biodiesel from inedible feedstocks, such as mahua oil seeds, offers a possible path towards the creation of sustainable energy. The full method of producing in-situ biodiesel from mahua oil seeds is covered in detail in this abstract, along with its significance in the context of renewable energy sources, important phases, and difficulties that must be overcome. Oil extraction, pretreatment, transesterification, separation, washing and purification, drying, and quality control are the main phases in the in-situ biodiesel synthesis process from mahua oil seeds. Mahua oil is extracted, given a first cleaning step to get rid of contaminants, and then put through a transesterification procedure that turns it into biodiesel and glycerol in a single reactor. Separating the leftover glycerol and washing and purifying the crude biodiesel to ensure it satisfies quality standards. Mahua oil-based in-situ biodiesel synthesis has renewable energy options and contributes to a more sustainable and environmentally friendly energy.

Keywords: Biodiesel; In situ transesterification; Fossil fuel

Abstract ID: BBE-OP82

Recovery of Lead and Zinc minerals from Complex Ore by using microbe mineral surface interaction

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Abstract
The exhaustion of high-grade ore due to large-scale exploitation, the world's demand for metals has gradually increased enormously as a result of industrialization. As a result, our challenge is to process lean grade ores in order to meet the needs of the majority of industries .Bioprocessing methods have attention-grabbing complexity in handling ores. Furthermore, as for the conventional inorganic reagents used in this work, biologically derived products are nontoxic and ecologically benign. The use of novel methods like bio-leaching, bio-flotation, and bio-flocculation for the beneficiation of complex ores has become a reality. We prepared 9K media culture for the growth of Thiobacillus ferrooxidans as a microorganism and the use of the microbe as a substitute for NaCN as a depressant of the sphalerite mineral. The Zeta Potential studies were carried out in order to learn about the surface properties of minerals. Finally, the mineral recovery percentage was increased by using different microorganisms for galena and sphalerite ore minerals.

Keywords: Recovery; Bioleaching; Bio flotation; Zeta potential; Microbes

Abstract ID: BBE-OP83

Oleic Acid Extraction from Neem Leaves: A Quantitative Study

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Abstract
Herbs have a significant role in our everyday existence. These becomes primary source for variety of chemicals that are extensively utilised in food, pharmaceutical, and nutritional sectors. Today, there is a growing worry about chemical pesticides in agriculture, which makes buying herbs, fruits, and vegetables from the market unsettling. There is a growing need for organic insecticides that offer benefits to both farmers and consumers. Many herbal plants have bioactive compounds that may prevent crop insect damage. Active ingredients must be taken from plants and combined for natural insecticides. Kokum, cardamom, neem (Azadirachta indica), and fennel are among the herbs that can be utilised for this purpose. The primary objective of our study is to extract and purify an organic insecticide of high quality from botanical sources. The selection of raw materials is determined by their anti-microbial, anti-inflammatory, and anti-tumour capabilities. The predominant fatty acid constituent found in neem leaves is oleic acid, with a composition varying between 25% and 54%. This study focuses on the extraction of oleic acid from neem leaves. Currently, the investigation has focused on examining the impact of rotating speed, agitation, and temperature.

Keywords: Natural pesticides; Extraction; Oleic acid; Neem leaves

Abstract ID: BBE-OP84

A Comparative Approach of Mechanical Agitation and Ultrasonication for Biodiesel Production

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Abstract
Increasing demand for fossil fuels and reservoir depletion attract the researcher to alternative fuels. The most promising fuel for overcoming these obstacles is biodiesel. The objective of this study is to determine the optimal parameter for the ultrasonic production of biodiesel from the algae oil. On the biodiesel Production, the reaction time, molar ratio of oil to methanol (MeOH), amount of catalyst, ultrasonic frequency, and ultrasonic output power were selected as research variables. On the basis of Reaction Time, Oil to Alcohol Ratio, Reaction Temperature, and Catalyst Concertation, the ultrasonic biodiesel production results are compared with the mechanical agitation method results. The optimum results obtained from the study is 45 min of reaction time, NaOH catalyst 1%wt of oil, 1:9 molar ratio oil to alcohol, 20 KHz of ultrasonic frequency and an output ultrasonic power of 180 W. Further the optimization observed is the increase in yield of biodiesel to 96.38% with a reduction in the reaction time by 15%.

Keywords: Ultrasonication; Biodiesel; Algae oil; Transesterification

Abstract ID: BBE-OP86

Dietary Fibers for Vitamin B12 Encapsulation

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Abstract
Vitamin B12, also known as Cobalamin, is an indispensable component of the nutrient pool in the human diet. Today, a whopping 47% of the population suffers from Vitamin B12 deficiency in India. The first immediate means of tackling this issue would be to provide Vitamin B12 in the form of supplements, tablets, and injections on a regular basis. However, the impediment in this approach as well as traditional methods of consuming Vitamin B12-rich foods is the poor absorption of it from the gastrointestinal tract to the bloodstream. Dietary fibres can pitch in here to serve as a game-changing material in bestowing controlled release characteristics to Vitamin B12 in the tract, hence improving its absorption. The paper presents the experimental validation of the same. A comparative study between encapsulations of different dietary fibre matrices and their combinations; which include cellulose, alginate, lignin, cellulose-alginate, lignin-alginate, and cellulose-lignin; for providing controlled release of Vitamin B12 has been presented. The encapsulations were tested for the rate of release of vitamin B12 in simulated stomach, intestinal and colon buffer fluids; with the help of techniques such as spectrophotometry and high-performance liquid chromatography. The results show promising potentials for the combinations of the fibres to be used as matrices for encapsulating vitamin B12, with the fibres complementing each other's properties and serving as even better matrices; tackling the issue of poor Vitamin B12 absorption efficiently.

Keywords: Vitamin B12; Poor absorption; Controlled release; Encapsulation; Dietary fibre matrices

Abstract ID: BBE-OP87

Waste Valorization: Methylene Blue absorbed Cocos nucifera shell biochar Catalyst for Biodiesel Transesterification

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Abstract
For numerous years, there has been an ongoing discussion and debate regarding an alternative to petroleum-based diesel, leading to the exploration of biodiesel or fatty acid methyl ester (FAME). Methylene blue dye, commonly employed in industries such as textiles, pharmaceuticals, and laboratories for coloring, visualization, and staining purposes, raises significant environmental concerns when released into water streams. These concerns encompass the toxicity of the dye to aquatic organisms, resulting in ecosystem disruption, bioaccumulation, degradation of water quality, and interference with water treatment processes. In this study, biochar derived from Cocos nucifera (coconut shell) is harnessed to adsorb methylene blue dye. Subsequently, this dye-laden biochar is employed in the transesterification process of waste cooking oil. A range of characterization techniques are employed to comprehend the catalyst's properties. XRD is employed to examine the crystal structure. FTIR analysis is conducted for functional group identification, and BET analysis provides insights into pore size, and SEM imaging facilitates surface morphological analysis. Confirmation of the presence of biodiesel (FAME) is achieved through a comprehensive analysis involving ^{1}HNMR, FTIR, and GC/MS.

Keywords: Waste valorization; Biodiesel; Green heterogenous catalyst; Transesterification

Abstract ID: BBE-OP88

Biochemical and Bioscience Engineering: Innovations at the Nexus of Science and Technology

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Abstract
Biochemical and Bioscience Engineering: Innovations at the Nexus of Science and Technology. Biochemical and bioscience engineering usually implies the use or development of methods of direct genetic manipulation for a socially desirable goal which might be the production of a particular chemical, but may also involve gene therapy, or the use of specially designed organisms to and in many other real-life applications. In simple words, biochemical and bioscience engineering is a multidisciplinary field that integrates the concepts of Biology and Chemistry along with engineering principles to understand biological systems. It is concerned with designing, developing, and applying processes, products, and systems that use biological organisms or their components. Biochemical engineering is a rapidly growing field with many opportunities for innovation. Rooted in molecular biology and biochemistry, it has emerged as a response to the growing need for sustainable solutions. The central goal of this field is to bridge the gap between scientific discovery and practical applications as researchers continue to uncover the intricacies of biological systems and engineer them to meet the world's pressing needs. This field holds immense promise for a sustainable and biocentric future.

Keywords: Genetic manipulation; Gene therapy; Biocentric future

Abstract ID: BBE-OP89

Role of Bacterial Motility in Biofilm Formation

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Abstract

Biofilm formation begins with bacteria attaching to surfaces using flagella-mediated motility, resulting in 3D microbial communities surrounded by an extracellular matrix (ECM). This ECM, consisting of exopolysaccharides, nucleic acids, proteins, and lipids, promotes adhesion and cohesion and provides resistance to antimicrobials, immune cells, and harsh conditions. Biofilms exhibit collective behaviors, such as migration through cell-cell interactions, allowing them to adapt to challenging environments. Nevertheless, they present significant medical, societal, and industrial challenges, causing most microbial infections and equipment contamination and demanding interdisciplinary research for practical solutions. Biofilms comprise diverse microbial species and form complex communities with emergent properties that enhance their survival. Cell communication influences biofilm structure and composition, while adaptability to changing conditions sustains these communities. The matrix's adaptability hinders antimicrobial diffusion, promoting the spread of antimicrobial resistance. The matrix also serves as a nutrient source during scarcity, supporting survival strategies. Our experiment involved cultivating biofilms from chemotactically active E. coli strains on different media, varying in glucose concentrations and agar percentages, to investigate growth patterns under nutrient limitation. Results indicated faster and thicker biofilm progression in LB compared to glucose and negative control plates. Interestingly, biofilm progression speed differed between agar percentages in the positive control plates. Phase contrast microscopy revealed distinct circular and chain-like single-cell morphologies and gram staining suggested potential mixed communities within the biofilm. Future research aims to explore how bacteria survive in negative control plates, understand the relationship between biofilm formation and motility, characterize the ECM's role, develop effective interventions, and address associated challenges.

