
UTM
UNIVERSITI TEKNOLOGI MALAYSIA
ASCEND 2030
INTERNATIONAL
ENERGY COLLOQIUM 2026
FUTURE ENERGY, BUILT TODAY
7 APRIL 2026 | N24, UTM
InEC2026

ABOUT INEC 2026

The International Energy Colloquium 2026 (InEC 2026) is the inaugural event of its kind at the Faculty of Chemical Engineering and Energy Engineering (FKT), Universiti Teknologi Malaysia (UTM). Jointly organised by the Energy Management Group (EMG) and the Advanced Nuclear Engineering Research Group (ANERGY) , the colloquium will take place on April 7, 2026, at N24, UTM. It is designed as a hybrid event, accommodating both physical and virtual participation from students.

The colloquium operates on the format of an international academic conference, but on a smaller, more focused scale. It is dedicated to fostering interdisciplinary cooperation in the energy sector, with a critical focus on material development, system integration, and real-world applications. Our central theme is “Future Energy, Built Today,” underscoring the role of today’s students in designing and innovating the next generation of energy systems.

InEC 2026 is specifically targeted at undergraduate and postgraduate students from both local and international institutions. Participants will gain direct exposure to the evolution of academic work, from research to publication and industrial application. The program features student presentations, plenary sessions, and an international forum, providing a valuable platform to strengthen career networking through interaction with industry players. Furthermore, all accepted articles will be published in Scopus-indexed conference proceedings.

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FOREWORD

PROF. DR. ROSLI MD ILLIAS

Deputy Vice Chancellor of Universiti Teknologi Malaysia (Research and Innovation)

Assalamualaikum warahmatullahi wabarakatuh, and Salam Sejahtera.

It is a privilege to welcome you to the International Energy Colloquium 2026 (InEC 2026). I wish to commend the Faculty of Chemical and Energy Engineering specifically the EMG and ANERGY research groups for convening this vital international platform under the theme, “Future Energy, Built Today.”

As the global energy transition accelerates, Universiti Teknologi Malaysia (UTM) remains steadfast in its commitment to driving sustainable solutions.

Through impactful research in hydrogen technologies, carbon capture, and nuclear innovation, we strive to bridge the gap between academic discovery and real-world industrial application, ensuring our contributions address the most pressing environmental challenges of our time.

Beyond technical advancement, this colloquium serves as a catalyst for a robust innovation ecosystem. By fostering high-level dialogue between researchers, policymakers, and industry leaders, we create a fertile ground for the cross-pollination of ideas. This synergy is essential for translating complex data into actionable strategies that will define the efficiency and resilience of our future energy infrastructure.

I extend my deepest gratitude to our keynote speakers, industry partners, and participants for your engagement and expertise. It is through such collective responsibility and global networking that we will successfully shape a cleaner, more sustainable world for generations to come.

FOREWORD

DR. NORAZANA IBRAHIM

Program Chair, InEC 2026

Assalamualaikum warahmatullahi wabarakatuh and a very good day.

It is a great honour to present this foreword for the International Energy Colloquium 2026 (InEC 2026), held under the theme “Future Energy, Built Today”, InEC 2026 has brought together a diverse community of researchers, and students from across disciplines and regions.

The colloquium highlights key developments in advanced materials, bioenergy, digitalisation, lifecycle assessment, low-carbon transition, and nuclear innovation demonstrating that these areas are not merely theoretical, but actively shaping practical solutions for the future of energy.

The success of this colloquium reflects the importance of collaboration across expertise, institutions, and borders. It also underscores the vital role of emerging engineers and researchers in driving innovation and contributing to a more sustainable and resilient energy landscape.

On behalf of the organising committee, I extend sincere appreciation to our keynote speakers, presenters, reviewers, and all participants for their valuable contributions and commitment in making InEC 2026 a meaningful and impactful platform.

It is our hope that this colloquium will continue to grow as a recognised forum for knowledge exchange and collaboration within the regional and global energy community.

Thank you and Terima kasih.

ABOUT EMG

The Energy Management Group is a dynamic research team dedicated in innovative solutions for energy and sustainable technologies. With a diverse range of expertise, our researchers specialize in combustion, explosion, and process safety, ensuring the development of innovative solutions to enhance industrial processes. We also focus on the conversion of biomass to biofuels, green solvents and fuel purification, employing cutting-edge techniques to maximize energy efficiency while minimizing environmental impact and promoting sustainable and clean energy sources. Additionally, we are passionate to develop innovative materials and technologies to enhance the efficiency and cost-effectiveness of solar energy conversion which enables us to optimize the performance of solar cells and explore new avenues for renewable energy generation. Our team also focus on research in corrosion inhibitors, coatings, and latex polymerization to enhance the longevity and reliability of energy infrastructure. With our expertise and commitment to sustainability, we aim to revolutionize energy management practices and contribute to a greener future.

ABOUT ANERGY

Established in November 2020, the Advanced Nuclear Engineering Research Group (ANERGy) is the premier research arm of Malaysia's only nuclear engineering program at Universiti Teknologi Malaysia (UTM). We serve as the nation's leading hub for nuclear expertise, bridging the gap between academic innovation and industrial application. We specialize in reactor simulation, radiation shielding, energy optimization, and site selection, supported by a dedicated Non-Destructive Testing (NDT) lab. We maintain a close collaboration with the Malaysian Nuclear Agency through a formal MoU, ensuring our research aligns with national interests. Our team leads multiple high-level research grants, hosts international conferences, and consistently earns accolades in innovation competitions. With a prolific publication record in Web of Science and Scopus, our work is internationally recognized, providing our postgraduate students access to a global network of experts. At ANERGy, we are more than researchers; we are the experts shaping the landscape of nuclear engineering in Malaysia.

KEYNOTE SESSION 1

DR. FANG YUN LONG

BIOGRAPHY

Fang Yun long currently works as the Head of the Preparatory Working Group for the Thailand Small Modular Reactor (SMR) Nuclear Power Project of CNI23 (China Nuclear Industry 23 Construction Company). Mr. Fang owns extensive expertise in nuclear engineering and project management, holding diverse professional certifications, including First-Class Constructor (Electromechanical & Construction), First-Class Cost Engineer (Installation), NDT Level III certificates, and IPMP Level C, etc. His contributions have been recognized with the Second Prize of the China Nuclear Energy Association Science and Technology Award, the China Patent Excellence Award, and honors such as "Outstanding Young Talents" in his company.

Throughout his career, Mr. Fang has been deeply engaged in the construction and management of key nuclear energy projects both in China and internationally. He has played a significant role in the International Thermonuclear Experimental Reactor (ITER) project, contributing to critical technological breakthroughs in component installation and welding processes. His extensive project portfolio also includes domestic nuclear power initiatives, where he has accumulated comprehensive experience project sites, management platforms, and company headquarters.

In alignment with this year's colloquium theme of "Innovations and Pathways to a Sustainable Energy Future," Mr. Fang will deliver a presentation titled *"Glance of the Development Trend and Situation of Nuclear Power in China" drawing from his experience to offer insights into the technological advancements and strategic direction of China's nuclear energy sector. Please join me in giving a warm welcome to Mr. Fang Yunlong!

KEYNOTE SESSION 2

IR TS DR SHAMSUL AMRI BIN SULAIMAN

BIOGRAPHY

Ir. Ts. Dr. Shamsul Amri Bin Sulaiman is the Chief Technology & Engineering Officer (CTEO) of Tenaga Nasional Berhad Power Generation Sdn Bhd (TNB Genco), where he leads technological and engineering strategies supporting Malaysia's energy transition and decarbonization agenda, driving innovation, operational excellence, and sustainability across one of Southeast Asia's largest power generation companies. With over 25 years of leadership in the power sector, he has played key roles in shaping Malaysia's generation landscape, including serving as Managing Director of Jimah East Power Sdn Bhd, where he oversaw the USD 3 billion ultra-supercritical coal project, one of the nation's largest.

His international experience includes leading power plant operations in Pakistan, Kuwait, and Cambodia as Head of Operation & Maintenance at TNB REMACO, and serving as Chief Operating Officer at Integrax Bhd, expanding his experience in energy infrastructure. A Khazanah Global Scholar, Dr. Shamsul holds a Ph.D. in Nuclear Engineering from Texas A&M University, an M.Sc. in Nuclear and Quantum Engineering from KAIST, and a B.Sc. in Mechanical Engineering from Virginia Tech, along with a postgraduate certificate in management from the University of Melbourne. He is a Registered Professional Engineer (Malaysia), Professional Technologist, ASEAN Chartered Professional Engineer, and Certified Safety Practitioner, with expertise spanning nuclear power planning, advanced reactor technologies, decarbonization pathways, biomass co-firing, and digitalization of plant operations. As a respected thought leader, he frequently delivers keynote addresses at international nuclear and energy conferences, contributing to regional dialogue on sustainable and secure energy while advancing Malaysia and ASEAN's role in the global nuclear energy landscape.

KEYNOTE SESSION 3

DR SYED NASIR SHAH

BIOGRAPHY

Syed Nasir Shah (SNS) is an Associate Principal Researcher at the Research and Development Centre of Dubai Electric and Water Authority (DEWA). Before this, he worked as an Assistant Professor at the Department of Energy Engineering, University of Engineering and Technology Taxila (UETT), Pakistan. Before joining UETT, he worked as a Postdoctoral researcher at QUILL Research Centre, Queen's University of Belfast, United Kingdom. Before this, he worked as an Assistant Professor in the chemical engineering department at COMSATS University Islamabad, Pakistan, and before this, he worked as a Postdoctoral researcher at the Centre of Research in Ionic Liquids (CORIL), Universiti Teknologi Petronas.

