A Hybrid Mode Conference

CONCEPT 11

11th Conference on Emerging Energy & Process Technology (CONCEPT 11) 2024

in conjuction with

10th International Symposium on Applied Chemistry (ISAC 2024)

&

4th International Conference on Chemical Process & Product Engineering (ICCPPE 2024)

with theme

"Transforming chemical research and innovation toward a sustainable future"

23rd - 24th OCTOBER 2024
Yogyakarta, Indonesia

BOOK OF PROGRAM

Organizer

UTM UNIVERSITI TEKNOLOGI MALAYSIA
Centre of Hydrogen Energy

Co-organizer

UNIVERSITAS DIPONEGORO SEMARANG
BRIN BADAN RISET DAN INOVASI NASIONAL

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11th CONCEPT 2024

11th CONFERENCE ON EMERGING ENERGY AND PROCESS TECHNOLOGY 2024

Hybrid Conference | The Alana Hotel & Convention Center, Yogyakarta, Indonesia

FOREWORD FROM ADVISOR OF CONCEPT 11 (2024)

Assalamualaikum wrh. wbt. and good day to all.

We did it! This year marks ten years since CONCEPT 2012, the landmark conference organized by the Centre of Hydrogen Energy (CHE), one of the promising research groups at UTM. Last year, we successfully held CONCEPT 10 in conjunction with the i-CORE conference, hosted by Universiti Malang. We are thrilled to return to Indonesia this year for CONCEPT 11, in conjunction with the 10th International Symposium on Applied Chemistry (ISAC 2024) organized by BRIN, and the 4th International Conference on Chemical Process and Product Engineering (ICCPPE 2024) hosted by UNDIP.

I would like to extend my heartfelt congratulations to the organizing committee, supervisors, and students for their unwavering support in making this unique event a reality. Unlike other research gatherings, CONCEPT is designed to foster a supportive research culture that promotes academic excellence in a warm and collaborative environment.

With the theme ‘Transforming chemical research and innovation toward a sustainable future’, this conference unites a coalition of individuals and organizations dedicated to advancing chemical research and innovation for a more sustainable world. The term “transformation” signifies a profound shift in how research and development can shape a future where sustainability is at the forefront of scientific endeavours. In recent years, sustainable practices in areas such as renewable energy, green chemistry, and the circular economy have gained significant traction, driving meaningful change within the chemical sector. Consequently, research has opened new opportunities and exciting avenues to tackle global challenges, from energy production to resource management. Collaboration is essential to achieving a sustainable future, and this conference provides a unique platform for scholars across various scientific disciplines to share, discuss, and collaborate on the mission of transforming chemical research and innovation for a sustainable tomorrow.

As always, we have a wealth of research findings to share. The topics are organized into several research themes that aim to enhance understanding, address concerns, highlight new developments and trends, identify best practices, demonstrate innovative products, and discuss relevant standards.

Thank You.

Professor Dr. Aishah Abdul Jalil
Director of Centre of Hydrogen Energy
Institute of Future Energy
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81310 Johor Bahru Malaysia

MESSAGE FROM THE CHAIR OF CONCEPT 11 (2024)

Welcome to CONCEPT 11, held in conjunction with ISAC2024 and ICCPPE2024 focused on the theme of "Transforming Chemical Research and Innovation Towards a Sustainable Future." As the conference chair, I am thrilled to witness the collective dedication of our global community to advancing sustainable practices within the chemical sector.The intersection of chemical research, innovation, and sustainability has never been more crucial. This conference serves as a vital platform for thought leaders, researchers, and innovators to discuss how we can revolutionize chemical processes and materials to address pressing environmental challenges. Together, we will explore innovative approaches that not only enhance efficiency and effectiveness in chemical practices but also ensure that our advancements contribute to a sustainable future for our planet.

Conferences like this one provide a valuable opportunity to address common challenges, share best practices, and explore groundbreaking scientific research and technologies. These discussions are crucial for enabling our ecosystems and the environment to evolve, adapt, and innovate, allowing them to meet the realities of tidal changes and the demands of the future.

It is our shared responsibility to leverage our expertise and creativity to drive forward the transition toward a greener, more sustainable future in the chemical industry. I extend my heartfelt gratitude to the organizing committee, our speakers, presenters, and participants for their invaluable contributions to this event.

Let us work together not only to transform our insights into impactful actions but also to foster connections that will support each other professionally. I encourage everyone to engage, share experiences, and enjoy the camaraderie that comes from being part of this vibrant community. May our time here be both productive and enjoyable, inspiring lasting collaborations that lead us toward a sustainable future in chemical research and innovation. Together, we can create a network that empowers us all to make a meaningful difference for generations to come.

Thank You.

Dr. Muhamed Yusuf Shahul Hamid
Chairperson CONCEPT 11 (2024)
Centre of Hydrogen Energy
Institute of Future Energy
Universiti Teknologi Malaysia
81310 Johor Bahru, Johor

CONFERENCE INFORMATION

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Conference Host	:	Centre of Hydrogen Energy (CHE) Institute of Future Energy (IFE) Universiti Teknologi Malaysia 81310 Johor Bahru
Conference Venue	:	The Alana Hotel & Convention Center, Yogyakarta, Indonesia
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LIST OF REVIEWERS FOR PAPERS SUBMITTED TO CONCEPT 11 (2024)

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Dr Fatahiya Mohamed Tap
Universiti Teknologi MARA

LIST OF ABSTRACTS

ABSTRACT

KEYNOTE SPEAKER 1

Chemical-Looping – An Environmentally Friendly Approach for Energy and Chemicals

Professor Dr Mohammad Mozahar Hossain
Department of Chemical Engineering, Interdisciplinary Research Center for Refining & Advanced Chemicals (IRC-RAC), King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia

ABSTRACT - In the last two decades, significant progress has been made towards a better understanding of world climate change, its long-term impact and searching solutions for the sustainable environment. In this regard, chemical looping combustion (CLC) has been extensively investigated as a promising approach for CO_2 capture from fossil fuel-based power plants. A Circulating fluidized bed process involving a durable oxygen carrier can open the door for CLC with inherent CO_2 capture using NG, diesel, heavy residues, coal and biomass as fuels in industrial scale electricity generation. Therefore, the application of CLC and CO_2 capture/use will secure the continuation of cheaper fossil energy-based power generation until the renewable alternatives reach to their competitiveness. On the other hand, the chemical looping approach can also be implemented for chemical and hydrogen production – which will not only enhance the overall process efficiency but also significantly contribute to the minimization of CO_2 emission. The chemical-looping strategy offers opportunities for process intensification and exergy loss minimization. An integrated CLC and chemical-looping chemical/hydrogen production will also create the opportunity for capture and use of CO_2 in chemicals production – a way of realization of the circular carbon economy. In many cases, the reduction of energy consumption is significant enough that the decrease of CO_2 emission target can be achieved without CO_2 capture. The present keynote will report the work in progress on both the CLC and Chemical-looping chemical/hydrogen production at Chemical Engineering-KFUPM.