Keywords: Biofilms; Motility; Speed; EPS

Abstract ID: BBE-OP90

Recent Advancements in Solar-Driven CO_2 Bioelectrosynthesis

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Abstract
The escalating concentration of CO_2 in the atmosphere at a rapid pace presents a critical global challenge, directly contributing to climate change. Approximately 65% of total CO_2 emissions are attributed to the use of fossil fuels, whether as a direct energy source or in industrial processes. This underscores the urgent need to develop a deployable carbon-neutral technology capable of recycling CO_2 to valuable fuels and chemicals. The overarching objective of attaining a sustainable carbon-neutral economy hinges on the creation of an efficient CO_2-reduction system that can produce biofuels. In this review paper, we provide an overview of recent advancements in biohybrid photoanode and photocathode materials. We delve into the reaction mechanisms observed at the photoanode and photocathode to enhance our comprehension of solar-driven microbial electrosynthesis. Furthermore, we explore the potential of electroactive microbes to achieve high selectivity and production rates for desired products through manipulation of their genomic sequences. Additionally, we address critical challenges associated with scaling up the system. These challenges encompass the removal of reactive oxygen species, the low solubility of CO_2 in typical electrolytes, and the low selectivity of product species. We also offer suggestions for new strategies aimed at achieving economically viable production of bio-based commodities.

Keywords: Microbial electrosynthesis; CO_2-reduction; photocatalysis; oxygen evolution reaction.

Abstract ID: BBE-OP92

Modelling and Simulation of Biofilm Formation in Microbial Fuel Cells (MFCs): Understanding Mechanisms and Enhancing Energy Conversion Efficiency

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Abstract
In recent times with the need to combat environmental challenges, Microbial Fuel Cell (MFC) provides an efficient and renewable solution. Microbial Fuel Cells (MFCs) are a type of bioelectrochemical cells which break down organic substrates and convert them to electrical energy with the aid of microbial metabolism. The basic structure of MFC includes an anaerobic anode and aerobic cathode separated by a proton exchange membrane which facilitates the transfer of protons from the anode chamber to the cathode chamber. In the process, electrons move from the anode to the cathode via an external circuit producing electricity. The heart of an MFC is the biofilm, formed through the passive immobilization technique, in which

microbial cells adhere to each other in an extracellular self-produced polymeric matrix. A review of published literature suggests that the biofilm is grown mostly over the anode for simultaneous treatment of wastewater and generation of electricity. Recently, biofilms have been employed as cathodes as alternatives to precious metallic cathodes during denitrification of water. To advance the understanding of biofilm behaviour in MFCs and optimize their performance, a comprehensive mathematical model of the biofilm has been proposed to capture the intricate biofilm formation process, the simultaneous wastewater treatment and electricity generation and the biofilm detachment process. Mass balance equations for substrate, biomass growth, dissolved gases and ions in the biofilm are formulated for both anode and cathode chambers. Appropriate growth kinetics is incorporated in the mass balance equations. The model predictions are in good agreement with the experimental results. The effects of key parameters, namely, area of the biofilm interface, biomass density, biofilm thickness and biofilm detachment rate on the percentage COD removal and electricity generation are explored for identifying the optimum process parameters maximizing the COD removal efficiency and the current density.

Keywords: Microbial fuel cell; Bioelectrode; Biofilm; Electron transfer

Abstract ID: BBE-OP93

Aspect of Bioprocess Engineering and Biorefinery in Biological Fermentative Hydrogen Production from Organic wastes

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Abstract
Since the Industrial revolution, society has searched for efficient, safer, and cleaner fuels. H2 has the highest energy density among the other known fuels (143 GJ tonne−1). Biohydrogen gas is considered, as a potential energy carrier since it is renewable and does not produce the "greenhouse effect". Biohydrogen can be produced in three broad ways: dark fermentation, biophotolysis (using microalgae), and photofermentation. The researchers throughout the World are searching for the best possible technology that will produce biohydrogen efficiently from different organic wastes (vegetable, fruits, and agricultural residues) and at a high rate. The variation in physicochemical parameters, such as C/N ratio in H2 production media, temperature, pH, inoculum age, and inoculum volume have prevalent importance in fermentative hydrogen production. Multiparameter statistical experimental design methodology (i.e., response surface methodology; RSM) has been adopted to improve the efficiency of fermentative H2 production. CFD simulation was also studied in specific photobioreactors towards uniform fluid dynamics and heat transfer throughout the reactor. From industrial effluents, purple-non-sulfur (PNS) bacteria have shown the potential of efficient biohydrogen production. Researchers have also studied mixed microbial consortia in the presence of light (a combination of both algae and PNS bacteria) for effective utilization of a wide range of wavelengths for biohydrogen production. Mathematical modeling on substrate utilization for biomass during H2 production and kinetics of substrate consumption for H2 production by bacteria has also been carried out. The kinetic parameters determined for H2 production is useful for the scaling up of the process. Finally, the aim is large-scale production of biohydrogen by efficient technology that is renewable and economically viable.

Keywords: Bioprocess engineering; Biorefinery; Biohydrogen production; Bioenergy; Bioplastics; CFD simulation; RSM optimization

Abstract ID: BBE-OP94

Design and Analysis of Fluid Pressure in Integrated Microfluidic Channel for Organic Fluids

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Abstract
The proposed study aims to design and simulate an integrated microcantilever within a microchannel to analyze the behavior of two different fluids, acetone and benzene, as they flow through the microchannel. The analysis is carried out using the finite element method, which integrates various physical phenomena, including solid physics, laminar flow, moving mesh dynamics, and fluid-structure interaction. The key objective of this research is to calculate the deflection of the microcantilever under various fluid flow conditions while maintaining a constant fluid flow rate. The novelty of this design lies in its ability to investigate and compare the behavior of acetone and benzene within microchannels. The results obtained from the simulation demonstrate noteworthy findings. Compared to a finite element method-based model that was previously designed and analyzed prior to the simulation, the study incorporates two different types of cantilevers, namely the T-cantilever and R-cantilever. The maximum deflection observed during the study was 34.23 μm when using organic fluid acetone, accompanied by a maximum pressure of 74.62 Pa. Conversely, the minimum pressure and deflection were recorded for the fluid benzene, with values of 0.85 Pa and 4.85 μm, respectively. Notably, the T-cantilever exhibited the maximum deflection and pressure, while the R-cantilever demonstrated the minimum deflection. This research provides valuable insights into the behavior of acetone and benzene in microchannels, offering a comparative analysis of different microcantilever types. These findings contribute to an understanding of microfluidic systems and may have practical applications in various fields, including microscale sensing and fluid analysis.

Keywords: Microcantilever; Acetone; benzene; Pressure; Fluid velocity

Abstract ID: BBE-OP95

Elucidating the Catalytic Function of Heteropolyacid Catalysts in Butyl Levulinate Synthesis for Green Diesel fuel Additive Production

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Abstract
This paper introduces an experimental approach for the production of butyl levulinate (BL)from levulinic acid (LA) using a catalyst composed of vanadium-incorporated Keggin phosphomolybdic acid. BL exhibits promising characteristics as a potential additive for blending in diesel fuel. The primary objective of this investigation is to assess the catalytic efficacy of vanadium-incorporated Keggin phosphomolybdic acid in the esterification process of LA with the aim of synthesizing BL. The present study describes the synergistic effects produced by the incorporation of vanadium into phosphomolybdic acid. The objective is to gain a deeper understanding of their respective contributions towards enhancing catalytic activity and selectivity. The catalysts are characterized using several analytical techniques, including XRD, FTIR, XPS, HR-TEM, BET, and FE-SEM. Catalytic performance is evaluated using a microwave reactor with different catalyst loadings (10–40 wt.%) and volume ratios (1:4–1:8) of LA and butanol. Subsequently, a comprehensive analysis of the kinetics and mechanism is performed to measure the reaction rate and gain insight into its fundamental mechanism.

Keywords: Butyl Levulinate; Heteropolyacid; Diesel additive; Green diesel; Bronsted acidity

Abstract ID: BBE-OP96

Analysis of Introgressed Transgenes in Transgensis Breeding Program of Cotton

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Abstract
Cotton is one of the world's most important cash crops. India is the third largest producer after the United States and China. The bollworm pests in the field are to blame for the decrease in productivity. To compensate for the loss, pest-specific genes are introduced into natural varieties using genetic engineering (Biotechnically); resulting in Genetically Modified Crops This article discusses the Zygosity diagnosis of Bt cotton using PCR-based approaches. The homozygous and heterozygous lines were distinguished using BGI and BGII gene primers. Heterozygous lines are not chosen since they contain non-transgenic genes in addition to the dominant one. The homozygous lines were chosen, and they were backcrossed with the recurrent parent to form a new variety.

Keywords: Genetically modified crops; *Bt* cotton; Zygosity; BGI; BGII

Abstract ID: BBE-OP97

Magnetically Separable Spent Coffee Grounds as a Potential Novel Support for the Covalent Immobilization of β-Glucosidase for Cellobiose Hydrolysis

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Abstract
Employing biomass-derived supports for immobilizing enzymes represents an eco-friendly remedy for mitigating environmental pollution. In this study, spent coffee grounds, an ecotoxic waste, have been successfully magnetized and amine-functionalized for the first time to immobilize β-glucosidase. The successful preparation of the support was characterized by FTIR, XRD, TGA, SEM, and TEM techniques. Covalent immobilization led to 92.81 mg/g β-glucosidase loading under optimized conditions and retained 87 % activity after immobilization. A relatively small kinetic change was observed in K_m value (902 to 946 μM) after immobilization, suggesting that immobilized β-glucosidase (Glu@AMSCG$_3$) was closely able to mimic the performance of free β-glucosidase. Moreover, Glu@AMSCG$_3$ shows exceptional stability (>90 % residual activity) at a pH range of 3 to 6. A residual activity of 87.94 % was maintained even at 80 °C compared to the free β-glucosidase, which shows only 6.5 % residual activity at the same temperature. After treating cellobiose with Glu@AMSCG$_3$ under optimum conditions for 10 reusability cycles, >79 % conversion was maintained. These findings suggest that spent coffee grounds may be a prospective candidate for application in enzyme immobilization.

Keywords: Magnetically separable spent coffee grounds; β-Glucosidase; Covalent immobilization; Cellobiose hydrolysis

Abstract ID: BBE-OP98

Investigation on the thermochemical conversion of oleaginous yeast biomass for multi-product profiling through pyrolysis GC-MS

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Abstract
Yeast lipid fermentation has gained attention in the last decade, especially for its ability in the conversion of biomass-derived fermentable sugars. Lipid synthesis is the focus of research at present, however, yeast in itself is considered a microbial factory of multiple products. Focusing on this fact it is prudent to investigate the diversity of products that can be obtained by thermochemical conversion of yeast biomass. This may lead to an understanding of an alternative approach to utilizing biomass-derived sugars. An investigation was thus carried out through a pyrolysis GC-MS study of *Rhodotorula mucilaginosa* IIPL32 (MTCC 25056) biomass obtained from glycerol, xylose, glucose, and sucrose as carbon sources. The profiling and further thermodynamic analysis showed that an array of compounds with variable concentrations were obtained covering

the class of alicyclic hydrocarbon to heteroatomic and pyridine derivatives. This may provide significant information for targeted value product recovery from yeast and/or other microbial spent biomass.