He obtained his BSc in Chemical Engineering from the University of Engineering and Technology, Peshawar, Pakistan, and his Master's in Process Engineering from the Pakistan Institute of Engineering and Applied Sciences, Islamabad, Pakistan. He received his Ph.D. in Chemical Engineering from Universiti Teknologi PETRONAS, Malaysia. He has graduated 17 postgraduate students and is supervising one doctoral students. He has published 47 Journal papers and four book chapters. His work has been cited 1530 times and has an h index of 24. His research focuses on synthesizing task-specific ionic liquids for separation and energy storage applications. He specializes in using ionic liquids as an extractant for separating contaminants from aqueous, organic, and air mediums.

EVENT PROGRAM

08:00 – 08:30 | Registration

08:30 – 09:00 | Keynote Session 1 :
Dr Fang Yun Long

09:00 – 09:30 | InEC2026 Opening Ceremony @ DK 8

09:30 – 10:00 | Keynote Session 2:
Ir. Ts. Dr. Shamsul Amri Bin Sulaiman

10:00 – 10:30 | Keynote Session 3 :
Dr. Syed Nasir Shah

10:30 – 10:45 | Break

10:45 – 12:45 | Parallel Session 1 (Physical) & 2 (Online)

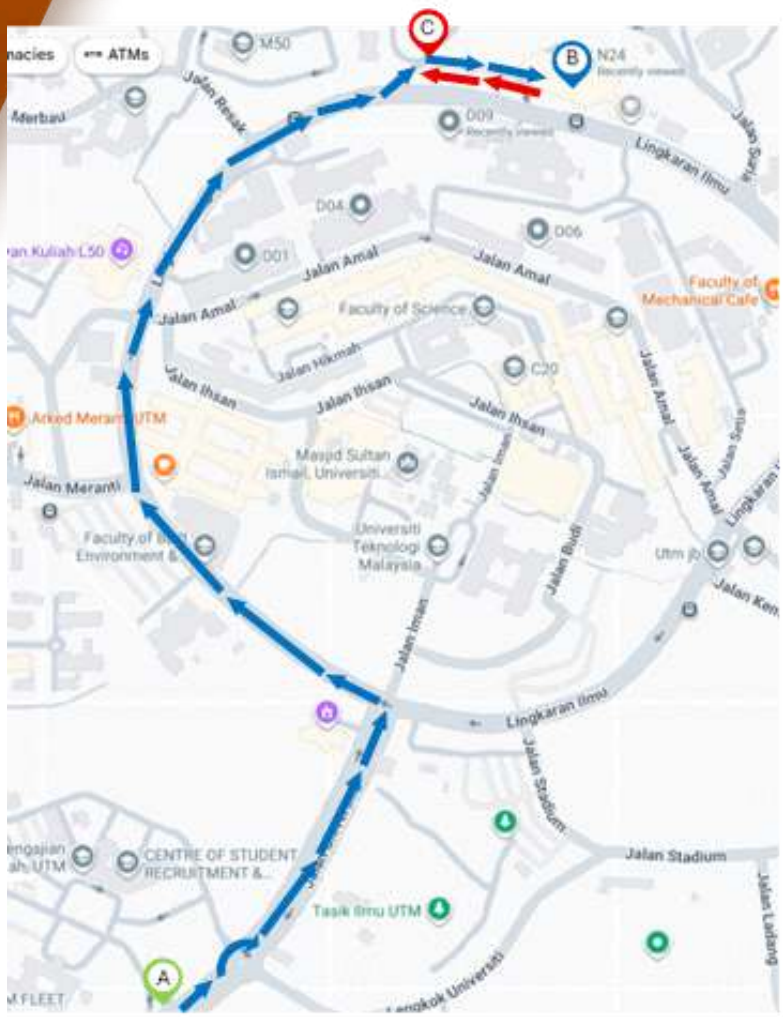
12:45 – 14:00 | Lunch Break

14:15 – 15:00 | Parallel Session 3 (Physical)

15:00 – 15:15 | Tea Break

15:15 – 16:00 | InEC2026 Closing Ceremony &
Award Presentation @ DK8

LAYOUT



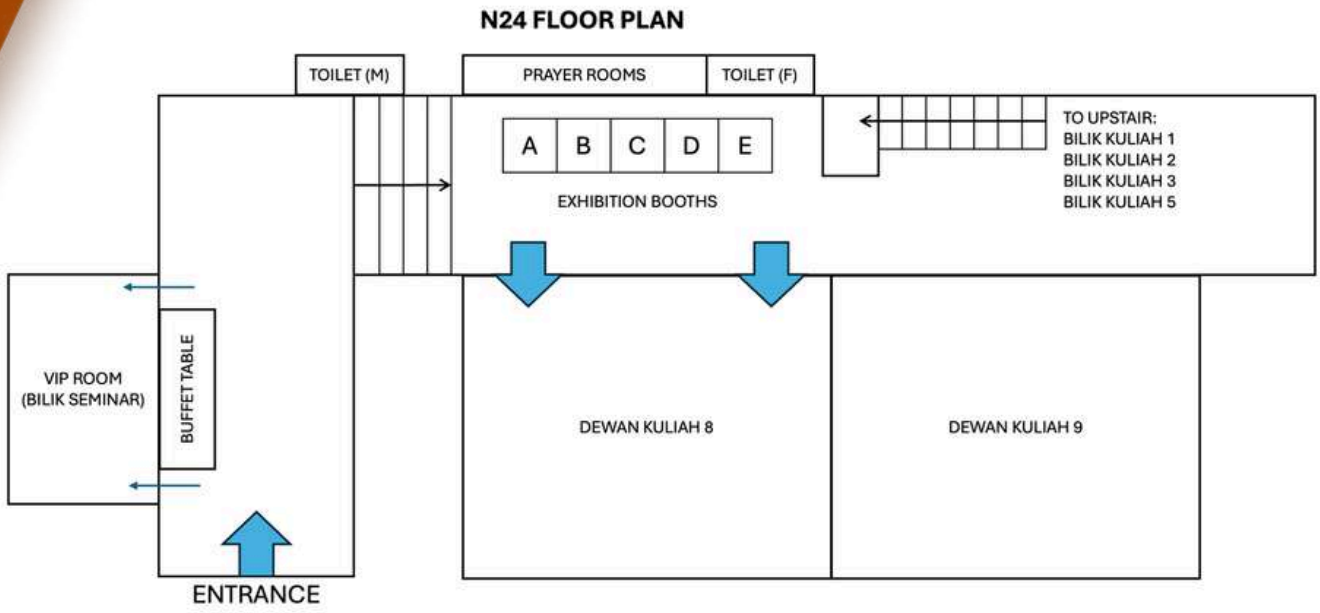
InEC2026 INTERNATIONAL ENERGY COLLOQUIUM 2026
Future Energy, Built Today

PARKING DIRECTION

- From UTM Main Entrance
- Head northeast on Jalan Universiti
- At the roundabout, take the 2nd exit to Jalan Universiti
- Turn left onto Lingkaran Ilmu
- Continue straight on Lingkaran Ilmu
- Turn left
- Turn right
- N24 Pick-Up/ Drop Off Point
- Continue straight
- N24 Car Park

VENUE	N24, Universiti Teknologi Malaysia (UTM), Johor Bahru, Johor
LOCATION	1.5621508,103.6386942
WEBSITE	https://fkt.utm.my/inec2026/
EMAIL	inec_fkt@utm.my

LAYOUT



Location InEC2026:

1. Keynote Session & Opening, Closung Ceremony - Dewan Kuliah 8, N24, UTM
2. Parallel Session - Bilik Kuliah 1,2,3,5, Dewan Kuliah 8, N24, UTM
3. Exhibition Booths:

   A - PRIMA GAS SDN. BHD.

   B - RELTECH LAB SDN. BHD.

   C - ENERGY MANAGEMENT GROUP (EMG)

   D - ADVANCED NUCLEAR ENGINEERING RESEARCH GROUP (ANERGy)

   E - ThX PROJECT

PARALLEL SESSION 1
SCHEDULE

Room/ Venue	1 Bilik Kuliah 1	2 Bilik Kuliah 2	3 Bilik Kuliah 3	4 Bilik Kuliah 5	5 Dewan Kuliah 8
Track	Advanced Materials	Biomass & Bioenergy	Digitalisation & Risk Engineering	Digitalisation & Life Cycle Assessment & Low Carbon Transition Engineering	Radiation Technology
Chair	Dr. Muhammad Syahir Bin Sarkawi	Dr. Nor Afifah Binti Basri	Dr. Norazana Binti Ibrahim	Dr. Muhammad Arif Bin Sazali	Assoc. Prof. Dr. Rafiziana Md Kasmani
Co-Chair	Nuzwanisyah Binti Sabri	Nur Nadzirah Binti Ahmad Fu'ad	Ling Hou Xiong	Yap Jing Hui	Harith Hadif Bin Mohd Alizam
1045 - 1100	**ID 001-001** Mr. Hollis Bunyeh Anak Francis Mengga Structural, Electrical and Surface Wettability Engineering of Zinc Oxide Nanowires for Photovoltaic Coatings	**ID 035-019** Mrs. Norizan Ibrahim Potensi Penggunaan Bahan Kitar Semula (Kaca) Untuk Inkubasi Aruhan Telur Ikan Tilapia	**ID 005-002** Mr. Mohd Azimie Bin Ahmad Hydrogen Sensor for Leak Detection With Ai Capability: A Novel Approach for Enhanced Safety and Monitoring	**ID 022-007** Dr. Munira Shahbuddin Climate Risks and Adaptation in The World's Largest Oil Shale Power Plant in Attarat, Jordan	**ID 018-005** Ms. Jie Ru Law Analysis Of Radiation Shielding Bunker for Prompt Gamma Neutron Activation Analysis Facility at Triga PUSPATI Reactor
1100 - 1115	**ID 011-012** Mr. Muhammad Amirun Aiman Amir Thermally Activated Concrete Waste as A Sustainable Adsorbent for Phosphorus Removal from Agricultural Stormwater	**ID 043-024** Mr. Muhammad Syahiran Abdul Malik Development of A Compact Reactor for Co-Pyrolysis of Waste Plastic and Used Cooking Oil into Valuable Products	**ID 047-048** Mr. Muhammad Danial Abdul Razak Low Temperature Cracking and Leaching Study of Monazite with Sulfuric Acid for Thorium Recovery	**ID 073-071** Muhammad Azhan Bin Abdullah The Effect of Catalysts on Esterification of Pyrolysis Oil from Spent Coffee Ground on Acidity Reduction and Storage Stability	**ID 026-011** Ms. Jia Hui Cheng Burnup and Reactivity Analysis of Thorium-Based Mixed Oxide e Fuel in Boiling Water Reactor