KEYNOTE SPEAKER 2

Converting Plants Waste into Solvent as Green Approaches for Synthesis of Nanoparticles Photocatalyst

Dr Nur Farhana Jaafar
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ABSTRACT - Wastewater treatment of persistent organic pollutants (POPs) faces several key challenges like high cost, large energy consumption and emerging contaminants. Photocatalysis is an advanced oxidation process (AOPs), which is a promising technology for treating wastewater contaminated with POPs in recent years with the aid of photocatalyst. Nowadays, various methods of synthesis have been explored and modified to produce photocatalysts with suitable properties where most of the methods used a lot of chemicals and consequently contributed to formation of more waste. Hence, to reduce the use of chemicals by prioritizing the green and sustainable aspects, exploring natural and green resources in photocatalyst synthesis is one of the alternatives. This work presents the potential of various sources of plant wastes and turns into extract to be used as alternative solvents for synthesis of various nanoparticles photocatalysts. Plants waste extract (PWE) containing rich amounts of useful bioactive components (phenolic, myricetin, flavanols) play an important role in assisting the production of nanoparticles. It has been known that active biocomponents from plant resources are employed to serve as the reducing, stabilizing, or capping agent during material growth. The results revealed that the reducing capacity of PWE during material synthesis was linked to their total phenolic and flavonoid content as well as the plant-based wastes extract with higher phenolic content generated smaller particle sizes and surface oxygen vacancies of photocatalyst, which contributed to enhanced pollutant degradation performance. Improved properties of photocatalyst give more potential for their ability to degrade various pollutants.

KEYNOTE SPEAKER 3

PdZn/ZnO−TiO_2 catalysts for CO_2 hydrogenation to methanol

Associate Professor Dr Hasliza Bahruji
Centre of Advanced Materials & Energy Science, Universiti Brunei Darussalam, Brunei

ABSTRACT - Carbon dioxide in the atmosphere has reached an alarming level and, therefore, requires a global effort to reduce emissions. CO2 hydrogenation to methanol (CTM) is one of the CCU technologies offering easy storage and transportation of liquid methanol. CTM is an exothermic reaction releasing -49.5 $kJmol^{-1}$ of energy at 298 K. The reaction thermodynamically favored low temperature and high pressure conditions. Porous ZnO/TiO_2 synthesized using different Zn and Ti ratios (Zn:Ti = 0.5, 1, 2) is investigated as PdZn alloy support for CO_2 hydrogenation to methanol. The partial transformation of ZnO/TiO_2 into $ZnTiO_3$ perovskite occurs on the PdZn perimeter, forming strong interfacial interaction with PdZn alloy. Variation of Zn:Ti ratios affected the formation of cubic and hexagonal $ZnTiO_3$. At low Zn:Ti ratio of 0.5, the cubic $ZnTiO_3$ generates a high density of surface oxygen vacancies, achieving ~1121.3 $mmolkg^{-1}h^{-1}$ methanol after 24 h reaction. The trace amount of methane and C^{2+} hydrocarbons from the C−C coupling reaction occur at 450°C. In-situ DRIFTS analysis provides insight into the reaction mechanism that occurs via two intermediate pathways i.e., formate and formyl *HCO species.

BIOMASS AND BIOPROCESS ENGINEERING (BBE)

BBE-034

Product Distribution and Characteristics of Microalgae *Spirulina platensis* Microwave-Assisted Pyrolysis

Mohammad Mirza Yuniar Romaz[1], Sukarni Sukarni[1, 2, a)], Ahmad Yusril Aminullah[1] and Retno Wulandari[1]

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ABSTRACT - The escalating global energy demand from non-renewable sources like coal, oil, and gas, due to the rapid increase in the global population, has led to the depletion of oil reserves. This highlights the urgent necessity to focus on renewable energy sources. In recent years, microalgae, particularly *Spirulina platensis*, has garnered attention as a source of third-generation biofuels. Pyrolysis is considered a promising method for converting microalgae into alternative fuels, and microwave-assisted pyrolysis is an emerging technique. This study delved into the product distribution and characteristics of microalgae *Spirulina platensis* through microwave-assisted pyrolysis. The samples' microstructure was examined using a scanning electron microscope (SEM), while Fourier-Transform Infrared (FTIR) spectroscopy was employed to analyze the functional groups and Energy Dispersive X-ray (EDX) spectroscopy to determine the elemental composition. The gas, liquid, and char yields were 25.1%, 44.9%, and 30% respectively, with a peak hydrogen production of 1512 ppm. *Spirulina platensis* was found to contain O-H compounds in the wavenumber range of 3200-3600 cm^{-1}, while crude oil contains N-H compounds in the wavenumber range of 3200-3600 cm^{-1} and C-H compounds in the wavenumber range of 2750-2950 cm^{-1}. These findings offer valuable insights into microalgae pyrolysis for biofuel production and other applications, underscoring the practical significance of this research.

CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS)

CCUS-018

Non-Nickel vs Nickel-Based Perovskites in Dry Reforming of Methane: A Short Review

Goh Yih Fei[2], *Aishah Abdul Jalil*[1,2*] *and Nurul Sahida Hassan*[2]

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Abstract - Dry reforming of methane (DRM) is a promising method for syngas production using two greenhouse gases, carbon dioxide and methane. Perovskite oxides, with the general formula ABO_3, where A is a lanthanide and B is a transition metal, exhibit high thermal stability, electronic and ionic conductivity, and resistance to coke formation. The substitution effects of different metals in the A and B sites of perovskites on catalytic performance are explored. For example, the substitution of Co at the B site enhances catalytic activity, hence reducing the required reaction temperature. The interaction of Co and Gd_2O_3 phases stabilizes the catalyst under DRM conditions. Similarly, $La_2Ce_2O_7$ mixed oxides demonstrate low-temperature activity and stability. This is attributable to their redox properties and oxygen mobility. This review focuses on the development and performance of non-nickel catalysts, specifically perovskite-based materials, in DRM. The physicochemical properties, synthesis methods, and catalytic performances of these perovskite catalysts are analyzed to exploit the potential to replace traditional nickel-based systems in DRM applications. This review manifests a recent perspective on the development of a non-nickel perovskite catalyst system for DRM.

CCUS-030

Synergizing CO_2 Capture and Electrochemical Conversion: Tailored Oxygen Vacancies and Amine-Based Electrolytes for Enhanced CO Production

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Abstract - Advancing electrochemical CO_2 reduction reactions (ECO_2RR) is pivotal in the urgent task of mitigating CO_2 emissions. Catalyst development focuses on enhancing CO_2 adsorption and activation, yet strategies addressing product desorption are underexplored. Drawing from the Sabatier principle, our study aims to enhance ECO_2RR performance, achieving an impressive 5% faradaic efficiency for CO production by optimizing product desorption. Through tailored manipulation of the electronic environment, utilizing oxygen vacancies (O_{vac}) in Ni-doped $SrTiO_3$, we lowered the energy barrier for product desorption. Introducing Ni^{2+} into the $SrTiO_3$ lattice promotes O_{vac} formation, altering the local electronic landscape. This doping-segregation method provides a unique avenue for controlling active metal cluster size and oxide support properties, promising diverse chemical reaction applications. Additionally, we present a novel methodology integrating CO_2 capture and conversion, utilizing CO_2 capture media directly as the electrolyte for electrochemical CO_2 conversion, further advancing the feasibility and sustainability of CO^2 utilization technologies.