Keywords: Microbial spent biomass; Pyrolysis; Waste valorization; Thermochemical conversion; Biorefinery

Abstract ID: BBE-OP99

DES mediated extraction of bioactive component of *Sonneratia apetala*

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Abstract
Deep Eutectic Solvents (DES) have emerged as green and sustainable alternatives to traditional organic solvents for the extraction of bioactive components from natural sources. This study explores the application of DES-mediated extraction techniques for the efficient and eco-friendly isolation of bioactive compounds from *Sonneratia apetala*, a mangrove plant renowned for its diverse pharmacological potential. *Sonneratia apetala* has garnered attention for its rich reservoir of bioactive compounds, including antioxidants, antimicrobial agents, and anti-inflammatory molecules, which hold immense promise for various pharmaceutical and nutraceutical applications. However, conventional extraction methods often employ hazardous solvents and can be environmentally detrimental.The present study explores DES-mediated extraction processes and their suitability for *Sonneratia apetala*. It includes the choice of DES formulations, extraction parameters, and their impact on the yield and quality of bioactive compounds.Furthermore, the study establishes the green and sustainable aspects of DES-mediated extraction, emphasizing its reduced environmental footprint, lower toxicity, and potential for recycling. The extraction of specific bioactive components is highlighted, showcasing the versatility of DES in the isolation of compounds with diverse health-promoting properties.In summary, DES-mediated extraction presents a promising avenue for the sustainable and efficient extraction of bioactive components from *Sonneratia apetala*, aligning with the growing emphasis on green chemistry and eco-friendly processes in the extraction and utilization of natural resources for pharmaceutical and nutraceutical purposes.

Keywords: Deep eutectic solvents; *Sonnaeratia Appetala*; Bioactive compounds; Extraction

Abstract ID: BBE-OP100

Effect of light intensity and wavelength on power plant algae *L. subtilis JUCHE1*

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Abstract
This study focuses on investigating the impact of both light intensity and wavelength on the growth of *Leptolyngbya subtilis* JUCHE1, a strain isolated from a thermal power plant, within a controlled laboratory environment. In this research, the effects of various light intensities, ranging from 0.9 kLux to 3.2 kLux, and diverse wavelengths, including red (~650 nm), yellow (~580 nm), green (~550 nm), and blue (~450 nm) have been examined with respect to algal growth rate, biomass yield, and pigment composition. Elevated light intensity generally yielded higher growth rates and biomass production, reaching an optimum level beyond which photoinhibition commenced. Furthermore, *Leptolyngbya subtilis* JUCHE1 exhibited distinct, wavelength-specific responses, with discernible growth peaks linked to particular wavelengths that mirrored the absorption spectrum of chlorophyll and auxiliary pigments. Our results underscore the critical interplay between light intensity and wavelength in achieving optimal algal growth. It is noteworthy that specific wavelengths demonstrated a substantial inhibitory effect on growth, emphasizing the necessity of fine-tuning the light spectrum for efficient cultivation.

Abstract ID: BBE-OP101

Disease suppression in *Abelmoschus esculentus* post rotary drum compost and vermicompost application in soil

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Abstract
In this study, efficacy of rotary drum compost and vermicompost was evaluated for okra plants to understand their disease suppressive action under natural conditions. Rotary drum compost and vermicompost was prepared from by standardized method from vegetable waste. Initial characterization of compost and vermicompost was evaluated to check stability and maturity of compost before soil application. Disease analysis in plants was conducted for a period of 120 days. Infection rate was found to be highest in control than plants treated with vegetable waste compost and vermicompost. Disease incidence and disease severity based on signs and symptoms such as drying and wilting of leaves, lesions on stems, white spots on leaves and stems etc. were found to be highest in control than plants treated with organic amendments. Disease suppressive rate was found to be 20% with vermicompost, 15% with rotary drum compost in *Abelmoschus esculentus,* respectively. Average disease severity of 3.5 was found in all the compost ratios and vermicompost ratios at the end of study. Results from this study indicated that the vegetable waste vermicompost has better disease suppressive capacity than the vegetable waste rotary drum compost in *Abelmoschus esculentus* plants.

Keywords: Compost; Vermicompost; Plant diseases

Abstract ID: BBE-OP102

Studies on the invertebrates diversity in the composting process of *Mikania micrantha Kunth*

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Abstract
The process of composting involves the conversion of organic materials into stable carbon components and accessible nutrients through the activity of various microbial communities. This process is characterized by its dynamic and complicated nature. Compost is composed of a diverse range of microorganisms and invertebrates, including bacteria, fungi, actinomycetes, and various macro-fauna. It is probable that the presence of invertebrates within the compost contributes to the process of decomposition, particularly during the maturation stage. These organisms flourish by consuming decomposing organic material, fulfilling the role of scavengers, and producing secondary organic compounds that contribute to the improvement of compost quality. The activity of these organisms facilitates the aeration of the compost, while their feeding action enhances the accessibility of organic waste to bacteria by increasing its surface area. Various types of invertebrates are observed at different phases of the composting process. This study aims to conduct the extraction, identification, and enumeration of invertebrates in *Mikania micrantha* composting. Several species that are commonly observed throughout the process include mites, beetles, springtails, woodlice, black soldier flies, ants, and millipedes. Among the species observed in this study, the invertebrates that exhibit the highest levels of abundance are mites having a population of 1261, and springtails of 770. The population and diversity of invertebrates exhibit significant variations as a result of several factors, including the stages of the composting process, the type of composting employed, the feedstock utilized, and the duration of the composting period. It might be argued that in addition to microorganisms, invertebrates also fulfill a significant function in the composting process.

Keywords: Composting; invertebrates; diversity

Abstract ID: BBE-OP103

Microbial Community Dynamics in the Rotary Drum Composting of *Parthenium hysterophorus*

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Abstract:
Composting is an effective technique for biologically transforming biomass into a value-added product. *Parthenium hysterophorus* (PH) is a rich source of nitrogen, phosphorus and potassium after the biomass is microbially transformed through composting. In a 20-day rotary drum composting (RDC) study, microbial communities were analysed in a mixture of (PH), cow dung, and sawdust using culture-dependent and culture-independent methods. The microbial density of the culturable microbes varied along the composting process. While mesophilic bacteria remained consistent (8.5 x 10^7 to 2 x 10^7 CFU g^{-1}), actinomycetes peaked on the 4th day (11 x 10^7 CFU g^{-1}), fungi on day 0 (10.5 x 10^7 CFU g^{-1}), and spore-forming bacteria on day 4 (22 x 10^7 CFU g^{-1}). Actinomycetes and fungi densities declined over time. The culture-dependent analysis revealed a peak abundance of spore-forming bacteria, actinomycetes, and mesophilic bacteria on the 4th day of composting, coinciding with thermophilic conditions. The study hypothesises extreme microbial activity-generated heat deactivates PH allelochemicals. Additionally, the research explores microbial succession in an engineered ecosystem like RDC, which is still underexplored.

Keywords: Culturable microorganisms; Microbial succession; RDC; PH

Abstract ID: BBE-OP107

Development of preventive medicine for diabetic through fermentation of pearl millet

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Abstract
Pearl millet known for maintaining the low glucose level in blood because of rich fibre content leads to biostimulative compounds for pancreatic activity. These bioactive compounds are slowly transformed to active state which increases the insulin production upon consumption, responsible for reducing blood glucose. Transformation of fibres present in pearl millet residue to bioactive compound will be enhanced by treating with microbial fermentation. The present study results given innovative product with enhanced antidiabetic property through fermentation of pearl millet (*Pennisetum gl aucum*) using probiotic microorganism *Lactobacillus bulgaricus*. The submerged fermented product of pearl millet floor with additive given αamylase inhibitor index 120µg of maltose released/ ml of enzyme compare to control aqueous extract 360 maltose released/ ml of enzyme . This indicates the good antidiabetic proptery as per FDA norms. The antidiabetic property is due to increase in the level of biotic which regulates the carbohydrate metabolism in the body especially blood glucose level. The present study gives a fermented beverage from pearl millet to be used as a preventive medicine to control diabetic in humans.

Keywords: Pearl millet; Lactobacillus bulgaricus; Fermented beverage; Antidiabetic property; Preventive medicine

Abstract ID: BBE-OP109

Elucidating the Role of Temperature and Catalytic Materials in Biorenewable Transformations

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Abstract
Biomass conversion technologies can be primarily classified into two categories, namely high temperature (>750 K) technologies or low temperature (<550 K) technologies. My research group works on both high and low-temperature technologies for catalytic transformation of lignocellulosic biomass and biomass-derived molecules to green gasoline, green diesel, bio-aviation fuel, biopolymers, bio-oil, bio-coal, and hydrogen-rich syngas. However, catalytic materials and process conditions are critical to the final product. In this regard, the present work provides an insight into the role of Bronsted acidity of heteropolyacid (HPA) in the production of green gasoline, green diesel, and bio-aviation fuel. It is followed by a detailed discussion on the importance of HPA's Keggin structure and deprotonation energy to provide an insight into the possibilities of several novel catalyst's synthesis. On the contrary, a high-temperature process is explored to produce hydrogen-rich syngas, bio-oil, and bio-coal to create a carbon-neutral steel and energy industry. The paper outlines the different ways to generate wealth from agricultural waste for a circular and carbon-neutral economy.

Keywords: Biomass; Biofuel; Green gasoline; Green diesel; Bioavitaion fuel

Abstract ID: BBE-OP110

Sorption of Cr(VI) and its subsequent removal from Aqueous Environment with algae *Sargassum myriocystum*

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Abstract
The present study focus on the adsorption of hexavalent chromium with *Sargassum myriocystum*, algae and the effect of various parameters like size of sorbent, contact time, temperature, sorbent dosage and agitating speed were enhanced with aid of response surface methodology. The maximum adsorption of hexavalent chromium in its optimized conditions were determined as solution temperature of 35°C, size of sorbent for 0.5284 mm 36 BSS mesh ,contact time (1 hour), agitating speed (50 rpm) and sorbent dosage (4.309 g).The utmost removal was 99% . Isotherm studies revealed that Langmuir model is fitting the algae with a hexavalent chromium uptake of 61.5384 mg/g. Thermodynamic study revealed that the system is endothermic in nature and values of Gibb's free energy, enthalpy and entropy change are in accordance. The sorbents were characterized with FTIR and SEM. FTIR and the studies revealed the presence of a few functional groups like carboxylic acid, amino and hydroxyl in hexavalent chromium adsorption. Pseudo first order kinetics are in accordance for this process. From above studies it can be concluded that *Sargassum myriocystum* had good removal capacity for hexavalent chromium from fabricated solutions.