PARALLEL SESSION 1
SCHEDULE

1115 - 1130	**ID 049-043** Mr. Wen Jian Goh Synthesis of A Biobased Shape Memory Polyester	**ID 013-033** Ms. Aina Idrus Enhanced SAF Production from Palm and Castor Oils Via Selective Deoxygenation and Cracking over Promoted Mn-Based Supported CaO–AC Catalysts	**ID 021-006** Mrs. Norlali Adsul Rahman Abdul Rahim Development of A Solar-Energy-Based IoT Gardening Automation System for Efficient Water and Energy Usage	**ID 040-046** Mr. Akmal Hisyam An IOT-Integrated Photobioreactor for Enhanced Carbon Capture and Biomass Production in Microalgae-Based Aquaculture	**ID 029-016** Mr. Yong Jun Hong Comparative Heat Transfer Analysis of Fuel Rod Temperature Profile using Liquid Sodium and Water Coolant in a Small Modular Reactor
1130 - 1145	**ID 027-014** Mr. Muhamad Faris Hamzi Bin Muhazim Sustainable Treatment of Ammoniacal Nitrogen in Oil Palm Plantation Effluent Using Thermally Activated Brick Waste	**ID 053-039** Mr. Kesavan Muraley Enhanced Performance of Palm Oil Biomass Derived Activated Carbon Graphite Electrode in Microbial Fuel Cells via Optimization of PVA: PVP Binder Formulation	**ID 054-040** Mr. Daen Shafin Hakeem Borhan Bioplastic from Rotten Cassava Starch Reinforced with Spent Coffee Ground as Filler	**ID 058-047** Mr. Paul Santa Maria Integrated Renewable–Electrolyser Systems for Green Hydrogen: A Quantitative Review	**ID 002-017** Mr. Ahmad Afif Jazimin Bin Khashiie Comparative Study on Gamma Radiation Shielding Properties of Cement Mixture with Rice Husk Ash and Palm Oil Fuel Ash for Building
1145 - 1200	**ID 039-022** Ms. Yuvatharshini Arumugam Design of Low-Corrosive Ionic Liquid s for Lubricant Additives Using Cosmo-Rs Ionic Conductivity Predictions	**ID 020-061** Ms. Norainun Basyirah Mohammad Sabri Corrosion Inhibitor Performance of Functionalized Amide-Based Compounds on Mild Steel in 1 M HCL at Elevated Temperatures	**ID 019-028** Mr. Wan Muhammad Irfan Bin Wan Salehudin Morris's Sensitivity Analysis of Natural Gas Dispersion in Malaysia's High Pressure Transmission Pipeline Leaks	**ID 064-053** Mr. Umar Irfan Bin Zulkifli Carbon Dioxide Capture Using Amino Acid - Based Deep Eutectic Solvent (AADES)	**ID 036-020** Mr. Ahmad Hambali Ismail Lightweight Poly (Lactic Acid)/Barite Composite for Low-Energy Gamma Radiation Shielding Using Additive Manufacturing

PARALLEL SESSION 1
SCHEDULE

1200 - 1215	**ID 048-029** Mrs. Nor Azwin Ahad The Effect of Fiber Alignment on Mechanical Properties of Sugarcane Fiber Reinforced Epoxy Composites	**ID 069-059** Ms. Ruzinah Isha Determination The Effect of Nickel Loading on Oil Palm Ash–Supported Catalyst for Polyethylene Pyrolysis by Thermogravimetric Analysis	**ID 065-051** Ms. Najihah Abd Rahman Aspen Plus Simulation and Experimental Evaluation of Physicochemical Properties of Diol-Gasoline Blends	**ID 061-063** Mrs. Tan Hooi Ling Effect of Magnetization and Deep Eutectic Solvent Functionalization on Spent Coffee Ground Biochar for Enhanced Co_2 Capture	**ID 037-021** Ms. Nur Fatin Athirah Binti Amran Thorium Extraction from Water Leach Purification Residue
1215 - 1230	**ID 051-036** Mr. Suthan Mariappen Physical, Thermal and Tensile Properties of Rotten Sweet Potato Starch-Based Bioplastics Plasticized with Glycerol	**ID 069-060** Ms. Ruzinah Isha A Study of Ca/Opa Catalyst in Polyethylene and Polystyrene Pyrolysis	**ID 032-057** Ms. Nur Sakinah Binti Mohd Fauzi Naim Simulation-Based Risk Analysis of Hydrogen Release Scenarios in Hydrogen Refuelling Station	**ID 057-044** Dr. Izzah Farhana Ab Aziz Thermally Calcined Waste Concrete as A High-Performance Adsorbent for Phosphate Removal: Adsorption Isotherm and Kinetic Evaluation	**ID 044-023** Mr. Bryan Leow Investigation of Zinc-Tungsten Composite for Radiation Shielding
1230 - 1245	**ID 031-058** Mr. Hong Jun Jiat TRIGA Fuel Element Sourceterm and Decay Heat Prediction	**ID 068-054** Ms. Nurul Syazliana Salleh Hudin Oxidative-Extractive Desulfurization of Sterically Hindered Benzothiophene from Model Oil Using Betaine-Based Deep Eutectic Solvent	**ID 071-064** Ms. Aleeya Nasuha Quantitative Risk Assessment (QRA) of Accidental Ammonia Release from Fuel Storage Tank to Human and Environment on Ammonia Fueled Ship	-	**ID 050-032** Mr. Syamil Ayman Suhailan A Review of Radiation Shielding Applications Applied by Different 3D Printing Technologies and Materials

PARALLEL SESSION 2
ONLINE | SCHEDULE

Room	1	2
Link	Google Meet Room 1	Google Meet Room 2
Chair	Dr. Asiah Nusaibah Binte Masri	Dr. Khairulnadzmi Jamaluddin
Co-Chair	Ng Yi Heng	Tuan Fatin Faqihah binti Tuan Arif Sahibu Azemi
1045 - 1100	**ID 023-008** Mr. Christopher Janting Liew Chalu Production of Paint Based on Waste Expanded Polystyrene	**ID 024-009** Dr. Noor 'Adilah Ibrahim Application of ARIMA Model in Forecasting Daily Wind Energy Production in Germany
1100 - 1115	**ID 015-004** Ms. Cindy Hartita Development of Automated Sorting System for Local Sunkist Using The K-Nearest Neighbour Method	**ID 028-013** Ms. Fatinah Najwa Roslan PC1D Analysis of TiO2 Antireflection Coating on Gas-Based Solar Cells
1115 - 1130	**ID 025-010** Ms. Assyifa Mourlina Faraquinnsha System-Level Evaluation of Piezoelectric Energy Harvesting as Complementary Microgeneration to Solar Photovoltaics in Smart Built Environments	**ID 069-056** Mr. Costantine Joannes A Brief Review of Rare Earth Elements (REEs) and Applications in Sustainable Energy
1130 - 1145	**ID 045-025** Mr. Cristian Mateo Hernandez Automation of Thermal Inspection: A Machine Vision-Based Approach to Predictive Maintenance	**ID 046-027** Ms. Nur Arina Binti Mat Rusni Energy Distribution and Intracavity Power Dynamics Enabling Higher-Order Harmonic Mode-Locking: A Comparative Study on TiO2/Ti3C2Tx and MoS2-ZnO
1145 - 1200	**ID 038-034** Ms. Ade Ayu Oktaviana From Waste to Carbon Sink: Potential of Sidoarjo Mud for CO_2 Capture	**ID 042-049** Mr. Eric Joseph Pereira Review of Lifecycle Assessment Approach for Integration of Oscillating Water Columns with Marine Structures in Malaysia
1200 - 1215	**ID 056-042** Mr. Aan Sefentry Zero Waste Approach to Palm Oil Mill Waste Combustion Engineering	**ID 030-015** Ms. Nur Farhani Zainudin Green Supply Chain Management as A Strategic Enabler of Low-Carbon Transition and Organisational Resilience in Maritime Supply Chains
1215 - 1230	**ID 033-050** Mr. Sukahir Sukahir Assessing Piper Seneca Ii Platform Wing Based on Aerodynamic Performance in Indonesia Pilot Civil Academy Banyuwangi	
1245 - 1415	**Lunch Break**	

PARALLEL SESSION 3
SCHEDULE

Room Venue	1 Bilik Kuliah 1	2 Bilik Kuliah 2	3 Bilik Kuliah 3	4 Bilik Kuliah 5
Track	Advanced Materials & Radiation Technology	Biomass & Bioenergy	Digitalisation & Risk Engineering	Digitalisation & Life Cycle Assessment & Low Carbon Transition Engineering
Chair	Dr. Muhammad Syahir Bin Sarkawi	Dr. Zulhairun Bin Abdul Karim	Dr. Norazana Binti Ibrahim	Dr. Muhammad Arif Bin Sazali
Co-Chair	Tan Hooi Ling	Nur Nadzirah Binti Ahmad Fu'ad	Ling Hou Xiong	Yap Jing Hui
1415 - 1430	**ID 072-070** Dr. Nor Afifah Basri Atmospheric Trajectory Analysis of Iodine-131 and Caesium-137 from Proposed Nuclear Power Plant Site in Singapore.	**ID 070-062** Ms. Aisyatul Khadijah Effect of Polyalphaolefin (PAO) Molecular Weight on The Physicochemical and Sealing Performance of Synthetic Valve Sealant	**ID 052-038** Ms. Nur Annisa Binti Abd Hafiz Zinc Oxide/ Reduced Graphene Oxide Reinforced Double-Network Hydrogel Electrolyte with Enhanced Conductivity and Tensile Strength	**ID 017-037** Ms. Hanis Hanif Processing of ANSTO Primary Filtrate Containing Lanthanide Concentration for The Thorium Separation Process Using Amine D2EHPA
1430 - 1445	**ID 012-045** Mr. Ahmad Hasnulhadi Che Kamaruddin Thorium Removal from Nuclear-Related Wastewater: Progress in Polymer-Engineered and Biomass-Derived Adsorbents	**ID 063-052** Mr. Muhammad Adlan Bin Ismail Halimi Deacidification of Diesel Through Extraction of Naphthenic Acid using Betaine-Based Deep Eutectic Solvents	**ID 066-055** Mr. Bakir Elouaret Comparative Phase Stability of Methanol and Hexylene Glycol in Avgas 100ll Gasoline	**ID 055-041** Mr. Muhammad Aiman Hakimi Bin Ahmad Zamani Measurement of The Coating Thickness on Carbon Steel Using Ultrasonic Testing Method