CATALYSIS ENGINEERING (CE)

CE-012

Chemical and Morphology Characteristics of Activated Carbon Derived from Mixture of Oil Palm Biomass Residue using Autothermal Pyrolysis at different Temperature

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Abstract – In this study, a mixture of oil palm biomass residue (OPBR) was used to produce activated carbon (AC). The AC processing involved chemical activation using $ZnCl_2$ as the activating agent, and the AC was activated at different temperatures ranging from 500 °C to 900 °C. The objective of this study was to characterize the chemical properties of the derived AC, including pore structure, surface morphology, functional groups, and thermal stability, at different activation temperatures. The Brunauer-Emmett-Teller analysis (BET), thermogravimetric analysis (TGA), elemental analyzer (CHNS-O), Fourier Transform Infrared (FTIR) Spectroscopy, and Scanning Electron Microscopic (SEM) techniques were used to characterize the derived AC. The study aimed to elucidate the impact of activation temperature on AC properties. Despite the huge potential of OPBR as a sustainable precursor for AC production, the optimal conditions for its conversion into high-quality AC remain unclear. This study addresses this gap by investigating the effects of different activation temperatures on the chemical properties and performance of AC derived from OPBR. The study found that the highest BET surface area was achieved at an activation temperature of 900 °C, which is 392.4679 m^2/g. Thus, the study concluded that the precursors from the OPBR have the potential to be used as a material in AC development through chemical activation with $ZnCl_2$ at an activation temperature of 900 °C.

CE-015

Synthesis Of Co/FSAPO-34 With Enhanced Acid Sites for Methanol-to-Light Olefins Conversion

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Abstract - Olefins are essential starting materials for the production of specific polymer products. Traditionally, olefin production heavily depends on fossil fuels, which significantly contribute to environmental issues. Methanol-to-olefin (MTO) provides an alternative route to producing olefins from non-fossil fuel sources. However, the industrial application of this method is hindered by the rapid deactivation of the catalyst. Fabricating a fibrous silica SAPO-34 (FSAPO-34) can overcome this issue by introducing mesoporous into the SAPO-34 structure. Nevertheless, the insufficient surface acidity of FSAPO-34 reduces the yield and selectivity of light olefins. In this study, Co/FSAPO-34 was synthesized by impregnating 2.5%wt cobalt metal onto the FSAPO-34 catalyst. The catalysts were characterized using FESEM, N_2 physisorption, and ammonia-TPD. FESEM results revealed that FSAPO-34 exhibited a well-ordered spherical morphology with a high dispersion of cobalt metal. Nitrogen physisorption results indicated a slight decrease in surface area and pore volume following the addition of cobalt to the FSAPO-34 catalyst surface. Clearly, the addition of cobalt metal has increased both weak and strong acid sites, as observed in the ammonia-TPD results. This enhancement in acidity resulted in higher catalytic activity and performance of Co/FSAPO-34 compared to the FSAPO-34 catalyst.

CE-019
Harnessing KCC-1 Unique Structure for Efficient CO Methanation with Fe Loading

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[3]Department of Chemical and Environmental Engineering, Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, 54100, Kuala Lumpur, Malaysia

Abstract - The rapid increase of carbon dioxide (CO_2) in the atmosphere has become concern in our world today. The implementation of CO_2 methanation has the potential to mitigate CO_2 emission and significantly enhance the value of synthetic natural gas production. In this study, we reported that the KCC-1 was synthesized by microemulsion method. The obtained KCC-1 was investigated as support with 5% iron (Fe) content prepared using impregnation method for CO_2 methanation reaction. These catalysts were characterized via X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM), and Fourier Transform Infrared Spectroscopy (FTIR-KBr). XRD analysis revealed the presence of metallic Fe and Fe_3O_4 phases with well-defined crystallite sizes, indicating high dispersion and phase purity. FESEM images demonstrated a unique dendrimeric mesoporous structure of KCC-1 with well-dispersed Fe nanoparticles. FTIR-KBr indicated the presence of surface hydroxyl and iron oxide species, with additional carbonate species formed post-reaction, suggesting active CO_2 adsorption and conversion. These findings highlight the potential of KCC-1 as an efficient support for Fe catalyst, capable of improving low-temperature catalytic activity through enhanced metal-support interactions.

DRUG DELIVERY SYSTEMS (DDS)

DDS-003

Enhancing Hydrophobicity of Mesostructured Silica Nanoparticles through Activated Carbon Modification for Biomedical Application

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Abstract - The widespread utilization of mesoporous silica nanoparticles (MSN) in diverse surface reactions, including adsorption and catalysis, has been driven by their distinctive features such as a highly porous structure and controllable internal and external surfaces. However, MSN inherently exhibits hydrophilicity, posing a challenge in applications involving predominantly hydrophobic organic compounds as reactants. To address this limitation, we explored the modification of MSN with activated carbon (AC) to enhance its hydrophobicity by employing two modification methods, co-condensation (CMSCN) and post-grafting (PMSCN). Crystallinity, surface parameters, functional groups, morphology, and chemical topography of the materials were characterized. Results revealed that MSN exhibited a higher pore count with larger diameters, whereas the addition of AC resulted in a reduction in crystallization, surface area, and pore diameter. Despite these alterations, Transmission Electron Microscope (TEM) images illustrated a persistent hexagonal mesoporous network, albeit less ordered and discernible due to the integration of AC on the surface. Contact angle measurements substantiated the increased hydrophobicity of MSN upon AC incorporation. In conclusion, the successful enhancement of MSN hydrophobicity through AC modification has opened a new possibility for its utilization in diverse fields, marking a significant advancement in tailoring material properties for specific applications.

DDS-048

A Review of Gold Nanoparticles with Tuneable Lower Critical Solution Temperature in Drug Delivery Application

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Abstract - For more than a half-century, the potential of Gold Nanoparticles has been investigated, resulting in a never-ending struggle to advance knowledge in drug delivery research. Lower critical solution temperature (LCST) is a critical physical parameter for evaluating the performance and effectiveness of a thermo-responsive polymer in drug delivery diligence. Understanding thermo- responsive mechanisms and differentiating between LCST and upper critical solution temperature (UCST) systems is therefore critical in understanding how LCST behaviour can be tuned for a specific drug delivery application. The review summarizes and critically discusses recent studies on tuned LCST behaviour using various methods. The review's point of view emphasized sampling the inventive research on Poly (N-isopropylacrylamide), PNIPAAm-based thermo-responsive polymers. The review anticipates that a single-step irradiation polymerization process at room temperature that does not involve chemical cross-linkers, accelerants, surfactants, or organic solvent will be advantageous.

ENVIRONMENTAL ENGINEERING (EE)

EE-008

Adsorption of Dissolved Metals and Sulphur in Waste Engine Oil using Low - Rank Coal Activated Carbon

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Abstract - Waste engine oil which contains several dissolved metals and sulfur is waste that causes pollution if it is thrown away without being used. Therefore, this research was carried out to overcome dissolved metals or sulfur in waste by using activated carbon derived from low-rank coal as an absorbent medium to determine the adsorption capacity and % removal in the adsorption process of used engine oil waste. The adsorption process was carried out in a batch reactor with a stirring speed of 150 rpm, standard temperature with a contact time of 30 minute with varying adsorbent doses of 5%, 10%, 15%, 20%, and 25%. It was found that increasing the adsorbent dose had a significant effect on the percentage of metal and sulfur removal. Optimum conditions are found at an adsorbent dose of 10%, sulfur removal from WEO is 35%, and the adsorbent capacity is 53.3 mg/g. The same thing also happened with metal removal of 38.5% and adsorbent capacity of 13.59 mg/g.