Keywords: *Sargassum myriocystum;* RSM; Chromium; Isotherm; Kinetics; Thermodynamic studies

Abstract ID: BBE-OP111

Manufacturing of Bio-Plastic using Lignocellulose

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Abstract
The plastic waste accumulation in environment becomes a major issue now a days. Therefore, technologies aimed at alleviate the environmental impacts of petroleum products have gained global relevance. This study focuses on the production of bio-plastics using lignocellulose feedstock with its advantages and disadvantages. Raw material used for production of transparent plastic is corn starch and for black plastic is coconut husk. Bio-plastics derived from lignocellulosic biomass hold immense potential as eco-friendly alternatives in various applications.
Lignocellulosic materials have huge potential due to its availability, renewability, and non-edible nature benefits to develop it into an eco-friendly bioplastic. Lignocellulose is subjected to a series of chemical and mechanical treatments to extract cellulose and hemicellulose components. Through a combination of enzymatic hydrolysis and fermentation, sugars are obtained and converted into bio-based polymer precursors. These precursors are then polymerized using innovative techniques to produce bio-plastic materials. Experimental results are validated through rigorous testing such as thermal test, friction test, tensile test, thickness test, recycling test and flame test. The data obtained compared with normal plastic. The thermal test performed shows threshold temperature value for bioplastic is 172 °C whereas for normal plastic it varies in between 180 °C – 220 °C. Flame test shows that there is no smoke emission in bioplastic whereas for normal plastic it emits harmful smoke. The production of bioplastics from plant biomass represents a model for the recycling and management of such waste with positive environmental effects.

Keywords: Bioplastics; Starch-based bioplastics; Lignocellulosic fibers; Thermal test

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Abstract ID: BBE-OP113

Conversion of flower waste biomass into value-added natural colorant

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Abstract
According to estimates, floral waste makes up about a third of all solid trash in India, making it one of the country's greatest land and water pollutants. The dead flowers are often thrown into the nearest body of water, which is typically a river. Flower garbage can be utilized for the extraction of natural colors. The present study deals with the collection of waste *Ixora coccinea* flower biomass for the extraction of natural pigment. Optimization of the extraction process was done using response surface methodology (RSM) for various extraction techniques. The pigment extracted was further analyzed by UV-visible spectroscopy, Raman spectroscopy, Fourier Transformed Infrared Spectroscopy, and High-Resolution Mass Spectrometry which showed the presence of anthocyanin. The total phenol, flavonoid, and anthocyanin content of the pigment were determined along with its antioxidant properties. To maintain stability, the pigment was encapsulated into a polymer and further characterized by FTIR and SEM (Scanning Electron Microscope). The biomass of fresh flowers and pigment yield from 50 *Ixora coccinea* flowering plants was calculated for the summer, autumn, winter, and spring seasons which revealed that the maximum pigment can be obtained during the summer season. Because pigment yield and biomass weight are correlated, a lot of biomasses are required for a high yield of pigment.

Keywords: Anthocyanin; Biomass; Extraction; Flower; Pigment

Abstract ID: BBE-OP115

Investigating Microwaves, Infrared Radiation and Ultrasounds for Improved Drying Efficiency and Quality of Beetroots

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Abstract
The aim of study was to present a modern method of drying intensification of fermented beetroots using microwaves (MW), infrared raiation (IR), and ultrasounds (US). The intensification of heat and mass transfer processes was analyzed. The drying kinetics, effective moisture diffusivity, drying time, changes in material temperature, specific energy consumption were evaluated under different conditions and optimal conditions were defined. The results allow stating that MW, IR, and US enhance the drying efficiency of final products without significant deterioration of product quality and elevation of material temperature.The applications of new MW, IR or US based technologies should bring significant benefits to the food industry, e.g. production of functional dried snacks from fermented beetroots.

Keywords: Microwave drying; Infrared drying; Ultrasounds; Beetroots

Abstract ID: BBE-OP117

Bio-energy By-product as an Enhancer of the Biomethanation Process

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Abstract

Biomethanation plays a significant role in energy generation from biodegradable wastes. It is also regarded as a feasible and effective method in food waste management. Biogas production can be enhanced by using various additives in the anaerobic digestion system. Biochar, a bio-energy by-product, is a porous, carbonaceous material produced from the thermochemical conversion of a wide variety of biomass, including agro-industrial by-products. Due to biochar's various distinctive properties, it has numerous environmental applications, including their uses as an additive in the biomethanation process. Even though biochar prepared from different biomasses has been explored in the field of biomethanation, biochar from some feedstocks is yet to be studied. The purpose of this work is to study the CH_4 composition in the anaerobic digestion (AD) system of food waste using two different biochar, i.e., Coir-pith biochar (CPB) and mustard de-oiled cake biochar (MCB).Additionally, digestate was studied to observe the effect of biochar addition on issues like Volatile fatty acid (VFA) accumulation, and pH drop in the AD system. Energy dispersive X-Ray analysis of biochar revealed that MCB had more alkaline earth metals in comparison to CPB. The MCB-amended system showed an alleviation of acidification caused by the accumulation of VFAs to some extent by recovering the pH to a normal range and promoting the consumption of VFAs. Moreover, the MCB-treated system showed an average of 17.47% increase in the methane composition of biogas when compared with CPB-amended digesters. In comparison with the control treatment (CT), the results showed that MCB addition enhanced CH_4 % by 28.9%.

Keywords: Anaerobic digestion; Mustard-oil biochar; Coir-pith biochar; Biomethanation

Abstract ID: BBE-OP119

Development and Analysis of a Dietary Fibre-rich Food Supplement for the Elderly: An Initial Work

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Abstract

Population aging is a predominant phenomenon worldwide. Aging increases the vulnerability of the body and results in the occurrence of health issues. The increasing adaptation of sedentary behavior among the elderly makes the situation more difficult. As people are now getting concerned about a healthy diet, the need for the consumption of adequate dietary fiber has been felt for its nutraceutical properties, especially the production of short-chain fatty acids by the gut microbiota. In this backdrop, an attempt is being made to develop a dietary fiber-rich food supplement for the elderly and analyze its properties. Several edible cereals and other edible ingredients were used for the formulation of the supplement. Preparatory and evaluatory methods and techniques were applied. An investigation of the possible mechanisms between the beneficial nutrient molecules and bodily effects has been taken into consideration. The outcomes indicate that the supplement is a good source of dietary fiber and can be used for the geriatric diet.

Keywords: Elderly food supplement; Fiber-rich supplement; Elderly health; Dietary fiber; Physiochemical properties

Abstract ID: BBE-OP120

High pressure Hydrogenation of CO and CO2 to Fuels and Chemicals in SS Microreactors

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Abstract

Catalytic conversion of biomass into fuels, chemical synthons and value-added chemicals using microreactors and tubular reactors is one of the research objectives at our NSF-CREST Bioenergy Center. Previous studies focused on the use of silicon(Si) and 3-D printed stainless steel (SS) microreactor to investigate metal-support interaction of catalysts on formation of hydrocarbons at 1 atm and 20 bar.1-4 The catalyst such as Co-Ru-KIT-6, with a mesoporous silica support, shows the long-range ordered structure as supported by BET and lower-angle XRD studies. Liquid fuel was obtained using this catalyst in the microreactor at 20 bar. 5 Our studies with Fe and Fe-Co catalysts have been extended to supports such as graphene

oxide and mixed SiO2-Al2O36 , and also in the presence of metal promoters. 7 An overview of our current studies on CO/CO_2 hydrogenation with different feed composition and temperatures will be presented.

Abstract ID: BBE-OP121

Machine learning driven enzyme engineering as a means to enable biomanufacturing

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Abstract
Production of chemicals through biorefineries dates back to WWI era, for example, butanol was fermented using Clostridium species [1]. Petroleum based refineries & chemical processes have superseded the commodity chemicals manufacturing space owing to economies at scale. However, we have started witnessing a renewed interest in biomanufacturing due to the ever-rising cost of petroleum and shift towards sustainable manufacturing practices due to pressing environmental concerns such as global warming.
Enzyme engineering, a sub-field of metabolic engineering, is a combinatorically complex design problem as peptides are made of 20 natural amino acids and are usually 400 amino acids long $O(20^{400})$. To address this challenge, we present a novel machine learning based approach called MLProScape [2] for engineering enzymes by using less than 100 sequence- function measurements. This approach is amenable to identifying key residues in both active and distal sites to the binding region. Unlike traditional approaches like directed evolution or structure guided design, this ML approach can be employed without the need for a high- throughput screening assay or high-quality crystal structure of the enzyme. To demonstrate proof-of-concept, we will highlight a few case-studies to engineer a variety of enzymatic properties such as catalytic activity and thermostability. Development of novel machine learning and computational approaches such as the ones described here should help pave way for enhanced biocatalytic conversion and cost-efficient synthesis of commodity chemicals.

Keywords: machine learning; enzyme engineering; biomanufacturing; commodity chemicals

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Abstract ID: BBE-OP122

Agro-Industrial Waste Valorization through Hydrothermal Conversion for co-production of Carbon Quantum Dots and Biofuels

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Abstract
Agro-processing industries generates a substantial quantity of waste materials, and conversion of these wastes into valuable material could be profitable considering both environmental and economic aspects. There are numerous biomass conversion techniques that can be applied for conversion of waste biomass into valuable materials. Hydrothermal conversion is one such techniques that can be used for co-production of biofuel and other valuable materials such as carbon quantum dots (CQDs), activated carbons etc. The current study investigates the applicability of hydrothermal conversion technique in producing biofuel and carbon quantum dots simultaneously from biomass wastes obtained from a flour mill. Water soluble CQDs of average size ranging from 4.67 nm-4.88 nm were produced from three types of wastes namely wheat straw, wheat

husk and fine husk powder. Hydrochars having calorific value in the range of 12.95- 25.94 MJ/kg were also produced during the conversion. The dependence of hydrochar characteristics on the composition of the feed-stock were also investigated. This study shows that hydrothermal conversion technique can be a way for not only producing high valued material which can be used in various fields but also for proper management of agro-industrial wastes which in turn can help to mitigate environmental problems caused by open dumping and burning of the wastes.