ID: 001-001

Structural, Electrical and Surface Wettability Engineering Of Zinc Oxide Nanowires For Photovoltaic Coatings

Hollis Bunyeh Anak Francis[1*], Rosnita Muhammad[1], Masleeyati Yusop[1]

[1]*Department of Physics, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia*

*Corresponding author: hollis@graduate.utm.my

Abstract. Surface contamination by dust, rain droplets and organic pollutants reduces photovoltaic (PV) solar cell energy output by 10 to 15% and required regular maintenance. This study investigates the synthesis and characterisation of zinc oxide (ZnO) nanowires grown by chemical bath deposition (CBD) for self-cleaning PV coating applications. ZnO seed layers were deposited by sol-gel spin coating and annealed at 300 °C for 3 hours to achieve a surface roughness of 2 nm RMS. Nanowires were subsequently grown at 90 °C using zinc nitrate and hexamethylenetetramine (HMTA) at three molar ratios: 1:1, 1:2/3 and 1:2/5. X-ray diffraction confirmed a hexagonal wurtzite crystal structure with preferential (101) orientation at $2\theta = 36.3°$. The 1:1 ratio yielded the highest crystallinity (crystallite size $D = 21.23$ nm; dislocation density $\delta = 1.99 \times 10^{-3}$ nm^{-2}) and the lowest sheet resistivity of 2.956×10^{5} Ω/sq, lower than the 1:2/5 ratio with approximately 80 nA current at 5 V. Tauc analysis yielded an optical bandgap of $E^{G} \approx 3.21$ eV, confirming visible spectrum transparency suitable for PV coating. Contact angle measurements demonstrated synthesis-controlled wettability from 77.9° (hydrophilic) at 1:2/5 to 111.3° (hydrophobic) at 1:1 achieved without any post deposition surface treatment. These results validate CBD grown ZnO nanowires as a cost-effective self-cleaning coating for PV panels via the lotus effect.

ID: 005-002

Hydrogen Sensor for Leak Detection with AI Capability: A Novel Approach for Enhanced Safety and Monitoring

Mohd Azimie Ahmad[1]

[1]*School of Engineering and Technology, Universiti of Technology Sarawak, No 1, Jalan Universiti, 96000, Sibu, Sarawak.*

*Corresponding author: azimie@uts.edu.my

Abstract. This study presents the development and integration of a hydrogen sensor with artificial intelligence capability for effective leak detection. Hydrogen is a promising clean energy source, but its highly flammable nature necessitates efficient leak detection systems. The proposed sensor combines high sensitivity and selectivity with real-time monitoring through IoT connectivity. The performance of the sensor was evaluated in laboratory settings, demonstrating rapid response and recovery times. The IoT integration enables remote monitoring, active and immediate alerts, enhancing safety protocols. This novel approach promises significant improvements over existing technologies, offering a reliable solution for hydrogen leak detection in various applications from local brand and expertise. Thus preventing catastrophic incident from occurring resulting with asset damage, lost of life and reputation damage due to penalties.

ID: 015-004

Development of Automated Sorting System The Local Sunkist Using The K-Nearest Neighbor Method

Cindy Hartita[1], Luvyta L. M. Syawalia[2], Yulia Resti[3], Ismail Thamrin[2], Irsyadi Yani[2*]

[1]*Doctoral Program of Engineering Science, Faculty of Engineering, Universitas Sriwijaya, Indonesia*
[2]*Department of Mechanical Engineering, Faculty of Engineering, Universitas Sriwijaya, Indonesia*
[3]*Department of Mathematics, Faculty of Mathematics and Natural Science, Universitas Sriwijaya, Indonesia*

*Corresponding author: irsyadiyani@ft.unsri.ac.id

Abstract. Increased demand for local Sunkist in Indonesia, especially during certain periods, has led to a growing need for accurate and efficient fruit sorting processes. Manual sorting processes have the potential to cause classification errors, which can result in distribution losses, reduced fruit quality, and health risks for consumers. This study aims to develop an automatic local Sunkist quality identification system based on digital image processing using the K-Nearest Neighbour (K-NN) method. The dataset used consists of 90 images of local Sunkist grouped into three categories, namely unripe, ripe, and rotten. Image acquisition was performed using a webcam installed in a lighting chamber to maintain lighting stability and minimize background interference. The image processing involved cropping the centre area of the image to a size of 20×20 pixels, extracting the Red, Green, and Blue (RGB) colour intensity values, and normalizing the data using the Min-Max Scaling method. The classification process was carried out using the K-NN method with a K value of 3 and Euclidean distance calculation. The results showed that the system was able to classify the ripeness level with an accuracy rate of 92.6%.

ID: 018-005

Analysis of Radiation Shielding Bunker for Prompt Gamma Neutron Activation Analysis Facility at TRIGA PUSPATI Reactor

Jie Ru Law[1], Muhammad Arif Sazali[1*], Khair'iah Yazid[2], Mohamad Hairie Rabir[2], Mark Dennis Usang[2]

[1]Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia, Malaysia
[2]Malaysian Nuclear Agency, 43600 Kajang, Malaysia

*Corresponding author: arifsazali@utm.my

Abstract. Prompt Gamma Neutron Activation Analysis (PGNAA) is a powerful non-destructive (NDT) technique for elemental analysis, widely used in various scientific and industrial applications. The development of a PGNAA facility at the TRIGA PUSPATI Reactor (RTP) requires a strong radiation shielding design to ensure operational safety and regulatory compliance. This study aims to design and optimize a radiation shielding bunker specifically for the RTP radial beamport using the OpenMC Monte Carlo code. The shielding performance of two wall configuration which were pure concrete and borated polyethylene (BPE)-lined concrete, were evaluated across total thicknesses of 40 cm, 50 cm, and 60 cm. The simulation assessed spatial flux distributions, radiation attenuation profiles, and annual effective doses for radiation workers. Results demonstrated that the BPE-lined configuration exhibited excellent neutron attenuation, suppressing neutron flux way better compared to pure concrete at 60 cm thickness. Furthermore, the BPE liner effectively reduced the generation of secondary capture gamma rays within the concrete wall. Radiological safety assessments indicated that a 40 cm thick pure concrete wall is unsafe (83.73 mSv/yr), exceeding the Malaysian annual dose limit of 20 mSv for radiation workers. However, optimization analysis revealed two viable designs which were a 60 cm pure concrete wall (7.32 mSv/yr) for cost-effective shielding and a 40 cm BPE-lined concrete wall (9.93 mSv/yr) for space-constrained environments.

ID: 021-006

Development of a Solar-Energy-Based IoT Gardening Automation System for Efficient Water and Energy Usage

Norlaili Abdul Rahman @ Abdul Rahim[1*], Yasven Sundaram[1]

[1]*Department of Mechanical Engineering,*
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Abstract. The growing global demand for sustainable agriculture underscores the urgent need for innovative technological solutions that enhance productivity while minimizing resource consumption. Smart farming systems, particularly those powered by renewable energy, have emerged as viable methods for meeting the challenges of modern agriculture. This research presents the development of a solar-powered smart gardening system integrated with an Internet of Things (IoT) platform to automate and optimize key aspects of plant cultivation. The system incorporates the NodeMCU ESP32 microcontroller, soil moisture sensors, a DHT11 temperature–humidity sensor, and a multi-channel relay module, all of which operate using a dedicated solar energy supply controlled through a solar charge controller and lithium-ion storage. Through the Blynk IoT platform, users are able to visualize real-time environmental data, receive automated alerts, and remotely manage irrigation operations. The system autonomously regulates watering based on predefined moisture thresholds, thereby eliminating guesswork and reducing the risk of overwatering or underwatering. This significantly reduces dependence on grid electricity and supports long-term cost savings. Overall, the findings indicate that the proposed solar-powered IoT gardening system is a reliable, energy-efficient, and scalable solution that can benefit home gardeners, small-scale farmers, and educational institutions. This research reinforces the role of renewable energy–driven IoT systems as essential tools in addressing contemporary agricultural challenges and advancing sustainable smart farming practices.

ID: 022-007

Climate Risks and Adaptation in the World's Largest Oil Shale Power Plant in Attarat, Jordan

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Abstract. PlantAttarat Power Company (APCO) in Jordan is the world's largest oil-shale fired mine-mouth electric power plant that feeds on 32,000 ton of shales to generate 554 MW for 16% of Jordanian household. This project is important to Jordan economic and social development by providing security to energy, food, employability and livelihood of its citizens. The power sector is vulnerable to projected changes in many dimensions of climate, including increasing frequency and intensity of extreme weather events such as flood and heatwaves. The most significant potential climate change threats are estimated to be rising air and water temperature. As power stations and related infrastructure can operate for 50 years or more, adaption measures should consider a range of projections including gradual change, more rapid changes, and possible changes in extremes over this period. Designing decentralised generation system reduces the need for large facilities located in the areas of high risks. This assessment was conducted to look into APCO wide range of climate variables and their expected impact on the energy generation. The cost of inaction or poorly consideration and non-executed actions are expected to be higher than well-planned and implemented actions to improve energy sector resiliency. Therefore, it is very important that every unit in the department to keep data and notes on actions, climate events, installation and improvements to project long-term cause and effects.