EE-010

Application of Activated Low-Rank Coal (LRC) as an Adsorbent for Rhodamine-B Dye Removal using the Adsorption Process

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Abstract - Among cationic dyes, Rhodamine-B (Rh-B) are commonly used by the chemical industry. Rhodamine-B known as a toxic and carcinogens water effluents, so the adsorption process to remove this dye by a number of materials as adsorbent have widely been studied. In this study, the adsorbent was provide by the activation process of East Kalimantan's low-rank coal (LRC) using 30% concentration of phosphoric acid solution (H_3PO_4). The primary aim of this research was to assess the effectiveness of activated LRC as an adsorbent in the adsorption process for Rh-B dye removal. The adsorption process carried out with several variables process, such as adsorbent dosage (60-140mg), contact time (5-60 min), and pH level (3-9), were examined for various initial dye concentration (50mg/L, 100mg/L, 150mg/L, 200mg/L and 250mg/L) to evaluate Rh-B dye removal efficiency from dye solution. The optimum condition for Rh-B dye removal were identified as an adsorbent dosage of 100mg, a contact time of 10 min and pH of 5, obtained the Rh-B dye removal efficiency was 56.8967%. The findings on the present investigation provide valuable insights into the use of activated LRC as an adsorbent for Rh-B dye removal.

EE-024

Effect Of Biological Parameters on Indoor Bioflocs Aquaculture System of Red Hybrid Tilapia

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Abstract - Contemporary aquaculture faces challenges such as excess fish food waste, jeopardizing water quality and escalating disease risks, particularly in intensive setups with high stocking densities. To tackle this, a solution lies in reducing uneaten premium fish feed, yet this can raise operational costs. An innovative alternative is integrating biofloc technology (BFT), addressing waste accumulation and potentially cutting over one-third of operational expenses. This study investigates the impact of biological factors on indoor biofloc aquaculture for red hybrid tilapia. Three experiments were conducted to assess water quality and growth performance. The first explored different tilapia stocking densities (15, 20, 25, and 30 fish/m^3), revealing that 20 fish/m^3 led to optimal growth without significantly affecting water quality. The second experiment varied carbon-to-nitrogen ratios (10:1, 13:1, 16:1, 20:1), with 16:1 providing the best balance for water quality and fish growth. In the third experiment, manipulating light exposure duration (No light, 6 hours, 12 hours, and 24 hours) showed that 6 hours yielded the best growth, as longer exposure increased floc concentration due to algae growth. Overall, these findings highlight that a stocking density of 20 fish/m^3, a carbon-to-nitrogen ratio of 16:1, and 6 hours of light exposure optimize red hybrid tilapia growth in indoor biofloc technology. Implementing BFT not only addresses waste issues but also enhances the sustainability and efficiency of aquaculture practices.

EE-028

Indoor Aquaponics of Tilapia (*Oreochromis spp.*) and Coriander (*Coriandrum Sativum*) in Tropical Climate (Malaysia) Setting

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Abstract - Indoor farming has been found to be a solution to solve sustainability of food resources especially as the world are in need of higher demand of food production. However, not much study has been conducted to study the successfulness of indoor farming in tropical climates like Malaysia. The study explores the impact of hydroponic grower setups and light intensity on growth and performance of plants and fish for 14 weeks. Two experiments are conducted: Set A examines four aquaponics systems (raft, media-based, horizontal NFT, vertical NFT) with LED grow lights, while Set B evaluates different photosynthetic photon flux densities (PPFD) in a standardized raft system (20, 35, 45, 55 µmol/s·m^2). Data collection focuses on coriander height, leaf number, tilapia weight gain alongside water quality analysis (pH, ammonia, nitrite, nitrate, dissolved oxygen). Set A results indicate superior performance of the rafting system, while in Set B, the highest yield is from the light intensity setting with PPFD of 35 µmol/s/m^2. It's evident that higher PPFD levels correspond to increased growth rates, however, due to the heat emitted by the light source, it infers the growth of coriander plant. Thus, future work will suggest in utilizing heat removal from the hydroponic unit.

FOOD CHEMISTRY AND PROCESSING (FCP)

FCP-020

Assessing the Physico-chemical and Functional Properties of Cassava and Wheat Flour

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Abstract - Cassava presents a wide range of industrial uses, creating opportunities for more rewarding markets. Therefore, significant research on native cassava for the food industry is necessary as a potential strategy to drive improvements in the value chain. Thus, the comparative analysis of native cassava flour and cassava starch in comparison to commercial cassava flour and wheat flour were studied regarding their physicochemical properties and functional properties for food industrial use. The properties of cassava and wheat were investigated using X-ray diffraction (XRD), scanning electronic microscope (SEM), fourier transform infrared (FTIR), syneresis, swelling power, water solubility index, and water absorption index analysis. The results showed that water absorption index, water solubility index and swelling power of native cassava starch were comparable to commercial wheat flour. The A-type starch crystallinity observed in native cassava flour and starch indicates that these flours could serve as potential substitutes for wheat in food applications. Results provided useful information for the development of food products and showed the promising application potential of native cassava starch in various food applications.

HYDROGEN TECHNOLOGY (HT)

HT-021

Hybrid Separation System of Water Electrolyzer in Balance-of-Plant

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Abstract - With the increasing global focus on transitioning to a more sustainable and eco-friendly energy landscape, green hydrogen produced through water electrolysis has emerged as a promising alternative. To harness the full potential of hydrogen, efficient and cost-effective hydrogen production technologies are essential. The advancement of alkaline water electrolyzer (AWE), proton exchange membrane electrolyzer (PEM), or anion exchange membrane electrolyzer (AEM) requires enhanced flexibility and efficiency of hydrogen separation system rather than modifying the overall balance of plant for different water electrolyzer stack to be used. The aim of this study is to develop a hybrid separation system in the balance of plants. This system serves as an extra module for electrolyte circulation during PEM electrolyzer conversion to AWE or AEM electrolyzer. The proposed hybrid separation system will facilitate flexibility in using different types of water electrolyzer stack technology as well as provide attractive commercial benefits for retrofitting existing balance-of-plant systems. Integrating hybrid hydrogen separation systems within a common hydrogen balance of plant framework enables seamless switching between different electrolyzer stack systems. The development of the simulation model is based on a classical process engineering approach by mass balance model and hydraulic calculation of gas-liquid flow in the interchangeable hydrogen separation system. Results show that the proposed hybrid hydrogen separation system enhances operational resilience, maximizes hydrogen production efficiency, and reduce retrofitting costs.

HT-036

Hydrogen Storage in the Era of Energy Transition: The Role of Liquid Organic Hydrogen Carriers (LOHCs)

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Abstract - Liquid Organic Hydrogen Carriers (LOHC) offer a practical solution to address the challenges of hydrogen storage and transport in the energy transition from fossil fuels to renewable energy. LOHC technology has recently gained attention due to its stable and safe liquid form, which enables efficient hydrogen storage, transport, and release using existing fuel infrastructures. This study presents a comprehensive bibliometric analysis of scientific publications on LOHC applications in hydrogen storage using Scopus database. A total of 703 documents were retrieved after data cleaning and harmonization using Microsoft Excel and OpenRefine. VOS viewer was employed for data visualization. Over the last 40 years (1982– July 2024), more than 2,267 authors from 564 organizations across 53 countries have contributed to this research area. Since 2016, research outputs have grown steadily, and the number has doubled in 2023 compared to 2020. Most of the studies were conducted in China (Asia) and Germany (Europe). However, the collaboration networks between these two countries were not strongly connected. The key research areas focus on dehydrogenation, hydrogenation, and catalysts, which represent the most frequently adopted keywords. Emerging areas of study that also become topics of interest include keyword of density functional theory (DFT). The DFT calculations are performed to investigate thermodynamic stability, electronic structure, and reaction mechanisms of catalysts involved in the LOHC system. This study provides valuable insights into the evolution, trends, and advancements in LOHC technology, highlighting current research and identifying potential directions for future exploration in hydrogen storage and transport application.