Keywords: Agro-industrial wastes; hydrothermal conversion; wheat straw; wheat husk; fine husk powder; carbon quantum dots; hydrochar.

Abstract ID: BBE-OP123

Bioremediation of oil contaminated soil through emulsification with coconut leaf-biochar

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Abstract
Biomass from coconut leaves is bulky and fibrous, so it is problematic for disposal and decomposition. Biochar prepared from coconut leaves is found to be highly alkaline in nature and shows remarkable emulsifying potentiality for petroleum. In the present study, coconut biochar was used as an emulsifier in oil contaminated soil (petroleum) under *in vitro* conditions. The physico-chemical parameters of soil were found to be influenced by amount of biochar applied and its duration of treatment. The emulsification index was being measured and compared, based on emulsification process parameters like mixing time, temperature, stirring intensity at different duration and combinations of biochar. Mixing time of 25 minutes at 35°C with stirring intensity of 1000rpm was found to be most effective for all the treatments for a period of three months. However, enhancement of microbial biomass of *Pseudomonas sp.* from $1x10^4$ to $1x10^8$ cfu in 100ml/kg soil with 5, 10 and 15% of biochar was observed. The most suitable treatment was found to be with 5% biochar, as the soil pH, porosity and water holding capacity were found to be in a range, which is important from agronomic point of view. However, further study needs to be done for a decade under *in situ* condition for improvement in soil structure and bioremediation with the aid of microorganisms.

Keywords: Biomass, biochar, oil contaminated soil, microflora, emulsification, bioremediation

Abstract ID: BBE-PP5

Syzygium Cumini: A Study on Phytochemical Constituents and Antimicrobial Activity of Ethanolic and Methanolic Seed Extracts

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Abstract
Plants contain biologically active compounds (phytochemicals) that have therapeutic and medicinal values. Syzygium cumini (Jamun) is one such plant which is widely used in India as a traditional form of treatment for various ailments. In this study, the ethanolic and methanolic seed extracts of S. cumini were characterized via UV-Visible (UV/Vis) and Fourier Transform Infrared spectroscopy (FTIR) spectroscopy. The preliminary phytochemical screening of the seed extracts of S. cumini were carried out using standard procedures which revealed the presence of various phytoconstituents like alkaloids, flavonoids, phenols, terpenoids, tannins, saponins, steroids and amino acids. The in vitro antimicrobial activity of the two extracts were investigated against two common pathogens Escherichia coli and Bacillus subtilis using the agar well diffusion assay. Antimicrobial screening showed notable zone of inhibitions with respect to the control. The results suggested the potent antimicrobial activity of S. cumini seed extracts which may be attributed to the bioactive constituents and supports the customary use of S. cumini.

Keywords: Syzygium cumini; Phytochemical screening; Antimicrobial activity

Abstract ID: BBE-PP6

Natural native polysaccharides: potential and tricky weapon to fight against cancer

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Abstract
Cancer is one of the most critical and serious health issues today, and it is also the leading cause of mortality. Nowadays, radiation and chemotherapy are the principal cancer treatment modalities, but they have severe safety concerns. Natural endogenous polysaccharides, often known as "biologic response modifiers," stimulate human immune responses to illnesses and infections. Several bioactive polysaccharides have been identified in preclinical models to suppress tumour progression and extend survival via immune activation, cell cycle arrest, and death. Polysaccharides derived from plants, microbes, and marine sources have lethal effects on cancer cells, mainly by various cytotoxic pathways.This study looks at how natural native polysaccharides influence apoptosis, autophagy, necroptosis, ferroptosis, pyroptosis, and cuproptosis in cancer cells. Insilico approaches have predicted additional drug targets in recent years. The current focus of drug discovery is on the creation of targeted medicines, which are described as "a single chemical operating on a single target of a single illness." This discovery is likely to pave the way for the future progress of natural polysaccharides as anticancer drugs in pharmacological investigations and clinical research.

Keywords: Polysaccharide; Cancer; Cytotoxic pathways; Apoptosis; Drug discovery

Abstract ID: BBE-PP7

Effect of Environment on Biodiversity and Ecosystem

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Abstract
Varieties of bio species like animals, plants, fungi, microorganisms which make our natural earth, exist together in our environment to create biodiversity. It is the inter relationship of genes, species, and ecosystems. This biodiversity is in great threat as there is a continuous loss of it. Various species in our eco system are becoming extinct at the fastest rate. This habitat destruction and huge loss is the direct consequences of human activity and different environmental issues. The over population growth, use of lands, over hunting, over fishing, over harvesting etc are the main human activities responsible for declining the biodiversity globally Pollution, contamination, global climate change, exploitation of natural resources, global warming are the environmental threats to bio diversity. The variation of composition in the ecosystem e.g introduction of invasive species in the eco-system also leads to destruction. As the diversity in life enriches the quality of life of individual, it's a very important issue for the policy-makers and researchers. With increasing biodiversity proper utilization of resources takes place provided by the nature . Ecologists are investigating the effect of environmental issues on diverse lives . They research for conservation and restoration of biodiversity in nature. In this article the effect of various issues on declining trend of biodiversity have been discussed briefly.

Keywords: Biodiversity; Ecosystem; Environment; Global warming

Abstract ID: BBE-PP8

Drug loaded cellulose aerogel for topical drug administration with controlled release

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Abstract

Oral Lichen planus (OLP) is a widespread chronic mucocutaneous, autoimmune disorder affecting the oral cavity. Multiple therapeutic approaches including both topical and systemic corticosteroids have been used in the management. As a consequence of the reported adverse effects of corticosteroids, different natural plant extracts have been suggested. Pomegranates have been identified for hundreds of years as natural treatment modality for their numerous benefits for health. Topical punica granatum extracts gel in management of OLP has been tried, the topical gel has the benefit of having a composition that is similar to saliva but the disadvantage is that dissolve quickly by saliva, thus providing less application time. As a result, drug-loaded cellulose solid aerogels are promising drug delivery carriers for delivering medications to the affected area via controlled release because the medication slowly dissolves in saliva and is released to the area of irritation. Here, characteristics such as ease of availability, biodegradability, biocompatibility, and nontoxicity make cellulose an ideal raw material for cellulose aerogel, which additionally provides a highly porous, interconnected fiber network, a high surface area, and the availability of various functional groups required for drug encapsulation. Finally, an intelligent and responsive cellulose aerogel-based gel drug delivery system is described.

Keywords: Aerogel; Drug delivery; Drug delivery carriers; Controlled release; Oral administration; Topical drug administration

Abstract ID: BBE-PP9

In vitro culture cultivation of *Acacia catechu* for natural dye production

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Abstract
In this study, natural dye was extracted from leaves of *Acacia catechu* for formulation of biocompatible dye for cotton fabrics. Plantlets of *Acacia catechu* were developed by *In vitro* plant tissue culture cultivation technique under aseptic condition. Nodal segments of *Acacia catechu* (3-4cm) sterilized with 0.1% mercuric chloride ($HgCl_2$) were kept into MS media supplemented with different plant growth regulator. MS media with cytokinin 6- Benzyl aminopurine (4.0 mg/l) had showed maximum bud break. These bud breaks were enhanced by adding mixture of kinetin (5.0mg/l) and Indole-3 acetic acid (0.5 mg/l) into MS media. The maximum shootings were observed after adding mixture of 6-Benzylaminopurine (3.0mg/l) and Indole-3 acetic acid (0.5mg/l). The maximum root induction was observed for media supplemented with Indole-3 butyric acid (1.0 mg/l). The artificial seeds were developed by encapsulating pollen grains of these plantlets with 3% sodium alginate and 100 mM calcium chloride. Leaves of these plantlets were dried and powdered. The phytochemical screening test for their aqueous extracts showed presence of carbohydrates, saponins, Amino acid, flavonoids, quinones, alkaloids This aqueous extract showed greater extent of zone of inhibition with size 2.1cm against growth of *Pseudomonas spp.* This natural dye was tested against cotton fabrics using copper sulphate as mordant with maximum stability for 4 hours in detergent solution at 50℃.

Keywords: *Acacia Catechu*; Natural dye; Artificial seed; *In vitro culture*

Abstract ID: BBE-PP10

Effect of different drying conditions on the kinetics and physical properties of Kombucha bacterial cellulose

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Abstract
Kombucha bacterial cellulose (KBC), obtained as a by-product of tea fermentation, has potential applications in diverse fields, including wound dressing, food production and packaging, optoelectronics and sensor-based technologies, polymer electrolyte membranes, and various medical applications such as implants and scaffolds, as well as drug delivery carriers. The high water content and presence of post-fermentation residues observed at the beginning of downstream processing necessitate the implementation of suitable drying conditions that can significantly affect the final characteristics of this versatile biopolymer. Thus, preliminary work was carried out to determine the impact of hot oven drying on the dry weight and thickness of the dried KBC. Further, to study the effect of different drying methods on its properties, it was subjected to microwave drying (180-900W), hot air oven drying (30-70°C), and room temperature drying. Additionally, the acquired data were fitted into different models to study the drying kinetics of KBC. The dried sheets were then analyzed to study the changes in water-holding capacity, rehydration, browning index, crystallinity, optical transmittance, and mechanical

properties. Hence, optimizing the drying conditions will help in reducing the time and cost without comprising any properties that allow it to be processed into various value-added products.

Keywords: Drying; Kombucha bacterial cellulose; Hot air oven; Microwave

Abstract ID: BBE-PP11

Vapour Phase Dehydration of sorbitol to isosorbide over Vanadium Phosphate Catalyst

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Abstract
Much attention has recently been paid to the usage of renewable biomass due to the energy and environmental crises. Sorbitol, a valuable molecule generated from biomass that may be used to make polyols, can be made from cellulose using glucose. An essential polymer and medications chemical, isosorbide, is produced when Sorbitol is dehydrated. One of the top twelve chemical building blocks is Sorbitol, created when glucose is hydrogenated. It can be converted into polyols such as isosorbide, ethylene glycol, and propylene glycol. Due to its stiff molecular structure and chiral centers, isosorbide is used explicitly in polymers, biomedicine, and cosmetics. The glass transition temperature of PET resin, which is frequently used in food and beverage containers, can be raised by isosorbide. Chiral separation resins based on isosorbide help separate enantiomeric compounds in the pharmaceuticals and fine chemicals market. We looked into utilizing vanadium phosphates to create isosorbide by dehydrating Sorbitol in the vapor phase. After 6 hours of reaction time with vanadium phosphate at room temperature, 89.8% of the Sorbitol was converted, with a high selectivity of 65.3% for isoSorbide.