ID: 023-008

Production of Paint Based on Waste Expanded Polystyrene

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Abstract. This study investigates the feasibility of producing paint using waste expanded polystyrene (EPS) as a polymeric binder, providing a sustainable alternative to conventional petroleum-based alkyd resins. Waste EPS was dissolved in toluene to form a binder solution and combined with titanium dioxide as a pigment to formulate paint samples with varying EPS contents. The prepared coatings were applied to plywood substrates and evaluated using adhesion and durability-related tests, including cross-cut tape and scratching resistance assessments. The results indicate that up to approximately 27% EPS can be incorporated into the paint formulation while maintaining acceptable workability and coating performance. Among the formulations tested, the paint containing 10 g of EPS in 100 mL of toluene with 5 g of titanium dioxide exhibited the most balanced viscosity and superior surface quality, showing improved adhesion and resistance to mechanical damage compared to other compositions. The EPS-based paint demonstrated good bonding to the substrate and satisfactory resistance to surface degradation, with no significant coating detachment observed in tape pull-off tests. These findings suggest that waste EPS can be effectively repurposed as a functional binder in paint formulations, offering a value-added recycling pathway that contributes to waste reduction and supports the development of more sustainable coating materials.

ID: 024-009

Application of ARIMA Model in Forecasting Daily Wind Energy Production in Germany

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Abstract. Implementation of renewable energy sources into the national power grids is a worldwide agenda but the stochastic nature of wind poses serious problems on the stability of the power systems. This study explores the role of Autoregressive Integrated Moving Average (ARIMA) in modelling the daily production of wind energy in Germany. The first approach is to create a solid statistical model that can be used to capture the linear relationships and volatility of daily wind generation. The methodology is based on the Box-Jenkins approach that includes data identification, parameter estimation, diagnostic checking, and forecasting. Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) analysis were used to identify candidate models, Autoregressive (AR) and Moving Average (MA) components. The Akaike Information Criterion (AIC) and the residual diagnostics were used to guide the choice of model. The analysis showed that the visual examination of the PACF indicated an ARIMA (2,0,0) model which is in accordance with the theory wind persistence. Diagnostic tests to be used in validating the independence of the residuals and model adequacy were applied such as Autoregressive Conditional Heteroscedasticity (ARCH) Test. Lastly, a 396-day forecast was produced using the best model to give a project baseline of how much energy will be available in future. The results highlight the effectiveness of time series analysis to control the intermittency of renewable energy as it provides meaningful information to grid operators in the optimization of load dispatch and the minimization of the need to rely on a back-up generation.

ID: 025-010

System-Level Evaluation of Piezoelectric Energy Harvesting as Complementary Microgeneration to Solar Photovoltaics in Smart Built Environments

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Abstract. Rapid urbanisation and the growing deployment of low-power electronic systems for monitoring, control, and smart infrastructure have intensified demand for embedded and reliable microgeneration technologies in the built environment. Although solar photovoltaic (PV) systems dominate distributed renewable energy generation, their performance is constrained by intermittency, shading, nighttime unavailability, and limited usable surface area in dense urban settings, creating a knowledge gap regarding complementary energy sources capable of operating under such conditions. This study evaluates the feasibility of piezoelectric energy harvesting as a scalable microgeneration technology and assesses its realistic role relative to solar PV at the system level. An integrated experimental and analytical methodology was adopted, involving development of a piezoelectric pavement prototype subjected to human-induced mechanical loading, evaluation of series and parallel electrical configurations, and temporal energy availability analysis based on measured electrical outputs. Voltage, current, and power were experimentally characterised under applied loads ranging from 65 to 94 kg, followed by time-integrated energy estimation and benchmarking against a representative small-scale PV system. Experimental results indicate that the piezoelectric system produced instantaneous power between 35 and 56 μW, with parallel configurations delivering higher usable power than series configurations due to increased current output. Temporal analysis shows that daily harvested energy is approximately 0.3 J under typical pedestrian activity, which is several orders of magnitude lower than daily energy yield of a 1 m² PV panel. Despite this disparity, piezoelectric harvesting remains operational in indoor and shaded environments, demonstrating its value as a complementary, activity-driven microgeneration technology for smart urban systems.

ID: 026-011

Burnup and Reactivity Analysis of Thorium-Based Mixed Oxide Fuel in Boiling Water Reactor

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Abstract. Conventional uranium fuel faces sustainability challenges, yet the potential of thorium-based Mixed Oxide (Th-MOX) fuel in Boiling Water Reactors (BWRs) remains underexplored. This study aims to evaluate the neutronic and burnup performance of UO_2–ThO_2 fuel within a BWR environment. A simplified 7×7 fuel assembly model was simulated using the OpenMC Monte Carlo code, comparing a standard UO_2 core against variants containing 10%, 30%, and 50% ThO_2 over a 360-day cycle. Depletion results confirmed a consistent linear burnup accumulation across all fuel types, reaching a discharge value of approximately 8.5 MWd/kgHM, verifying constant power operation. However, increasing thorium content significantly reduces initial excess reactivity, with keff dropping from 1.29 (UO_2) to 0.96 (50% ThO_2) due to the high thermal neutron capture of Th-232. While high-thorium variants appeared subcritical under standard Low-Enriched Uranium (LEU) conditions, analysis confirmed substantial in-situ U-233 breeding, despite a temporary "reactivity bottleneck" caused by Protactinium-233 accumulation. In conclusion, while Th-MOX fuel offers enhanced long-term sustainability and higher conversion efficiencies, its implementation necessitates higher initial enrichment or heterogeneous assembly designs to overcome the initial reactivity penalty.

ID: 011-012

Thermally Activated Concrete Waste as a Sustainable Adsorbent for Phosphorus Removal from Agricultural Stormwater

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Abstract. Agricultural stormwater runoff represents a significant non-point source of phosphorus entering surface waters, where prolonged nutrient enrichment accelerates eutrophication and degrades aquatic ecosystems. Despite the growing emphasis on nutrient management strategies, the valorization of construction-derived materials for phosphorus mitigation remains insufficiently explored. This study examines the feasibility of thermally activated concrete waste (TACW) as a sustainable adsorbent for phosphorus removal from agricultural drainage stormwater. The investigation encompasses mineralogical and morphological characterization of the modified material, assessment of baseline stormwater quality, and evaluation of operational parameters governing removal efficiency. Concrete waste was mechanically reduced and thermally treated at 700°C for 3 h to induce physicochemical transformation. Thermal activation promoted the formation of reactive oxide phases, particularly CaO, which are known to enhance phosphate affinity through surface complexation and precipitation mechanisms. Field sampling revealed a phosphorus concentration of 3.73 mg/L, categorizing the stormwater as Class V (severely polluted) under the Malaysian National Water Quality Standards, thereby indicating substantial nutrient loading. Batch adsorption experiments demonstrated that an optimum dosage of 6 g achieved a maximum removal efficiency of approximately 76%, with equilibrium attained within 90 min. The performance of TACW markedly exceeded that of untreated concrete waste, highlighting the role of thermal modification in improving surface reactivity and adsorption capacity. Collectively, the findings substantiate the potential of thermally activated concrete waste as an effective and environmentally responsible material for phosphorus control in agricultural drainage systems, aligning with broader objectives of construction waste utilization and circular resource management.

ID: 028-013

PC1D Analysis of TiO_2 Antireflection Coating on GaAs-Based Solar Cells

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Abstract. The structure of GaAs solar cells consists of N-type and P-type regions of GaAs with constant thickness of 0.1 µm and 30 µm. To optimize the efficiency and performance of GaAs solar cells, the study systematically modifies the thickness and refractive index of TiO_2 following the chosen wavelength within the range of 250 nm to 1200 nm. Through computational modelling and experimental validation, various thicknesses and refractive indexes of the TiO_2 layer were determined to determine the optimal parameters for minimizing reflection and maximizing light absorption. The results indicate that a TiO_2 layer with a thickness of 62.396 nm and a refractive index of 2.404 provides the best anti-reflective properties for GaAs solar cells. These parameters effectively reduce the reflection losses across a broad spectrum of incident light wavelengths, leading to an increase in photocurrent and overall efficiency of the solar cells. The findings demonstrate a significant improvement in the efficiency of GaAs solar cells with the optimized TiO_2 ARC, offering valuable insights for the development of high-performance photovoltaic devices. The study underscores the importance of precise control over the thickness and refractive index of ARC materials in enhancing the efficiency of solar cells, contributing to the advancement of sustainable energy technologies.

ID: 027-014

Sustainable Treatment of Ammoniacal Nitrogen in Oil Palm Plantation Effluent Using Thermally Activated Brick Waste

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Abstract. Elevated concentrations of ammoniacal nitrogen (NH_3–N) in agricultural drainage systems are increasingly associated with eutrophication, oxygen depletion, and ecological degradation in receiving waters. In oil palm plantations, nutrient-enriched runoff often reflects insufficient mitigation strategies and limited utilization of locally available waste-derived materials. This study evaluates the feasibility of thermally activated brick waste as a sustainable adsorbent for the removal of NH_3–N from plantation drainage water collected at Jalan Kg Parit Yusof 4, Batu Pahat, Johor. Emphasis was placed on adsorbent characterization, baseline water quality assessment, and optimization of operational parameters governing adsorption performance. Mineralogical and morphological analyses using X-ray diffraction (XRD) and scanning electron microscopy (SEM) revealed that thermal treatment at 700°C for 3 h transformed the brick waste into a more reactive crystalline structure with a well-developed porous architecture. The formation of interconnected macropores ranging from 72.27 µm to 180.9 µm is indicative of enhanced surface accessibility and potential active sites for solute interaction. Baseline monitoring of the drainage water indicated a severely impaired system, reflected by a Water Quality Index (WQI) of 31.93 (Class IV), predominantly influenced by elevated NH_3–N concentrations of 11.90 mg/L. Batch adsorption experiments demonstrated that an adsorbent dosage of 4 g yielded an optimum removal efficiency of 57.98%, while equilibrium was attained within 30 min with a maximum efficiency of 60.50%. The relatively rapid uptake suggests that surface-mediated interactions play a significant role during the initial adsorption phase. Overall, the findings substantiate the potential of thermally activated brick waste as a low-cost and environmentally viable material for mitigating nitrogen pollution in agricultural drainage networks, contributing to a circular approach in construction waste beneficial reuse.