MATERIALS CHEMISTRY AND CATALYSIS (MCC)

MCC-007

Promotional Effects of Nickel Lanthanum-Based Catalysts for CO_2 Reforming of Methane: Short Review

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Abstract - The carbon dioxide (CO2) reforming of methane (CRM) significantly offers the benefits of industrialization and commercialization for the production of value-added syngas via Fischer-Tropsch process. Growing interests in commercializing CRM technology has driven the development of many Ni-based catalyst formulations. This short review summarizes recent studies of Ni-based lanthanum containing catalysts and its promotional effects on carbon mitigation, metal dispersion and catalytic activity. Additionally, comprehension of CRM pathways induced by nickel lanthanum-based catalysts and the corresponding pictorial depiction are discussed and provided in this paper.

MCC-014

Strategic energy levels of graphitic carbon nitride and fibrous silica iron for enhanced photocatalytic conversion of carbon dioxide to methanol

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Abstract - In this study, the graphitic carbon nitride (g-C_3N_4) was successfully synthesized through thermal polymerization and then doped into the fibrous silica iron (FSFe), denoted as g-C_3N_4/FSFe. The synthesized catalysts were characterized using X-ray Diffraction (XRD), Fourier Transform Infrared Spectrometer (FTIR), and UV-Vis Diffuse Reflectance Spectroscopy (UV-Vis/DRS) and also tested for photocatalytic conversion of carbon dioxide (CO_2) to methanol (CH_3OH). The addition of the g-C_3N_4 into FSFe lowered the band gap energy and acts as electron acceptors, which in turn increased the catalytic performance of the conversion of CO_2 to CH_3OH. The g-C_3N_4/FSFe exhibits the highest CH_3OH yield (2.3×10^4 µmol g_{cat}^{-1}) compared to bare FSFe and gC_3N_4 under visible light irradiation within 240 min. The higher CH_3OH yield over g-C_3N_4/FSFe is mostly owing to the ideal band gap positions of g-C_3N_4 and FSFe.

MCC-027

Rambutan Seeds: A Prospectives and Sustainable Biomass for Emerging and Future Energy Storage Technologies

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Abstract - With the rising concern of global warming, the world now is focusing more on sustainable and renewable sources of energy. The investigation and exploration of renewable and environmentally friendly biomass dominate the world nowadays. Rambutan seeds, which are obtainable from a tropical tree available in abundance in Southeast Asia seem to be a prospective material that can be used for biomass generation for emerging energy storage applications due to its high silica and carbon contents. In this review article, the potential of using Rambutan seeds as a sustainable biomass source is explored where the production, harvest, and the high yield of biomass content was discussed. Its environmentally friendly nature, and chemical compositions focusing more on its carbon and silica content, have been elucidated. Different methods for converting the seeds into useful biomass and biomaterial such as pyrolysis and hydrolysis were explained. The economic importance and the feasibility of the seeds of converting the biomass into useful energy storage materials like supercapacitors, and fuel cells are reported. The review concluded by discussing the prospects, and challenges of using Rambutan seeds as a sustainable biomass for energy storage, where realistic recommendations are provided. The findings of the review show that Rambutan, particularly the seeds and the peels, has lots of biomass content, which is beneficial for various types of applications. Although, few studies directly reported the use of Rambutan seeds in energy storage applications such as in lithium-ion batteries cathode and supercapacitors, nevertheless, its high amount of carbon and silica could be used as a source of porous materials for application in energy storage such as hydrogen storage, supercapacitors, and other related energy storage systems. Therefore, it can be recognized that the use of Rambutan seeds can be explored and considered as a potential biomass source for porous material, such as carbon materials, in emerging energy storage technologies.

MCC-035

Acid Concentration in Zinc Oxide/Polypropylene Non-Woven Fabric for Photocatalytic Degradation of Benzophenone-3

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Abstract - With the rising concern of global warming, the world now is focusing more on sustainable and renewable sources of energy. The investigation and exploration of renewable and environmentally friendly biomass dominate the world nowadays. Rambutan seeds, which are obtainable from a tropical tree available in abundance in Southeast Asia seem to be a prospective material that can be used for biomass generation for emerging energy storage applications due to its high silica and carbon contents. In this review article, the potential of using Rambutan seeds as a sustainable biomass source is explored where the production, harvest, and the high yield of biomass content was discussed. Its environmentally friendly nature, and chemical compositions focusing more on its carbon and silica content, have been elucidated. Different methods for converting the seeds into useful biomass and biomaterial such as pyrolysis and hydrolysis were explained. The economic importance and the feasibility of the seeds of converting the biomass into useful energy storage materials like supercapacitors, and fuel cells are reported. The review concluded by discussing the prospects, and challenges of using Rambutan seeds as a sustainable biomass for energy storage, where realistic recommendations are provided. The findings of the review show that Rambutan, particularly the seeds and the peels, has lots of biomass content, which is beneficial for various types of applications. Although, few studies directly reported the use of Rambutan seeds in energy storage applications such as in lithium-ion batteries cathode and supercapacitors, nevertheless, its high amount of carbon and silica could be used as a source of porous materials for application in energy storage such as hydrogen storage, supercapacitors, and other related energy storage systems. Therefore, it can be recognized that the use of Rambutan seeds can be explored and considered as a potential biomass source for porous material, such as carbon materials, in emerging energy storage technologies.

MCC-037

Zinc Oxide Nanoparticles Synthesis from Terminalia Catappa Leaves and Its Characterization for Absorbing Methyl Orange Dye

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ABSTRACT - With increasing industrialization, dye pollution has become a major environmental issue, contributing to water contamination and posing risks to both ecosystems and human health. This research focuses on developing an eco-friendly method for synthesizing zinc oxide nanoparticles (ZnO NPs) from dried Terminalia catappa leaves to observe their adsorption capabilities. The study targets the removal of methyl orange dye from wastewater, addressing environmental concerns related to water pollution and aligning with Malaysia's Sustainable Development Goal (SDG) 6 on clean water and sanitation. The effects of varying parameters such as dye concentration, pH, and nanoparticle dosage on adsorption efficiency were investigated, with the highest adsorption efficiency of 45.0% observed at a ZnO nanoparticle dosage of 0.10 g. The optimum pH for adsorption was found to be 6, with an efficiency of 21.7%, while the lowest dye concentration (5 ppm) showed the highest adsorption efficiency of 18.2%. Advanced characterization techniques, including UV- Visible spectrophotometer (UV-Vis), Scanning Electron Microscopy (SEM), and Fourier Transform Infrared (FTIR) spectroscopy, were employed to analyze the nanoparticles. The results indicate that this green synthesis approach shows significant potential for creating efficient and sustainable adsorbents for dye removal, offering a practical solution to water purification challenges.