Keywords: Dehydration; Isosorbide; Sorbitol

Abstract ID: BBE-PP12

Mass synthesis of bacoside A and biomass from *Bacopa monnieri* cell suspension culture using a bioreactor

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Abstract
Bacopa monnieri; also known as 'Brahmi', is one of the most important Indian medicinal herbs. The main bioactive compounds in brahmi are saponin called as bacoside A. Bacoside content in field grow plant ranges from 0.05%-0.85%. Bacoside is a key ingredient in many traditional medicine formulations that target CNS and tackle disorder consisting of memory loss, and anxiety. These compounds are naturally synthesized in quite a small quantity, therefore purification from biological material gives rise to a limited yield, and impurities and utilizes an exceptionally huge measure of biomass. Bioreactors are effective alternatives to traditional crop production due to their stability, improved regulations of culture conditions, more effective nutrient uptake capacity, huge amounts of biomass, and product outcome. In this current study, callus culture from leaf explant was established and presence of bacoside was confirmed using HPLC. Culture condition for callus suspension culture using shake flask was optimized using various statistical tool such as Plackett-Burman and Response Surface Methodology to determine maximum biomass, cell viability and bacoside content. Mass synthesis was carried out from cell suspension culture using various mode of bioreactor (batch and fed batch strategy) where intermittent sampling was performed to determine substrate consumption, biomass and bacoside.

Keywords: *Bacopa monnieri,;* Bcoside; Biomass; Callus suspension culture; Bioreactor

Abstract ID: BBE-PP13

Fermentation assisted extraction of chitin from shrimp waste

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Abstract
Shrimp waste has been used extensively for the commercial production of chitin. Both chemical and biological method can be used for the chitin extraction. Chitin extraction by chemical method has been found to be hazardous in nature due to the application of strong acids and bases. In the other hand, biological method has been found to be ecofriendly in nature in which lactic acid producing bacteria, and protease producing bacteria has been applied for the chitin extraction. Fermentation assisted extraction of chitin from shrimp shell waste was explored in this studied. Lactic acid producing bacteria *Lactobacillus rhamnosus* and *Bacillus subtilis* were utilized for the co-fermentation of shrimp waste in shake flask culture as well as in bioreactor. Fermentation media for chitin extraction from shrimp waste was optimized using Plackett-Burman followed by Response Surface Methodology. Percentage of demineralization, percentage of deproteination and chitin yield was estimated. The extracted chitin and commercial chitin from shrimp waste was characterized by X-ray Diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR).

Keywords: Shrimp waste; Chitin; Demineralizatio; Deproteination; Chitin yield

Abstract ID: BBE-PP14

Investigating the Performance of Native Microalgal Consortium for Nutrient Removal in Hydroponic Wastewater: Experimental Evaluation and Economic Prospects

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Abstract
Given the global population growth and the increasing food demand in urban areas, novel strategies have emerged to enhance resource-efficient urban agriculture. One such approach is the utilization of greenhouses equipped with hydroponic systems, which offer improved control over plant growth and sustainability. However, effective management of nutrients in hydroponic agricultural systems remains an environmental challenge, warranting further exploration from the perspective of a circular economy.

To address this challenge, cultivation of microalgae in hydroponic effluent is proposed as a bioremediation technique with the added advantage of producing nutrient-rich algal biomass, which can be valorized later. Therefore, in the present study a native microalgal consortium was cultivated using the effluent collected from a hydroponic system to produce microalgal biomass enriched with nutrients and lipids.

Three different type of cultivation system (autotrophic, mixotrophic, and heterotrophic) was used for the microalgal cultivation with varying glucose concentrations ranging from 0 to 2.5 mg/ml and the systems' performance was evaluated based on the biomass productivity, nutrient utilization and biomass quality. Further, a techno-economic analysis is conducted to evaluate the economic feasibility of the proposed system. It is expected that such an approach will help in establishing a sustainable food production system from the circular economy perspective.

Keywords: Hydroponic effluent; Biomass production; Nutrient utilization; Techno-economic assessment; Circular economy

Abstract ID: BBE-PP15

Fabrication of silicone-based microparticles for application in high-density cell culture

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Abstract
Microcarrier-based cell culture has the potential to achieve high-density cell culture and a higher yield of protein. Additionally, such microcarrier-based culture is known to reduce shear stress in the bioprocessing of eukaryotic cells. Here we choose insect cells (Sf-9) as the protein expression systems since they are widely used in expressing recombinant proteins, vaccines, and VLP due to their ability to perform post-translational modification comparable to mammalian cells. In this context, we fabricated PDMS (Polydimethylsiloxane) microspheres using suspension polymerization. First, we optimized the RPM, SDS concentration, and curing time to achieve the diameter of the PDMS microspheres in the range of 200μm to 500μm. Secondly, we implemented a gelatine coating to increase the extent of cell attachment. Finally, we performed 3D imaging to assess the extent of cell attachment on the PDMS spheres using laser

scanning confocal microscopy. The result shows that gelatine-coated PDMS microspheres can be a potential direction for attaching cells in a microcarrier-based culture. The proposed framework assumes importance in building a cost-effective solution for performing high-density cell culture.

Keywords: Microcarriers; Insect cells; High-density cell culture; PDMS microspheres

Abstract ID: BBE-PP16

Subcellular localization of the 4S biodesulfurization pathway enzymes of *Gordonia* sp. IITR100

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Abstract
High sulfur content in fossil fuels is a rising concern. It imparts devastating effects on the environment by causing acid rain, on human health, as well as corrodes the pipelines and poisons the catalysts in petroleum refineries. Hydrodesulfurization (HDS) is used to reduce the sulfur level to about a certain level, however, it fails to cater to all kinds of sulfur present, like thiophenic sulfur, dibenzothiophenic sulfur moieties. Biodesulfurization, as the name suggests, is removal of sulfur by microorganisms. Our lab isolate, *Gordonia* sp. IITR100, which performs biodesulfurization through 4S pathway has the ability to desulfurize both aliphatic and aromatic organosulfurs. The spatial localization of the enzymes for desulfurization has not been reported in any host. Colocalization of enzymes has been suggested to enhance desulfurization rates. In this study, we created translational fusions of the enzymes DszA, DszB and DszC involved in desulfurization with GFP and mCherry with an objective to determine their subcellular localization in both native and heterologous hosts, as well as naturally desulfurizing host, *Rhodococcus erythropolis* IGTS8. The study will pave the way for developing processes for enhanced biodesulfurization.

Keywords: Biodesulfurization; *Gordonia* sp. IITR100; Enzyme; GFP; Spatial localization

Abstract ID: BBE-PP18

Extraction of pigments of Ixora coccinea flower using a novel food-based solvent

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Abstract
Ixora coccinea, or scarlet jungle flame of Rubiaceae family produces orange-red to scarlet flowers, which are rich reserve of phytochemicals. Traditionally extraction of pigments from Ixora flower utilizes solvents like acidified ethanol, petroleum ether, ethyl acetate, n-butanol, etc. The current study evaluated the potential of a novel extraction solvent soda water for extracting Ixora pigments. The extraction efficiency of soda water was initially compared with acidified ethanol and hot water (80 °C) through visual inspection and spectrum analysis for 30 days. Maximum pigment extraction and desirable color were observed in the soda water extract (heated with Ixora petals at 80 °C for 55 min). The solvent extraction process was then optimized in terms of solvent-to-flower ratio and the optimized ratio was used to analyze the color stability through Browning Index comparison. Optimized color of the Ixora flower extract, at different withering stages, was obtained based on the total monomeric anthocyanin content (mg/L) and Browning index. Further optimization of color stability with varying temperature and light conditions will be conducted for achieving unambiguous conclusion. This study will definitely pave the way for the preferable use of natural colors in foods as compared to harmful artificial colors which have detrimental health effects.

Keywords: Browning index; Ixora flower; Monomeric anthocyanin; Soda Water; Withering.

Abstract ID: BBE-PP23

Development of aptamer-based electrochemical biosensor using Ag-modified screen-printed carbon electrode for the detection of *E. coli* in water sample

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Abstract
E. coli serves as an indicator organism for assessing fecal contamination and the potential presence of waterborne pathogens. However, the traditional methods employed for detection of bacteria are time-consuming and need pre-enrichment, DNA isolation, amplification, and purification. Moreover, these methods demand the use of complex instruments, laboratories, and skilled professionals. The present work has demonstrated the development of easy, rapid, sensitive, and portable biosensor for the onsite detection of *E. coli* in water samples. The screen-printed carbon electrodes (SPCE) were modified by electrodeposition of Ag particles onto the working electrode using 3 mM $AgNO_3$ in 0.1 M KNO_3 solution. The distribution of the particles over the electrode surface and the particle size were analyzed by scanning electron microscopy (SEM). A thiol-modified DNA aptamer specific to the *E. coli* ATCC 8739 strain was immobilized onto the electrode surface through thiol-Ag covalent binding. The aptamer functionalized SPCE was characterized using cyclic voltammetry (CV). The functionality of the biosensor was determined by differential pulse voltammetry (DPV). A proportional decrease in the current signals was observed with increasing *E. coli* concentration. The linearity was obtained from 53 CFU/ml to 1.06×10^6 CFU/ml. The regression line equation was obtained as $\Delta I = 5.8980C + 5.7113$ with $R^2 = 0.97$. A relative standard deviation (RSD) was calculated as 3.46 % (n = 3), which showed good reproducibility. The developed biosensor demonstrated minimum detection limit of 53 CFU /ml *E. coli* in a response time of 15 minutes

Keywords: Electrochemical biosensor; Electrodeposition; Aptamer functionalization; Bacteria detection

Abstract ID: BBE-PP25

Insilico Structure Based Drug Designing Against DNMT1 Gene For Treatment Of Triple-Negative Breast Cancer (TNBC)

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Abstract
In breast cancer aberrant DNA methylation patterns are commonly observed in breast cancer cells. DNMT1 is responsible for these abnormal DNA methylation, which results in the silencing of tumour suppressor genes or activation of oncogenes and leads to the development and progression of breast cancer. DNMT1 has been implicated in modulating the expression of hormone receptors in triple negative breast cancer (TNBC). Aberrant hypermethylation patterns controlled by DNMT1 can result in the loss or reduction of hormone receptor expression, affecting response to hormonal therapies.
We have selected drug candidate by structure-based drug designing to inhibit the hypermethylation activity of DNMT1 protein, so, it will be unable to carry out its functions in the tumour cells in breast cancer. First, tertiary structure DNMT1 predicted and validated with the PDB. Through docking based virtual screening using PyRx 7 potential drug candidates were selected based on their highest binding affinity with DNMT1 from 70 phytochemical ligands library. Through toxicity and druggability analysis 1 of them cyclovalone was selected as a potential drug candidate with appropriate ADMET profiles and carcinogenicity parameters. Through in vitro and in vivo studies cyclovalone be a potential drug candidate targeting DNMT1 protein in breast cancer, will be confirmed.