ID: 030-015

Green Supply Chain Management as a Strategic Enabler of Low-Carbon Transition and Organisational Resilience in Maritime Supply Chains

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Abstract. The maritime supply chain is a critical component of global energy distribution and trade, yet it faces increasing pressure from decarbonisation targets, climate policies, and systemic disruptions. As the sector transitions toward low-carbon energy systems, organisations must integrate sustainability initiatives while strengthening their resilience capabilities. Although Green Supply Chain Management (GSCM) has been widely studied in relation to environmental performance, its role in supporting low-carbon transition and enhancing organizational resilience in maritime supply chains remains insufficiently conceptualised. This study aims to develop a theory-driven conceptual framework that positions GSCM as a strategic enabler of low-carbon transition and organizational resilience within maritime energy logistics. The research adopts an analytical conceptual modelling approach grounded in an integrative review of existing literature and is theoretically underpinned by the Resource-Based View and Dynamic Capabilities Theory. The framework proposes that GSCM practices, including green procurement, emission reduction initiatives, and sustainable logistics coordination, contribute to carbon mitigation while simultaneously strengthening adaptive and risk management capabilities. The findings advance the understanding of GSCM beyond environmental compliance by framing it as a resilience-building mechanism within maritime energy systems. This study provides theoretical direction for future empirical validation and offers practical implications for stakeholders navigating sustainable energy transformation in maritime supply chains.

ID: 029-016

Comparative Heat Transfer Analysis of Fuel Rod Temperature Profile Using Liquid Sodium and Water Coolant in a Small Modular Reactor

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Abstract. This study investigates the thermal performance of a NuScale-type Small Modular Reactor (SMR) fuel rod by comparing liquid sodium and conventional water as coolants using steady-state CFD simulations in ANSYS. The motivation for this work is to address the thermal management limitations of water-cooled SMRs, in which low thermal conductivity and high operating pressure can limit heat removal and increase fuel temperatures. A three-dimensional model of a single fuel rod with cladding surrounded by coolant was developed, and identical geometry, boundary conditions, and a volumetric heat generation rate of $q''' = 3.0 \times 10^8$ W/m³ were applied for both coolant cases. The simulations analyzed temperature distributions, heat flux, and radial thermal gradients within the fuel, cladding, and coolant regions. The results indicate that liquid sodium provides significantly more effective heat removal than water. In the sodium-cooled case, the fuel centerline temperature reached approximately 762.5 K and decreased smoothly to about 385 K in the coolant, resulting in a total fuel-to-coolant temperature rise of about 377.5 K. In contrast, the water-cooled case produced a much higher fuel centerline temperature of approximately 1900 K and a fuel-to-coolant temperature rise of about 1600 K. The sodium-cooled configuration also showed smaller temperature drops across the cladding and more uniform radial temperature gradients. These findings demonstrate that liquid sodium offers superior thermal performance and a larger thermal safety margin compared to water, highlighting its strong potential as an advanced coolant for enhancing heat removal efficiency and safety in next-generation SMR designs.

ID: 002-017

Comparative Study on Gamma Radiation Shielding Properties of Cement Mixture with Rice Husk Ash and Palm Oil Fuel Ash for Building

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Abstract. This research aimed to compare the gamma radiation shielding properties of cement mixtures with two agricultural waste-based materials produced in Malaysia, which are Rice Husk Ash (RHA) and Palm Oil Fuel Ash (POFA). This research is motivated by the demand for environmentally friendly and cost-effective alternatives to conventional shielding materials such as lead and concrete, particularly in building materials. The objective of this research is to prepare samples using concrete mixtures of RHA and POFA with different weight percentages and thicknesses and evaluate the Shielding Effectiveness (SE) of the samples against gamma radiation. The effectiveness is evaluated using the calculations of Half-Value Layer (HVL), Linear Attenuation Coefficient (LAC), and Mass Attenuation Coefficient (MAC)to determine the best sample and compare it with conventional shielding material. Radiation shielding testing was performed using a Thallium-Activated Sodium Iodide Scintillation (NaI(Tl)) detector and a gamma source Cesium-137 (Cs-137). The results showed an optimum replacement level of 10 % for enhanced gamma radiation attenuations for both RHA-Blended Concrete (RHA-BC) and POFA-Blended Concrete (POFA-BC), where POFA-BC exhibited better performances compared to RHA-BC. POFA-BC achieved a maximum LAC of 0.2205 cm^{-1}, a minimum HVL of 3.1435 cm, and a MAC of 0.1011 cm^2/g, indicating more effective gamma ray attenuations. Mechanical performance of POFA-BC demonstrated higher compressive strength than RHA-BC reaching 45.67 MPa. Additionally, a Material Cost Saving (MCS) approximately 80 % from the Control-Concrete (CC) cost for both RHA-BC and POFA-BC and a Waste Utilization Efficiency (WUE) of 18.92 % at 10 % replacement. Overall, the results indicate that POFA-BC exhibits better radiation shielding and mechanical performances than RHA-BC, suitability for sustainable building and radiation protection applications. This research shows an understanding of eco-friendly alternatives to conventional shielding materials, aimed to improve public health, safety, and environmental conservation through innovative use of local resources

ID: 035-019

Potensi Penggunaan Bahan Kitar Semula (Kaca) untuk Inkubasi Aruhan Telur Ikan Tilapia

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Abstrak. Peningkatan permintaan terhadap benih Oreochromis niloticus telah mendorong penggunaan sistem inkubator aruhan secara meluas dalam industri akuakultur. Walaupun botol plastik sering digunakan sebagai inkubator kos rendah oleh penternak berskala kecil, penggunaannya menyumbang kepada peningkatan sisa plastik dan pencemaran alam sekitar. Oleh itu, kajian ini dijalankan bagi menilai keberkesanan botol kaca kitar semula sebagai alternatif kepada botol plastik dalam proses inkubasi aruhan telur ikan tilapia serta membandingkan prestasi kedua-dua bahan tersebut.

Reka bentuk eksperimen perbandingan digunakan dengan tiga replikasi bagi setiap jenis inkubator (botol kaca dan botol plastik). Parameter utama yang dianalisis termasuk suhu, oksigen terlarut (DO), pH, ammonia, jumlah telur menetas dan kadar penetasan (%). Hasil kajian menunjukkan bahawa inkubator botol kaca mencatatkan kadar penetasan yang secara konsisten lebih tinggi berbanding botol plastik. Selain itu, parameter kualiti air dalam botol kaca didapati lebih stabil, khususnya dari segi kawalan suhu dan kandungan ammonia yang lebih rendah, sekali gus menyumbang kepada perkembangan embrio yang lebih baik. Secara keseluruhan, botol kaca kitar semula mempunyai potensi tinggi sebagai alternatif yang efektif dan lestari dalam inkubasi aruhan telur tilapia. Penggunaannya bukan sahaja memberikan prestasi penetasan yang setara atau lebih baik, malah menyokong usaha pengurangan penggunaan plastik dalam operasi akuakultur berskala kecil. Kajian lanjutan dengan skala yang lebih besar dan tempoh pemerhatian yang lebih panjang dicadangkan bagi mengukuhkan dapatan ini

ID: 036-020

Lightweight Poly(Lactic Acid)/Barite Composite for Low-Energy Gamma Radiation Shielding using an Additive Manufacturing

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Abstract. The application of additive manufacturing technology has expanded and has the potential to be applied to radiation protection. The technology can be used to fabricate lightweight shielding materials, especially for low-energy gamma radiation, across various sectors, including medical laboratories, nuclear facilities, and industrial gauge applications. This study evaluates the 3D-printed poly(lactic acid) (PLA) radiation shielding performance against low-energy gamma radiation from americium-241 (241Am). Barium sulfate (BaSO4) or barite with 5% and 10% content was added as a filler to PLA to enhance the radiation shielding performance. The PLA composite filament was fabricated, and samples were printed using a fused deposition modelling (FDM) type 3D printer. To assess filler dispersion, micro-computed tomography (micro-CT) analysis was conducted. The result showed no signs of agglomeration, and BaSO4 was evenly distributed on PLA. The radiation shielding performance was determined using a radiation transmission experiment to determine the linear attenuation coefficient, μ, and the half-value layer (HVL) of the printed PLA samples. The results show that the printed PLA with 10% BaSO4 content produced the best shielding performance with the highest μ values and lowest HVL values. The presence of BaSO4 in PLA improved its shielding performance. The application of additive manufacturing technology was indeed beneficial for radiation shielding due to its benefits, such as low production cost, easy fabrication even with complex geometry, and instant fabrication. The use of high-performance shielding material produced by additive manufacturing can meet demand and provide an alternative to lightweight materials, especially for low-energy gamma radiation in radiation protection applications.