MCC-038

Curcuma longa L. mediated Selenium Nanoparticles Against Gram-positive and Gram-negative Bacteria

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ABSTRACT - Low toxicity materials with excellent compatibility can be achieved by practicing green approach in synthesis. Therefore, green synthesis has been the main approach for selenium nanoparticles (SeNPs) synthesis for being environmentally friendly and in parallel with efforts toward sustainability. Turmeric plants (Curcuma longa L.) are one of the abundant plants in tropical area which is commonly available in Asian region. Hence, Curcuma longa L. extract was used in green synthesized SeNPs in this study. The SeNPs successfully produced from C. longa L. extract and sodium selenite, Na_2SeO_3 via sol-gel method in incubation oven at 60°C overnight. The colour changes from brownish to deep orange indicated the formation of SeNPs. The surface plasmon resonance of SeNPs were observed at 265nm by using UV-vis spectra analysis. The C=O band and O-H stretch from phenolic compound responsible for SeNPs formation was observed from FTIR analysis. The morphology and the size of the nanoparticles were calculated from SEM imaging. The morphology of the SeNPs were found to be polydisperse with the size of the SeNPs were between 10-50nm. Two antibacterial assays were exposed to SeNPs to evaluate its efficacy towards possible infections from different pathogens. The average inhibition zone in Staphylococcus aureus assay was at 19.8 mm and 12.21 in Escherichia coli assay. The SeNPs synthesized displayed excellent antibacterial efficiency against gram-positive and gram-negative bacteria. Therefore, this SeNPs has a potential to be implemented in antibacterial wound patch and surgical coating materials.

MCC-039

Synthesis of Mesoporous Silica with Natural Surfactant from *Hibiscus rosa-sinensis* Leaf Extract as Methylene Blue Adsorbent in Aqueous Solution

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ABSTRACT - Mesoporous silica with diverse structures and pore sizes can be prepared using various types of surfactants as structure directing agents. However, synthetic surfactants are toxic and not eco-friendly. It is necessary to replace synthetic surfactants with natural surfactants. Extract of *Hibiscus rosa-sinensis* leaf is rich in saponins that can act as natural surfactant in mesoporous silica synthesis. The effect of adding *Hibiscus rosa-sinensis* leaf extract on mesoporosity was evaluated by adjusting the weight ratio of silica to extract at 1:0.5, 1:1, 1:1.5, and 1:2. The highest mesoporosity properties, such as pore diameter and volume were obtained at 6.024 $m^2\ g^{-1}$ and 0.587 $cm^3\ g^{-1}$, respectively, with methylene blue adsorption capacity up to 43.66 mg/g. The adsorption of methylene blue on mesoporous silica fits with the pseudo second-order kinetic model and Langmuir model.

MCC-040

Synthesis of MXene Modified with Pluronic P-123 and its Perfomance for Dyes Adsorption

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ABSTRACT - MXene, a new two-dimensional nanomaterial, has attracted much attention due to its hydrophilicity, excellent electrical conductivity, stability, electrochemical property, etc. However, the spontaneous aggregation and re-stacking of nanosheets in 2D MXene due to hydrogen bonding and van der Waals forces are not beneficial to the applications. In order to fully utilize Mxenes, here, processing of MXene with Pluronic P-123 via a template method is reported. The result of characterized show that surface area P/MX higher than MX, 17.96 and 5.72 m^2/g respectively. The adsorption ability of MXene modified (P/MX) for three dyes including Methylene blue (MB), Methyl orange (MO) and Malacite green (MG) is investigated. Compared with MXene pristine, P/MX exhibited adsorption performance for MB with maximum %removal of 81.22%. The adsorption data shows that the adsorption process followed pseudo second-order kinetic model and Freundlich isotherm adsorption model.

MCC-041

Synthesis of CeO_2-based oxide (CeO_2-La_2O_3-NiO) with Various Calcination Temperature as Catalyst for Deoxygenation of Waste Cooking Oil

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ABSTRACT - Improper disposal of waste cooking oil can pollute the environment and damage the ecosystem and human health. Therefore, recycling and converting waste cooking oil into renewable energy, such as biofuel, is a solution to minimize the harmful effects of waste cooking oil. One of the reactions that can be used to convert waste cooking oil into biofuel is deoxygenation using a semi-batch reactor with nitrogen flow. CeO_2-based oxide (CeO_2-La_2O_3-NiO) with variation calcination temperatures (300, 600, and 750 °C) was used as catalyst in the deoxygenation reaction. The result showed that optimum conditions were obtained on the $La_{0.25}Ni_{0.25}Ce_{0.5}$ catalyst with a calcination temperature of 600 °C, selectivity 96,94% linear hydrocarbon and 3,06% cyclic hydrocarbon compounds. And producing 67% hydrocarbons with selective products towards the n-(C15-C17) diesel fraction. The results of the deoxygenation reaction showed a good hydrocarbon selectivity of the catalyst to an average green diesel yield obtained in the C15-C17 chain.

MCC-047

Enhance Low Temperature CO_2 Methanation via Bimetallic Cobalt Nickel Catalyst

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ABSTRACT - Recently, the methanation of CO_2 is a crucial process in reducing CO_2 emissions. Carbon dioxide (CO_2) is one of the major greenhouse gases that need to be captured and utilized. Therefore, catalyst research for the methanation of CO_2 becomes essential to facilitate the process. Interest in catalysis Centre-1 (KCC-1) has increased because of its dendrimeric silica fibers, which provide a significant number of basic sites. Otherwise, Nickel suffers from fast deactivation due to metal sintering and deactivation Ni catalyst due to high temperature causing the need of promoters. For CO_2 methanation to be catalytically successful, promoters and or supporters like Co must be added. Herein, an impregnation method was used to prepare Ni/Co-KCC-1 catalyst samples, while the KCC-1 matrix was prepared initially by microwave-assisted hydrothermal processing with amount of Ni loading 5wt.% plus 5wt.% of Co. The prepared catalysts were characterized by field emission scanning electron microscopy (FESEM), nitrogen physisorption, Fourier transform infrared spectroscopy (FTIR), and carbon dioxide temperature programmed desorption (CO_2-TPD). Then, the catalytic activity was performed on CO_2 methanation in a fixed-bed reactor at temperature range of 150-500 °C under atmospheric pressure. A better dispersion of Ni on catalyst surfaces is likely to result from the addition of Cobalt. It is show that Ni/Co-KCC1 has a higher proportion of moderate strength basic sites for activating CO_2 in methanation than Ni/Co or Ni/KCC-1. The catalytic performance CO_2 methanation showed that Ni-Co/KCC-1 displayed excellent CO_2 conversion (96%) and CH_4 selectivity (100%) compared to other catalyst.

MATERIALS DESIGN AND PROCESSING FOR PRODUCT DEVELOPMENT (MDP)

MDP-013

Application of activated charcoal made using the principle of Partial Oxidation to reduce Fe levels using the Adsorption Isotherm method in water Sources for residents of Batuah Kutai Kartanegara village, East Kalimantan province

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ABSTRACT - The water quality in East Kalimantan with its extensive peatlands causes high Fe content and the potential for abundant shells which have the potential to be used as activated charcoal as an adsorbent are two things that should be synergized. High levels of Fe in water used daily have great potential for human health. The aim of this research is the application of activated charcoal from palm oil shells which is made using the principle of partial oxidation to reduce Fe levels using the Isotherm adsorption method in the water sources of Batuah village residents, Kutai Kartanegara Regency, East Kalimantan Province. The content of Fe compounds in this study was based on the Quality Standards of PERMENKES No. 32 of 2017. Determination of adsorption was carried out by varying the mass of activated charcoal by 1, 2, 3, 4, and 5 grams in 10 ppm iron solution with a stirring speed of 200 rpm for 120 minutes. minute. The adsorption methods used are Langmuir adsorption, Freundlich adsorption, and BET adsorption. The best results were obtained using the Langmuir adsorption equation with R2 = 0.9993 and an adsorption capacity of 0.4340 mg/g. Langmuir adsorption was used to adsorb well water with a concentration of 1.8867 ppm and succeeded in adsorbing 92.56%. With the results, the concentration of well water after going through the adsorption process was 0.14 ppm. So the adsorption results have met water quality standards with a maximum iron compound content of 1 ppm. So in practice, activated charcoal can be used for deep adsorption of iron metal based on the Langmuir adsorption equation and with stirring conditions of 200 rpm for 120 minutes.