Keywords: Breast cancer; Tumour cells; DNMT1; Triple negative breast cancer; Hypermethylation; Drug-designing

Abstract ID: BBE-PP26

An up-to-date review of microbially-induced carbonate precipitation process and its applications

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Abstract

Microbially-induced carbonate precipitation (MICP) is a natural process wherein microbes alter the environment and cause the creation of carbonate minerals. MICP is quicker than typical mineralization owing to the involvement of microbial enzymes. It is economical, sustainable, and environmentally friendly. MICP has many applications, including reinforcing soil and building materials, mending concrete cracks, capturing CO2, and producing bio-composites. This review seeks to understand the physiology of the MICP process, along with its applications in sustainable construction. Research progress made in this area over the past one decade is lucidly presented. Focus is placed on bio-concrete, which through microbial self-healing, effectively combats concrete's vulnerability to cracking in a durable and practical fashion. Use of the ureolytic *bacterium*, *Lysinibacillus sphaericus* is explored in the context of self-healing concrete formulation, with focus on its merits over other microbial species with carbonate precipitating potential.

Keywords*:* Microbially induced carbonate precipitation; Bio-concrete; Lysinibacillus sphaericus

Abstract ID: BBE-PP27

In-silico Designing of Inhibitors Against Telomerase Enzyme for treatment of Breast Cancer

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Abstract

Living organisms constitute of cells which normally proliferate, keeping a balance between a daily cell death of 10^{12} cells and their corresponding replenishment by division during which, the DNA replicates. In eukaryotes, the linear nature of DNA accounts for end problem of replication in which a gap gets incorporated at the 3' end of the replicating DNA strand, which keeps on increasing leading to shortening of the chromosome ultimately resulting in cell death. In the germ line cells, an enzyme is produced by the telomerase gene, which is a ribonucleoprotein complex. This is responsible for the maintenance of the length of chromosome, which is absent in the somatic cells, due to silencing of the gene. It is also found that this gene is activated in the tumour cells. The objective of this research project is to design an efficient drug which works as an inhibitor against telomerase enzyme, which is overproduced in the tumour cells during progression of breast cancer. In this way, activity of telomerase enzyme can be inhibited due to which it will be unable to carry out its functions in the tumour cells, thereby providing a mechanism to control their proliferation within the body. The approach for this project is based on Structure Based Drug Discovery.

Keywords: Telomerase; Tumour cells; Chromosome; End replication problem; Eukaryotes

Abstract ID: BBE-PP28

Production of Biocement by MICP Method Using Urease Producing Bacteria Isolated from Soil

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Abstract

The multidisciplinary research between geotechnical engineers and microbiologists has paved a way into a new frontier of knowledge called Geobiology. Biocementation is a recently developed new branch in geotechnical engineering that deals with the application of microbiological activity to improve the engineering properties of soils. The work presented in this report utilizes the urease mediated MICP method for Biocement formation under laboratory scale. Biocement produced from both mixed culture and pure strains were tested for their ability to enhance the properties of expansive soil. Ultimate Compressive Strength (UCS), Maximum Dry Density (MDD), Optimum Moisture Content (OMC) and Swelling property of the expansive soil before and after the addition of 5% of Biocement produced by pure bacterial strain and mixed consortium were tested and compared. Most of cases it was found that mixed consortium of urease producing bacteria showed better improvement of soil property compared to pure strain. Hence the present work shows that the mixed consortium developed is highly potential for Biocement formation and can be applicable for treatment of expansive soil.

Keywords: Biocement; MICP; Geobiology

Abstract ID: BBE-PP30

Discovery of potential phytochemicals as inhibitors for Nipah virus attachment glycoprotein by in-silico docking based virtual screening

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Abstract
Nipah virus (NiV) infections results fatal encephalitis. However, effective FDA-approved medications are not available to treat this illness. Recent studies showed that NiV attachment glycoprotein plays a key role in viral entry and attachment to host cell receptors. Here in our studies, we used this surface protein of the virus as target to screen phytochemicals ligands from a library created from PubChem database, using Computer-Aided Drug Designing (CADD) methods. The X-ray crystal structures of target NiV attachment glycoprotein retrieved from PDB. A phytochemicals library of 120 ligands docked against NiV attachment glycoprotein as target. Based on docking scores, 15 phytochemicals were selected and their ADME properties were tested using SWISS ADME. After druggability and drug-likeness test, Isolonchocarpin one of the best probable drug candidate was found with a binding affinity score of -7.3 kcal/mol and satisfied the Lipinski's Rule of Five.

Keywords: Nipah Virus; Nipah Virus Attachment Glycoprotein; docking; phytochemicals.

Abstract ID: BBE-PP31

Evaluation of suitable drug for blockage of HER2 receptor- A step towards preventing Breast cancer

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Abstract
Breast cancer is driven by uncontrolled cell growth, primarily due to Human Epidermal Growth Factor Receptors (HER) on tumor cells. HER2 overexpression leads toaggressive HER2-positive breast cancer. HER receptors form signaling pairs; HER2-HER3 being potent in activating pathways like MAPK and PI3K, impacting cancer progression. To block HER2 and prevent dimerization, we created a library of hit compounds using MTiOpenScreen. After eliminating unsuitable candidates, compoundswere auto-docked to HER2 with PyRx, and binding affinities were assessed. Optimal ligands with suitable drug properties were selected, and results were visualized using PyMOL and Discovery Studio Visualizer, advancing potential breast cancer treatments.

Keywords: Breast cancer; HER2; Molecular docking

Abstract ID: BBE-PP32

Fermentative degradation of antinutrient of pseudocereals for development of food products

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Abstract
Pseudocereals, including quinoa, amaranth, and buckwheat, have gained prominence in recent years due to their exceptional nutritional profiles. However, their consumption is often hindered by the presence of antinutritional factors, such as saponins, phytates, and tannins, which can interfere with nutrient absorption and digestion. This study explores the fermentative degradation of these antinutrients as a promising approach to enhance the utilization of pseudocereals in food products.The fermentative degradation process involves the application of microorganisms, such as lactic acid bacteria and yeasts, to pseudocereal-based matrices under controlled conditions. This approach aims to mitigate the adverse effects of

antinutrients while simultaneously promoting the release of bioactive compounds, improving sensory attributes, enhancing the nutritional quality of pseudocereals by increasing the bioavailability of essential minerals and proteins. Fermentative degradation of pseudocereal antinutrients and its implications for the development of innovative and nutritious food products are established. Various factors influencing the degradation process, including fermentation time, temperature, microbial strains, and pseudocereal varieties,have also been probed. Additionally, there lies the scope of studies on potential health benefits of fermented pseudocereal products, such as improved gut health and increased antioxidant activity. Overall, fermentative degradation emerges as a sustainable and bioactive-rich approach to harness the nutritional potential of pseudocereals, making them more accessible and appealing to consumers while addressing the challenge of antinutrient reduction.

Keywords: Pseudocereals; Fermentation; Antinutrient; Food; Sustainable

Abstract ID: BBE-PP33

Advancements in Bioethanol Production: Fermentation Strategies, Challenges, and Future Prospects

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Abstract
Biofuels have emerged as a sustainable alternative to conventional fossil fuels, offering a promising solution to combat climate change and reduce our reliance on non-renewable fossil fuels. The main purpose of biofuels is to provide a greener and an eco-friendly fuel source. Bioethanol, one of the most prominent biofuels, is produced worldwide from various renewable sources such as corn, sugarcane, and cellulosic biomass.
Addition of ethanol in petrol and diesel fuels helps reduce carbon emissions, mitigating the impacts of climate change. This has led to bioethanol being chosen as a key biofuel globally. Bioethanol research has gained recognition not just because of its potential as a biofuel, but also as a method to repurpose agricultural waste.
This paper provides an overview of bioethanol's role as a green fuel, its worldwide production, low-cost production techniques, the ongoing research efforts, its addition to conventional fuels, and the reasons behind its selection as a sustainable solution, while highlighting both global and Indian positions in the bioethanol industry. Additionally, it provides insight into the genetic engineering strategies of *Saccharomyces cerevisiae* and fermentation techniques used in the production process which helps maximize productivity and streamline the process.

Keywords: Bioethanol; Fermentation; Feedstock; Saccharomyces cerevisiae; Sustainability

Abstract ID: BBE-PP34

Process development of the plant (Ficus Religiosa) DNA extract as adsorbent

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Abstract
This study investigates the potential of utilizing a plant-based DNA adsorbent derived from Ficus religiosa (sacred fig) leaves. The research explores crucial parameters, including adsorbent dosage, contact duration, and agitation speed, shedding light on the efficiency of this eco-friendly approach. The properties of the DNA-based adsorbent are thoroughly examined using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and X-ray diffraction (XRD). SEM reveals its surface morphology, while FTIR identifies functional groups, and XRD analyzes its crystalline structure.
This novel application of plant DNA powder as an adsorbent for heavy metal removal is intriguing and highlights the potential of DNA-based materials in environmental remediation. DNA's unique chemical properties, such as its ability to form strong coordination complexes with metal ions, could make it an effective adsorbent for heavy metal pollution control. This study not only demonstrates an innovative approach to plant DNA extraction and purification but also explores the functionalization of the resulting DNA powder for environmental applications. The use of advanced analytical techniques

(XRD, SEM, and FTIR) for DNA characterization adds depth to the research, showcasing the versatility of DNA-based materials in addressing environmental challenges related to heavy metal contamination in wastewater and groundwater.

Keywords: Plant DNA; Ficus religiosa; Heavy metal

Abstract ID: BBE-PP35

Influence of pH, Temperature and Bacteria on Degradation of Iron Oxide

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Abstract
Industrial sludge containing iron oxide is regarded as a major environmental concern as it percolates and contaminates the groundwater. An effective cost efficient remedial measure is necessary to degrade the iron oxide. This study aimed to identify the influence of pH, Temperature, Agitation and Bacteria in its degradation for an incubation period of three days. The highest degradation efficiency was observed in an iron oxide solution of 150 mg/ml with incubation at a temperature of 35°C, pH 9 and 12% (v/v) inoculum of *Lysinibacillus fusiformis*. The bacterial degradation effect of 12% (v/v) inoculum in 150 mg/ml was confirmed by Zone inhibition assay in petri plates. The present study confirms the degradation process on the site of contamination itself. As there is no need to select a site for processing the sludge, this method could be considered economical and eco-friendly.