ID: 039-022

Design of Low-Corrosive Ionic Liquids for Lubricant Additives Using COSMO-RS Ionic Conductivity Predictions

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Abstract. Ionic liquid (IL) molecular structure and transport properties influence the corrosive behaviour of the lubricant additive. Experimental screening of ionic liquids is challenging due to the vast number of possible cation–anion combinations. In this study, the Conductor-like Screening Model for Real Solvents (COSMO-RS) was employed as a predictive computational framework to screen and design halogen-free ionic liquids suitable for lubricant applications. IL composed of several cations, including imidazolium, ammonium, phosphonium, guanidinium, and choline-based cations paired with amino acid and fatty acid anions were optimized for COSMO-RS analysis. Molecular structures were geometry-optimized using density functional theory, and COSMO-RS calculations were performed to predict ionic conductivity and viscosity as key descriptors governing ion mobility and corrosion behaviour. The result revealed that the corrosion characteristic of IL is strongly governed by the molecular size of both cation and anion, the types of cation and cation-anion interaction. Amino acid-based ILs exhibited moderate ionic conductivity and lower viscosity, while fatty acid-based ILs showed higher viscosity and lower ionic conductivity. Viscosity and ionic conductivity are inversely proportional follows the Walden rule. ILs with moderate ionic conductivity can be used as an additive in lubricant formulations because high conductivity may corrode metals, whereas low conductivity fails to form a tribofilm. Additionally, very high viscosity can significantly impact tribological performance. COSMO-RS provides a reliable and effective computational screening approach for identifying low-corrosive IL additives that show promise before being experimentally formulated.

ID: 044-023

Investigation of Zinc-Tungsten Composite for Radiation Shielding

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Abstract. Radiation shielding materials play a crucial role in nuclear, medical, and industrial applications to minimize exposure to harmful ionizing radiation. Traditional shielding materials such as lead, while effective, pose environmental and health concerns, necessitating the exploration of alternative materials. This study investigates the radiation shielding performance of zinctungsten (Zn-W) composites using a simulation-based approach. Therefore, this research aims to: (1) evaluate transmitted neutron and gamma flux through Zn-W composites, (2) investigate transmitted neutron and gamma dose attenuation behaviour, and (3) identify tungsten compositions that achieve improved shielding performance while considering density-related effects. Neutron transport was simulated using the OpenMC Monte Carlo code under a fixed-source configuration, while gamma-ray attenuation was evaluated deterministicaly using the decay equation. Zn-W composites containing 0-50 wt% tungsten were modeled. The results indicate that increasing tungsten content leads to enhanced neutron attenuation and reduced gamma transmission. These findings support the potential of Zn-W composites as lead-free radiation shielding materials and highlight the effectiveness of simulation-based methods for preliminary material evaluation.

ID: 043-024

Development of a Compact Reactor for Co-Pyrolysis of Waste Plastic and Used Cooking Oil into Valuable Products

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Abstract. The accumulation of plastic waste and improper disposal of used cooking oil pose serious environmental issues that require an innovative and sustainable management approach to overcome continuous pollution caused by traditional dumping and incineration practices. Co-pyrolysis, an advanced thermochemical process, offers a waste-to-energy solution by decomposing various feedstocks (including plastics and waste oils) to three different end products of co-pyrolytic oil, syngas and char in an inert environment. This paper presents the development of a compact, low-cost reactor designed for the efficient valorisation of waste plastics and used cooking oil to produce a valuable co-pyrolytic oil, syngas and char product. The 1000ml reactor was fabricated using readily available materials and engineered for batch stirred operation at moderate temperature up to 500 oC under a nitrogen-rich atmosphere. Waste Polypropylene (PP) and Used Palm Oil (UPO) mixture were processed to evaluate product yield and composition. Preliminary results show that the characteristics of co-pyrolytic oil and syngas are promising and can be upgraded to alternative fuel sources, while char can be used for soil fertility enhancement. The reactor's compact design and cost effectiveness provide a practical and environmental pathway for decentralising waste to usable energy and products that contribute significantly to sustainable development efforts.

ID: 045-025

Energy Distribution and Intracavity Power Dynamics Enabling Higher-Order Harmonic Mode-Locking: A Comparative Study on $TiO_2/Ti_3C_2T_x$ and MoS_2-ZnO

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Abstract. This work addresses the need for advanced predictive maintenance by developing an automated thermal inspection system based on infrared thermography and machine vision. Traditional manual inspections are often subjective, intermittent, and prone to human error, limiting the reliability of monitoring in energy systems and critical infrastructure. The main objective of this study is to automate the detection and classification of thermal anomalies to improve safety, reduce diagnostic uncertainty, and support data-driven maintenance decision-making. The proposed methodology integrates a machine vision workflow for thermal image preprocessing, including resizing, normalization, and feature extraction using Histogram-Oriented Gradients (HOG). The extracted descriptors are standardized and used to train a Support Vector Machine (SVM) classifier. The system categorizes thermal conditions into three operating states: normal, hotspot-related anomaly, and crack-related anomaly. This approach provides a lightweight and interpretable baseline suitable for rapid implementation without requiring significant computational resources. Experimental validation was performed using a thermal image dataset of photovoltaic (PV) solar panels acquired under controlled conditions. The proposed HOG + SVM sequence achieved an overall classification accuracy of approximately 0.82, demonstrating consistent performance in distinguishing normal panels from those with early-stage thermal defects. Confusion matrix analysis showed that most misclassifications occurred between anomaly classes and samples with borderline normal values, suggesting that thermal degradation patterns may share similar spatial characteristics in the early stages of failure. In conclusion, the results demonstrate that machine learning techniques, combined with infrared thermography, can provide a reliable baseline for the automated inspection of photovoltaic systems. The proposed system offers a scalable foundation for future predictive maintenance solutions, with the potential to extend to industrial assets such as motors, electrical cabinets, and mechanical transmission systems.

ID: 046-027

Energy Distribution and Intracavity Power Dynamics Enabling Higher-Order Harmonic Mode-Locking: A Comparative Study on $TiO_2/Ti_3C_2T_x$ and MoS_2-ZnO

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Abstract. Energy distribution and intracavity power dynamics are fundamental factors that govern the generation of higher-order harmonic mode-locking (HML) in ultrafast fiber lasers. In this work, we present a comparative investigation of $TiO_2/Ti_3C_2T_x$ and MoS_2-ZnO, composite based saturable absorbers (SAs) integrated into a thulium–holmium-doped fiber laser (THDFL). The $TiO_2/Ti_3C_2T_x$ SA successfully enabled harmonic mode-locking up to the 17th harmonic order, while a MoS_2-ZnO SA achieved HML up to the 22nd harmonic order under the same cavity configuration. Interestingly, the required pump power to reach these harmonic orders differs significantly between the two SAs, highlighting the role of material-dependent nonlinear absorption and saturation dynamics. This difference illustrates a complex interplay between intracavity pulse energy, pump power, and harmonic scaling, where the redistribution of energy within the cavity directly influences the achievable repetition rate of solitons in 2 μm ultrafast fiber lasers.

ID: 019-028

Morris's Sensitivity Analysis of Natural Gas Dispersion in Malaysia's High Pressure Transmission Pipeline Leaks

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Abstract. Natural gas transmission pipelines are a critical component of Malaysia's energy infrastructure; however, accidental leaks from high-pressure systems can generate extensive flammable gas clouds that pose serious safety and environmental risks. This study investigates the sensitivity of natural gas dispersion behaviour to key pipeline parameters using consequence modelling and statistical screening under Malaysian atmospheric conditions. Dispersion scenarios were simulated using ALOHA, with leak size from 1 mm to 100 mm, internal operating pressure from 34 bar to 69 bar, and pipeline diameter from 51 mm to 1220 mm selected as input parameters, while hazard extents were evaluated using LEL10, LEL60, and LEL100 distances. Forty simulation cases were analysed, and the Morris sensitivity analysis was applied to quantify parameter influence, non-linearity, and interaction effects. The results indicate that leak size is the dominant factor controlling dispersion extent, followed by internal pressure as a secondary contributor, while pipeline diameter exhibits the weakest direct influence on hazard distance. Among the output metrics, LEL10 shows the highest variability and sensitivity, confirming its suitability as a conservative indicator for emergency planning. Overall, the findings provide a systematic and physically grounded basis for prioritising largeleak detection, pressure management, and LEL-based consequence modelling in the safety management of Malaysia's high-pressure gas transmission pipelines.

ID: 048-029

The Effect of Fiber Alignment on Mechanical Properties of Sugarcane Fiber Reinforced Epoxy Composites

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Abstract. Natural fiber reinforced polymer composites have gained increasing attention due to their sustainability, low density and potential to replace synthetic fiber composites in engineering applications. This research investigates the effect of fiber alignment on the mechanical properties of sugarcane fiber reinforced epoxy composites. Sugarcane fibers were used as a natural filler with epoxy resin as the matrix material. The composites were fabricated using the casting method with two different fiber alignments, namely vertical, and horizontal, at fiber contents of 5 wt%, 10 wt% and 15 wt%. Mechanical characterization was carried out through tensile, flexural and Izod impact testing in accordance with relevant ASTM standards, while fracture surface analysis was performed using high resolution visual observation to identify dominant failure mechanisms. The results demonstrate that both fiber alignment and fiber content significantly influence the mechanical behaviour of the composites. Vertical fiber alignment exhibited the highest overall mechanical performance that achieving a maximum tensile strength of approximately 32 MPa, the highest Young's modulus, flexural strength and also impact resistance at 15 wt% fiber content due to efficient stress transfer along the loading direction. In contrast, horizontal fiber alignment consistently produced the lowest mechanical performance with tensile strength as low as 14 MPa at 15 wt% fiber content, which was attributed to matrix dominated failure and ineffective load transfer. Fractography analysis further supported these findings by revealing fiber breakage, pull-out and crack bridging in vertical alignment composites, while smooth and brittle fracture surfaces were observed in horizontal alignment samples. Overall, this research confirms that optimizing fiber alignment and fiber content is crucial for improving the mechanical performance of sugarcane fiber reinforced epoxy composites. These findings are important as they demonstrate the potential of sugarcane bagasse waste to be utilized as a sustainable reinforcement material for lightweight and semi structural engineering applications, thereby contributing to environmentally friendly composite development.