PROCESS MODELLING, SIMULATION AND OPTIMIZATION (PMSO)

PMSO-045Optimization of Waste Lubricating Oil Pyrolysis Assisted by Microwave and Lignite Activated Carbon

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ABSTRACT - Waste lubricating oil (WLO) of motorcycle is included in the category of hazardous and toxic materials. One alternative treatment that can be chosen to handle this waste is to process WLO into kerosene compounds. Kerosene has quite extensive uses, including being used as fuel or solvent in industry. This study aims to obtain optimum conditions for the pyrolysis process of waste lubricating oil into kerosene assisted by microwaves using microwave absorbents in the form of activated carbon (LAC) processed from lignite. The optimization design was carried out using the Box-Behkken method consisting of 15 experimental designs with 3 center points. The optimized process variables were temperature with variations of 400°C, 450°C, and 500°C, microwave power with variations of 400 W, 600 W, and 800 W, and also the ratio of LAC to WLO with variations of 1:1, 1:1.25, and 1:1.5. The response variable in this study was analyzed using GC-MS and represented as a percentage of kerosene compounds with a carbon chain length of C10-C16. Data processing using design expert resulted in recommendations for optimum conditions of temperature 400°C, microwave power 800 W, and the ratio of 1:1.356 with a kerosene fraction reaching 89.374%. Field testing of these optimum conditions resulted in a kerosene fraction of 85.41% with density characteristics of 808.0713 kg/m^3 and a calorific value of 45.46 MJ/kg.

REACTION KINETICS AND THERMODYNAMIC (RKT)

RKT-033

Effect Of In-Situ Activated Carbon Catalyst on Arthrospira Platensis Pyrolysis Towards Kinetics And Thermodynamics Parameter

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ABSTRACT - The thermal decomposition behaviour and kinetic parameter of non-catalytic and catalytic pyrolysis of *Arthrospira platensis* (AP) using activated carbon (AC) as *in-situ* catalyst were observed using thermogravimetric analysis at four different heating rates of 10, 20, 30 and 40 °C/min. Iso-conversional model is applied to analyze mass loss data by employing three methods (Ozawa-Flynn-Wall, Kissinger-Akahira-Sunose and Starink) to approximate the kinetics and thermodynamics parameter. Activation energy (Ea) and pre-exponential value (A) were calculated based on temperature range of 178—580°C where it is identified as main decomposition zone with maximum mass loss rate of -0.004 mg/s. The average activation energy of catalytic and non-catalytic pyrolysis is 135.78 and 151.59 kJ/mol, respectively. Lower Ea value indicates accelerated thermal degradation process. The result showed that addition of activated carbon is able to reduce AP activation energy due to its surface functional group and transition metal content.

RENEWABLE ENERGY (RE)

RE-011

Performance Test of a Diesel Engine Fueled with Biodiesel from Used Cooking Oil Using a Lignite Coal Heterogeneous Catalyst Assisted by Ultrasonic Waves

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ABSTRACT - The abstract As technology grows, fuel needs increase. However, the availability of existing fuel sources is limited. So it is necessary to take steps to create another alternative fuel as an energy reserve for the future, namely biodiesel. This research aims to test the extent of diesel engine performance when using biodiesel as fuel and the results of this research are expected to be able to produce fuel that is environmentally friendly and capable of producing good engine performance. In this research, engine performance was tested using a DongFeng R180 Diesel Engine on the quality of biodiesel from used cooking oil. Then a comparison of variations with a mixture of B20%, B40%, B100%, and 100% diesel was carried out to find out how much fuel consumption was produced by the diesel engine itself. The results of this research show that the most fuel-efficient fuel mixture is B100% at 1100 rpm with a consumption of 1,282 kg/hour. Meanwhile, the most wasteful fuel mixture is Solar100 which requires fuel consumption of 1,997 kg/hour at 1900 rpm. The fuel mixture that has the highest torque value is 51.79 at 1100 rpm, while the lowest torque value is at 1900 rpm with a torque value of 29.98, and for the fuel mixture that has the highest power value is at 1700 rpm with The power produced is 19,869 kW, while the rotation that produces the lowest power is 1100 rpm with the power produced is 19,821 kW.

RE-023

Potential of Sludge Palm Oil (SPO) As Feedstock for Biodiesel Production

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ABSTRACT - One of the major challenge obstacles on the biodiesel production is the high cost of oil as feedstock which consists of almost 70 % of the total production costs. The search for cheap sources of the feedstock is still the objective of some researches in the field of renewable energy, especially biodiesel. Therefore, in order to reduce of the cost biodiesel production, non edible sources such as waste cooking oil, non edible vegetable oil such as jatropha curcas oil and residual fats are commonly used for the biodiesel production due to its low cost and don't affect the food chain. Generally, sludge palm oil (SPO) released from the palm oil refining process, is a low cost material with potential value due to its high content of free fatty acids (FFA). Accordingly, there is potential to upgrade sludge palm oil (SPO) to valuable oil. In this work, biodiesel production has been carried out using sludge palm oil as feedstock and NaOH as catalyst to get the percentage of yield of biodiesel. Transesterification reactions were carried out with a ultrasound-assisted. The highest yield percentage was obtained at the loading of 0.75 % NaOH as catalyst, 20 minutes reaction time with a yield of 83.46 %.

RE-029

Integration Of Salinity Gradient Power for Urban-Industrial Energy System with Hydrogen Energy Storage

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ABSTRACT - Optimization of energy usage and process integration are crucial aspects to be addressed in energy systems to minimize greenhouse gaseous (GHG) emissions. The demand for cleaner energy has urged the usage of renewable energy, drawing attention to the potential of salinity gradient power (SGP). SGP is a clean, renewable energy source based on the difference in salt concentration between two water sources, freshwater and seawater. SGP potential is estimated through the Reverse Electrodialysis (RED) process, where ion membranes are arranged alternately to capture Gibbs energy while mixing both water sources. It is known for its high efficiency and operational flexibility, which can significantly reduce the environmental impact. SGP has the potential to address the power demands in the Urban-Industrial Energy System (UIES), which encourages the exchange of resources between industrial and urban sectors and supports the transition towards sustainability. Pinch Analysis is a well-established technique commonly used to optimize energy recovery design and reduce energy consumption in a system. It is utilized to integrate heat and power, including renewable energy, that is retrieved through SGP with the assistance of an energy storage system to support the fluctuations of energy supply and demand in UIES. Liquid Organic Hydrogen Carrier (LOHC) as a hydrogen energy storage system has the potential to address the issues as it is practical due to the clean and pollutant-free conversion of hydrogen to be stored in the energy system. It is technically feasible and supports long-term energy storage in the system. The organic Rankine Cycle (ORC) connects heat and power systems where ORC turbines will generate electricity from the excess heat available. The power generated is converted to hydrogen and stored in LOHC for later use, to be converted back into electricity by a regenerative fuel cell system. This study selected the Kinabatangan River in Sabah to analyze the potential SGP extraction. An illustrative scenario with industrial process plants, residential households and renewable energies was developed to demonstrate the proposed methodology of integrating SGP and hydrogen energy storage systems in UIES. It was observed based on different monsoon seasons as seasonal changes highly influence SGP potential. Northeast Monsoon season generated the highest SGP at a rate of 32.9 kg/day. The optimization of energy in the system revealed that there was a reduction of 30.14% in cooling utility requirements. The utilization of LOHC-based energy storage can fully satisfy the energy demands without outsourcing additional electricity, and it was targeted at a capacity of 363.70 kg. Excess electricity of 4,608,370 kWh/yr is available in the system, to be sold to the electricity grid for RM 1,440,702/yr. Therefore, it leads to a 31% reduction in net utility cost of RM 7,662,084/yr. The system's payback period is 17.9 years, which is considered feasible due to significant improvement in energy efficiency in the long run.