Keywords: Iron oxide; pH; Temperature; Bacteria; Degradation

Abstract ID: BBE-PP37

Bioprocess Innovation Study to Maximize Trans-esterified Products from Triglycerides Obtained from Non-edible Sources

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Abstract
The utility of alternative fuels has become mandatory in view of exhausting fossil fuels as well as the obnoxious primary and secondary pollutants that emanate from the combustion of fossil fuels for energy requirements. The onset of biofuels replacing the utility of fossil fuels has been shown to address risky effects that are consequent from the environmental Eco-friendliness as well as compatibility of biofuels compared to fossil fuels.The present study was carried out with the intention of primarily keeping the quality of the environment with an objective of waste vegetable oil utilization, and minimal and less harmful exhaust pollutants. The economic viability of the biodiesel was yet another objective. Conversion of waste vegetable oil into biodiesel was carried out by the transesterification reaction with fine tuning of sodium methoxide catalyst governed by Design of Experiments software. The process was carried out in both lab scale in a 5L product reactor and the pilot plant scale in a portable skid-mounted reactor plant of capacity 25L capable of producing 15 L/batch, and 60 L/day. The products obtained were subjected to standard tests to compare with prescribed levels of parameters as per ASTM standards. Then the product biodiesel was tested for its performance by using it as blends with commercial diesel derived from petroleum and testing them for combustion in an internal combustion engine, which also included exhaust gases quality assay. Glycerol being a valued chemical was obtained as a byproduct that needed purification. Phosphoric acid is preferred for washing and obtaining reasonably pure glycerol. The study facilitated a good yield of two products namely biodiesel (99%) and glycerol (87.5%) from the point of utility and economics both products are commercially viable.

Keywords: Waste vegetable oil; Trans-esterification; Biodiesel; Glycerol

Abstract ID: BBE-PP38

Bioethanol Production from Fruit Waste Using a Bioreactor

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Abstract

It is well known that dependence on fossil fuels and other non-renewable resources by the human race is causing a high depletion in the resources available. It has caused unfavourable effects which include excess global warming, unpredictable weather changes, decreasing air quality, and so on. Crops such as sugarcane and corn cannot meet the global demands of bioethanol production as they are some of the primary sources of food and feed. Due to this, the production of biofuels from waste sources will be feasible and an alternative to ethanol production from sugarcane. In this study, we have initiated a process for the production of ethanol from agricultural wastes and bagasse. In the process, the raw materials used are banana peels, watermelon peels, pomegranate peels, and apple peels to produce bioethanol on a lab scale, and after optimization of parameters, the process was scaled up to a 2-liter fermenter. The highest yield of 29.71% was obtained in the 2 L fermenter. The flash point of the bioethanol was found to be 55 ^{o}C, the fire point at 60 ^{o}C, and a specific gravity of 0.9626.

Keywords: Bioethanol; Fermentation; Fruit waste; Yeast; Bioreactor

Abstract ID: BBE-PP44

Preparation and Efficacy Testing of Bio-fertilizer

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Abstract

A material called bio-fertilizer contains living microorganisms that are advantageous to the growth and development of plants. Microbial strains use a variety of mechanisms, such as nitrogen fixation, potassium and phosphorus solubilization, phyto-hormone excretion, production of compounds that suppress phytopathogens, protection of plants from abiotic and biotic stresses, and detoxification of subsurface pollutants, to increase nutrient uptake, increase soil fertility, and increase crop yields. Bio-fertilizers are considered to be a promising and non-toxic alternative to synthetic agro-chemicals, including fungal control and the reduction of mycotoxins contamination, in light of the expanding global demand for food and the risks associated with the excessive use of chemical fertilizers and pesticides. Research into the widespread use of bio-fertilizers is one of the main stream in scientific activity for the development of sustainable agriculture since it is believed that the use of microbial inoculants will overcome the drawbacks connected with chemical-based farming systems.

Keywords: Bio-fertilizer; Nitrogen fixation; Phyto-hormones; Soil fertility

Abstract ID: BBE-PP45

Polymer Warrior: Battling bacterial resistance

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Abstract
Effective antimicrobial drugs are crucial in the ongoing fight against infectious diseases caused by harmful microbes. Around 50% of microbial infections stem from contaminated surfaces, and the rise of antibiotic resistance intensifies the need for new antimicrobial molecules. One promising approach is the use of antimicrobial polymers (AMPs) to combat bacterial resistance. This study delves into exploring AMPs, specifically examining the impact of polycations on antimicrobial performance. Two distinct polymers, Polyelectrolyte 1 (PE1) and Polyelectrolyte 2 (PE2), were synthesized using nanoprecipitation methods and meticulously assessed for their antimicrobial properties against E. coli, B. subtilis, B. amyloliquefaciens, and C. freundii. Efficacy evaluations were conducted through well diffusion, minimum inhibitory concentration (MIC), and cell viability assays at varying polymer concentrations. PE1 and PE2 exhibited a notable zone of inhibition compared to the control group. PE2, containing aromatic units, surpassed PE1, which featured aliphatic groups. PE2 demonstrated an impressive MIC range of 80μM to 100μM, indicating its remarkable potential in inhibiting bacterial growth. Cell viability assays indicated a reduction in colony size, indicating the bactericidal effect of the polymers. The results highlight that the aromatic segmentation in the polymers facilitated effective microbial inhibition by coating the microbe's surface.

Keywords: Polymer; Cell viability; Minimum inhibitory concentration

Abstract ID: BBE-PP47

Bioremediation reduces environment induce allergy

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Abstract
Pollutants in nature are linked to various acute and chronic detriments in biotic and abiotic components of nature. Conventional methods for removing pollutants are not efficient; instead, they end up with the formation of secondary pollutants. Significant destructive impacts of pollutants are perinatal disorders, mortality, respiratory disorders, allergy, cancer, cardiovascular and mental disorders, and other harmful effects. Allergy is exaggerated immune response. Pollutants are responsible for allergy. Multiple pollutants work as allergen causes allergy to have some common feature. For Example: - Allergens are either protein or glycoprotein in nature, with multiple antigenic sites, or epitopes, per molecule. Many allergens have intrinsic enzymatic activity that affects the immune response. Many allergens contain potential pathogen associated molecular patterns, or PAMPS. Many allergens enter the host via mucosal tissues at very low concentrations, which tend to predispose the individual to generate TH2 responses, leading to B-cell secretion of IgE Reduce pollutant reduces allergy. The pollutant substrate can recognize different microbial enzymes at optimum conditions (temperature/pH/contact time/concentration) to efficiently transform them into other rather unharmful products. The most representative enzymes involved in bioremediation include cytochrome P450s, laccases, hydrolases, dehalogenases, dehydrogenases, proteases, and lipases, which have shown promising potential degradation of polymers, aromatic hydrocarbons, halogenated compounds, dyes, detergents, agrochemical compounds, etc. Such bioremediation is favoured by various mechanisms such as oxidation, reduction, elimination, and ring-opening. The significant degradation of pollutants can be upgraded utilizing genetically engineered microorganisms that produce many recombinant enzymes through eco-friendly new technology. So far, few microbial enzymes have been exploited, and vast microbial diversity is still unexplored. This review would also be useful for further research to enhance the efficiency of degradation of xenobiotic pollutants, including agrochemical, microplastic, polyhalogenated
compounds, and other hydrocarbons.

Keyword: Allergy; PAMPS; TH2 responses; Cytochrome P450

Abstract ID: BBE-PP48

Role of Inorganic Polyphosphates and Calcium as bioenergetics stimulator

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Abstract

Metabolism is a complex network of biochemical reactions that are crucial for the proper functioning of living organisms. Among the various metabolic processes, bioenergetics, which involves the conversion of nutrients into energy, plays a fundamental role in sustaining cellular functions. In recent years, emerging research has analysed on the involvement of mammalian Inorganic Polyphosphates in bioenergetic metabolism. Inorganic Polyphosphates are chains of phosphate groups linked by high-energy phosphoanhydride bonds. While initially considered rare in mammalian cells, recent studies have revealed their presence and essential roles in various biological processes. Mammalian cells can synthesize and store inorganic polyphosphates, which can range in length from a few phosphate groups to several hundred. Calcium is also an essential mineral that plays a pivotal role in various cellular processes, including bioenergetic metabolism. Intracellular calcium levels must be regulated to maintain cellular homeostasis and ensure optimal metabolic function. However, disruptions in calcium homeostasis can lead to an imbalance in bioenergetic metabolism, which has profound implications for cellular health and the development of various diseases. Calcium acts as a ubiquitous second messenger, mediating cellular responses to a wide range of stimuli. It plays a crucial role in the regulation of bioenergetic metabolism by influencing key enzymes and signaling pathways involved in energy production and utilization. We are reviewing their function and role.

Keywords: Metabolic processes; Inorganic polyphosphates; Calcium; Bioenergetic; Homeostasis

Abstract ID: BBE-PP49

Design carrier for chemotherapeutics and drugs from Chitosan

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Abstract

Chemotherapy is used to treat cancer. However, insufficient retention at the target site and Some toxicity remains critical challenges. Exosomes are natural carriers into which drugs can be loaded. Exosomes are cell-secreted nanoparticles (generally with a size of 30–150 nm) bearing numerous biological molecules including nucleic acids, proteins, and lipids, which are thought to play important roles in intercellular communication. As carriers, exosomes hold promise as advanced platforms for targeted drug/gene delivery, owing to their unique properties, such as innate stability, low immunogenicity, and excellent tissue/cell penetration capacity. Chitosan has attracted considerable attention as a carrier backbone for delivering therapeutic cargos because of its biocompatibility and mucoadhesive property. However, pH and concentration-dependent solubility of chitosan has been restricted further applications to clinical settings. Inspired by marine mussels and crustaceans, in this study, we present chitosan-based nanoparticles containing catechol–Fe^{3+} complexes (Cat-CS NPs) as a tumor-activatable delivery system to achieve highly efficient locoregional treatment of cancer *via* a simple spray process while minimizing adverse effects towards surrounding normal tissues. Our work to make Chitosan carrier, as like exosome carrier to carry chemotherapeutics and drugs.

Keywords: Chemotherapy; Cancer; Exosomes; Chitosan