RE-031

Enhancing Photoelectrochemical Water Splitting Efficiency Using Gallium Loaded on Fibrous Silica Titania

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ABSTRACT - Metal sulfides emerge as promising photoanode materials in photoelectrochemical (PEC) water splitting due to their suitable bandgaps and tunable properties through heterojunction formation. Herein, fibrous silica-titania (FST) was successfully prepared by the microemulsion method prior to the addition of gallium oxide (Ga/FST) via impregnation method, which then characterized by XRD, FESEM, and UV-vis/DRS. The result demonstrated that the photocurrent density of Ga/FST was 22.1 mA/cm^2, which is 1.5 times higher than that of FST (13.0 mA/cm^2). Insertion of Ga in the FST structure resulted in the strong interaction between ZnS and FST, which then improved the utilization of photogenerated electrons, narrowed the band gap, and boosted the charge carrier separation. Introducing ZnS into the FST configuration proved to be a highly effective strategy for crafting a superior photoanode tailored for PEC water splitting.

RE-032

Tuning The Bandgap of Bismuth Oxide with Fibrous Silica Morphology for Enhancing Photoelectrochemical Water-Splitting Activity

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ABSTRACT - Since decades ago, hydrogen energy has captivated significant eyes due to its highly exothermic reaction and potential of zero carbon emission, and deemed as a potential candidate to replace conventional fossil fuels. Moreover, the production of hydrogen via the photoelectrochemical (PEC) water-splitting approach has been regarded as an outstanding approach due low cost of operation, highly efficient and environmentally friendly. Significant semiconductor materials such as TiO_2, CdS, Fe_2O_3 and Co_3O_4 have been devoted to the PEC study. However, the performance of these materials still remained unsatisfactory due to their own severe limitations. Bi_2O_3 on the other hand, exhibited a narrow bandgap, a reasonable incident photon to current efficiency, and an appropriate band edge position which make it an exceptional photoanode material for PEC water-splitting. However, ascribed to the rapid carrier recombination and sluggish water oxidation kinetic, the PEC performance of Bi_2O_3 is still restricted. Impressively, fibrous silica morphology is one of the outstanding strategies which not only eliminates the aforementioned obstacles but also can improve the stability of the Bi_2O_3 in the electrolyte solution. Herein, we innovatively fabricated fibrous silica bismuth oxide (FSBiO) for PEC water-splitting study. The FSBiO photoanode was successfully developed via microemulsion method which was proven by the FTIR and SEM analyses. More importantly, FSBiO photoanode also demonstrated an outstanding PEC water-splitting performance with a photocurrent density enhanced more than 1.5-folds as compared to the commercial Bi_2O_3. This study provides new insight into the potential of fibrous morphology for enhanced PEC water-splitting activity.

SEPARATION PROCESS (SP)

SP-001

Metal Organic Framework (Mof)-Based Membranes for Vanadium Redox Flow Battery

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ABSTRACT - Metal-organic frameworks (MOFs) have emerged as promising additives for perfluorinated and non-flourinated hydrocarbon-based membranes in vanadium redox flow batteries (VRFBs), aiming to improve selectivity and enhance battery efficiency. This review explores the challenges posed by high vanadium permeability in the membranes and the methods used to address them, such as incorporating additives or nanofillers. While these approaches have shown promise, concerns regarding membrane stability and proton conductivity remain. MOFs offer a novel solution to these challenges due to their designable pore system and surface properties. Studies have demonstrated that MOFs can enhance ion transport within membranes while improving mechanical stability, thus extending membrane lifespan. Various MOFs, including MOF-808, ZIF-7, UiO-66, and KAUST-7, have been investigated for their potential in VRFB applications. Recent research has shown that MOF-based composite membranes can significantly improve selectivity and battery efficiency. However, the stability of these composite membranes under harsh VRFB conditions requires further investigation. Additionally, simplifying the preparation method for MOFs could facilitate their widespread application. This review emphasizes the necessity for thorough studies evaluating the preparation, performance and stability of MOF-based membranes in VRFBs, leading to more efficient and durable energy storage systems.

SURFACE CHEMISTRY AND NANOPARTICLES (SCN)

SCN-046

Effect of Nickel and Silver Coating on Surface Functionalized Alumina Ceramic Foam as Explosion-Suppressing Material

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ABSTRACT - Porous materials play a crucial role as effective explosive attenuators, capable of extinguishing flames and dispersing energy waves generated by explosions [1]. Ceramic foam, known for its substantial porosity and resistance to high temperatures and shocks, emerges as a promising medium for this purpose. This study delves into the potential of ceramic foam to suppress free radicals produced during gas combustion through collisions within its structure, thereby restraining reactive heat release and quenching flame propagation. While ceramic foams effectively attenuate shock waves, their brittleness limits their applications. To overcome this drawback, the study proposes surface coating with metallic materials, specifically nickel and silver nanoparticles (NPs) on alumina foams, to enhance desired characteristics such as anti-fouling, self-cleaning, high thermal ability, and wear resistance. Previous research has highlighted the varied performances of porous materials composed of metal and ceramic as flame-suppression elements in mitigating explosions. The metal-coated ceramic foams undergo comprehensive analysis, including examination of physical properties, elemental composition, crystallinity, phase identification, morphology, and compressive strength. Explosion tests using aluminium powder at various concentrations are conducted in a 1.2-L Hartmann vessel to evaluate the ability of the metal-coated ceramic foam to quench flames as shown in Fig. 1

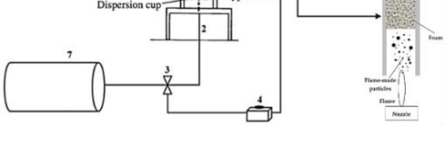

Fig. 1. *Experimental apparatus: 1. Venting device, 2. Gas nozzle, 3. Solenoid valve, 4. Time controller, 5. Pressure transducer/sensor, 6. Data acquisition system, 7. Air compressor, and 8. Ceramic foam.*

Results show a significant reduction, up to 20%, in maximal explosion overpressure (P_{max}), with Ag-coated ceramic foam demonstrating ~15.4% reduction compared to Ni-coated ceramic foam (P_{max}: 0.1729 bar) and ceramic foam (P_{max}: 0.1862 bar). The pressure dynamics evolution is closely linked to the interaction of flame with the coated foam struts, dependent on how free radicals attach to Ni or Ag elements during combustion. Overall, Ag-coated ceramic foam exhibits the most effective suppression of flame propagation and pressure buildup. The study's findings hold great significance for guiding the safety design of spherical suppression materials in engineering applications, offering valuable insights for process safety researchers and engineers.

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