ID: 037-030

Thorium Extraction from Water Leach Purification Residue

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Abstract. Rare-earth elements extraction activities in Malaysia generates an average of 75000 tonnes of Water Leach Purification (WLP) residue containing an estimated 106 tonnes of thorium that leads to radioactivity concentration that exceed 1 Bq/g set by the authorities. The existing baking and cracking processes results in significant amount of thorium remaining in the residue as thorium pyrophosphate, complicating thorium extraction and its waste management. Therefore, this study aims to determine the optimum parameters for the baking and cracking of WLP residue to enhance thorium extraction by evaluating leaching efficiency. This study focuses on the parametric analysis of baking and cracking methods applied to WLP residue to optimize the thorium extraction efficiency and thus to reduce the radioactive levels of the byproduct of the process. The sample is evaluated using various characterization techniques, such as XRF and ICP-MS for its elemental composition FTIR for its chemical structure and TGA in measuring the stability and decomposition behaviour. The sample is evaluated using various characterization techniques, such as XRF and ICP-MS for its elemental composition, FTIR for its chemical structure and TGA in measuring the stability and decomposition behaviour. This study will contribute to the existing body of knowledge of the rare earth industry by providing a comprehensive study into the most optimum parameter that can enhance thorium extraction efficiency and achieve the goal to reduce the radioactivity level of the waste.

ID: 050-032

A Review of Radiation Shielding Applications Applied by Different 3D Printing Technologies and Materials

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Abstract. In many high-risk fields, radiation shielding is crucial for shielding workers and equipment from ionizing radiation. The important contributions of modern 3D printing technologies, such as fused deposition modeling, selective laser melting, binder jetting, and vat photopolymerization, to the development of lightweight, versatile shielding solutions are evaluated in this review. These consist of tungsten and polymer composites, boron carbide-infused matrices, and polyethylene lattices with high atomic number fillers like silica aerogels or bismuth. According to Monte Carlo simulations and experimental validations, these materials achieve linear attenuation coefficients greater than 0.5 cm^{-1} for 1 MeV gamma rays while achieving mass reductions of 40 to 60 percent when compared to traditional lead or concrete barriers. Applications include space exploration for rovers and habitats in NASA's Artemis program to block cosmic rays; nuclear facilities for modular reactor enclosures; medical radiotherapy through patient-specific boluses; aerospace satellites protected from solar particle events; and defense applications with portable neutron barriers, such as helmets made of tungsten polylactic acid that are able to attenuate 90% of 662 keV gamma radiation at a thickness of 2 cm. While issues like material porosity, density inconsistencies, and radiation degradation still exist, advancements in nanomaterials, in situ alloying, and topology optimization offer practical solutions, supported by over 50 studies conducted between 2020 and 2025. To establish 3D printing as a revolutionary paradigm in radiation protection, future research should focus on sustainable biocomposites made from recycled materials, multiscale hierarchical printing to minimize scattering, additive manufacturing in orbit for adaptive space shielding, and artificial intelligence or machine learning algorithms for predictive performance modeling in complex radiation fields.

ID: 013-033

Enhanced SAF Production from Palm and Castor Oils via Selective Deoxygenation and Cracking over Promoted Mn-Based Supported CaO–AC Catalysts

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Abstract. The urgent transition toward Sustainable Aviation Fuel (SAF) demands the development of catalytic systems capable of precise carbon chain management to meet C8–C16 hydrocarbon specifications. This study investigates the catalytic performance of a Manganese-based catalyst supported on a Calcium Oxide and Activated Carbon composite (Mn–X/CaO-AC) for the conversion of triglyceride-based feedstocks. The scope of the research focuses on the performance of this system using two distinct feedstocks: palm oil and castor oil, evaluated under mild reaction conditions of 330 °C and a three-hour reaction time. The methodology utilized a synergistic catalyst design where the CaO–AC support provided necessary basicity and high surface area, while the metal dopant acted as a selective promoter for C–C bond cleavage. Liquid products were analyzed via Gas Chromatography to assess the selectivity toward SAF versus Green Diesel (C15–C18) fractions. Experimental results demonstrated that the Mn–X/CaO-AC catalyst effectively functions as a "chemical scissor," successfully shifting the product distribution away from heavier paraffins toward the aviation-grade carbon range. When utilizing palm oil, the catalyst achieved a total liquid yield of 90.72% with an SAF selectivity of 80.6%. However, the most significant observation occurred with the use of castor oil, which yielded a remarkable 93.0% SAF selectivity and a total liquid yield of 94%. This superior performance with castor oil is attributed to the presence of the hydroxyl group (–OH) at the C12 position of ricinoleic acid. The metal-modified active sites facilitated a "targeted cracking" mechanism at this specific hydroxylated carbon site, allowing for near-complete conversion into the SAF range without over-cracking to light gaseous products. The main conclusion of this work is that the Mn–X/CaO-AC system offers a highly efficient and stable pathway for SAF production, particularly when paired with hydroxylated feedstocks like castor oil. The study provides a novel contribution to the field by demonstrating how metal promotion can be used to tune the cracking-deoxygenation pathway, achieving fuel qualities that satisfy ASTM D1655 aviation standards under energy-efficient conditions.

ID: 038-034

From Waste to Carbon Sink: Potential of Sidoarjo Mud for CO_2 Capture

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Abstract. In recent years, various materials have been developed as carbon capture media for mitigating greenhouse gas emissions, such as biochar and zeolites, characterized by their high surface area and porous structure conducive to CO_2 adsorption. Additionally, mineral-rich sludge waste also holds potential as a carbon adsorbent. Indonesia possesses unique geological material in the form of Sidoarjo mud formed due to an industrial exploration accident, with high mineral content, particularly CaO capable of direct reaction with CO_2 through mineral carbonation mechanisms. In this study, Sidoarjo mud was pyrolyzed at 600°C for 2 hours to enhance surface area and pore formation. CO_2 uptake tests were conducted using the Micromeritics ASAP 2420 instrument. The results indicated that pure mud exhibited an adsorption capacity of approximately 0.11 mmol g^{-1}, whereas pyrolyzed samples showed lower capacities ranging from 0.085 to 0.09 mmol g^{-1}. The pyrolysis process did not enhance CO_2 adsorption performance, likely due to the reduction of mineral-based active sites and surface functional groups during thermal treatment, despite the potential increase in surface area. These findings underscore the crucial role of mineral composition in controlling CO_2 adsorption at low pressures. Overall, raw Sidoarjo mud demonstrates potential as an affordable and sustainable carbon capture material, presenting opportunities for utilizing mineral waste as a greenhouse gas mitigation solution.

ID: 051-036

Physical, Thermal and Tensile Properties of Rotten Sweet Potato Starch-Based Bioplastics Plasticized with Glycerol

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Abstract. The widespread environmental impact of synthetic plastics has intensified the search for biodegradable alternatives, with starch-based bioplastics emerging as a promising solution. This study focused on the development and characterization of bioplastic films derived from rotten orange sweet potato starch, an underutilized agricultural waste biomass, plasticized using glycerol. The feasibility of employing rotten sweet potato starch as a raw material was evaluated, together with the influence of starch concentration and glycerol content on the physicochemical and biodegradation properties of the resulting bioplastics. Starch was extracted from both rotten and fresh sweet potatoes, followed by film preparation using the solution casting method. The bioplastic films were characterized through tensile testing, Fourier Transform Infrared Spectroscopy (FTIR), thermogravimetric analysis (TGA), swelling analysis, and soil burial biodegradability testing. The results demonstrated that formulation parameters significantly affected film behaviour, with an optimum glycerol content of approximately 130 phr and an optimum starch content of approximately 9 g identified. FTIR analysis confirmed the presence of characteristic starch functional groups, indicating physical interactions between starch and glycerol without chemical modification. Thermal analysis revealed typical multi-stage degradation behaviour of starch-based materials, while swelling and biodegradation results indicated high hydrophilicity and excellent biodegradability, with more than 80% weight loss observed within 21 days of soil burial. Overall, the findings confirm that rotten sweet potato starch can serve as a viable and sustainable raw material for bioplastic production, contributing to agricultural waste valorisation and supporting the development of environmentally friendly packaging materials in line with global sustainability goals.

ID: 017-037

Processing Of ANSTO Primary Filtrate Containing Lanthanide Concentration for the Thorium Separation Using D2EHPA

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Abstract. Monazite is a key mineral used in the production of rare earth elements and contains a small percentage of thorium and uranium. As is known to the public, uranium is a main material for fuel in a Nuclear Power Plant (NPP). Thorium, on the other hand, is an alternative to nuclear fuel cycles. In this paper, Thorium nitrate is extracted from the lanthanide concentration. This study focuses on evaluating the efficiency of the extraction of thorium from lanthanide concentration and finding the optimum concentration for D2EHPA. The results of this study highlight the high extraction efficiency, demonstrating the effectiveness of D2EHPA. Specifically in this experiment, the leaching efficiency reached 89.1% while the separation efficiencies were 24.31% for 10% of D2EHPA and 60.54% for 20% of D2EHPA. This research supports the development of thorium-based nuclear fuel by providing an extraction method, while also contributing to future clean energy applications.

ID: 052-038

Zinc Oxide/Reduced-Graphene Oxide-Reinforced Double-Network Hydrogel Electrolyte with Enhanced Conductivity and Tensile Strength

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Abstract. Hydrogel-based supercapacitors have been widely investigated for flexible and wearable energy storage applications due to their softness, stretchability, and biocompatibility. However, conventional hydrogels suffer from weak mechanical strength and poor structural stability, where repeated bending, stretching, and excessive mechanical force can easily damage the polymer network, leading to performance degradation and shortened device lifespan. To overcome these limitations, a mechanically robust double-network (DN) hydrogel electrolyte was developed in this study. The DN hydrogel was fabricated using agarose as the physically cross-linked first network and poly(hydroxyethyl acrylamide-co-acrylic acid) [P(HEAAM-coAA)] as the chemically cross-linked second network via a sequential mixing method, where the polymer matrix and nanofillers were introduced in separate stages before photopolymerization. Zinc oxide (ZnO) and reduced graphene oxide (rGO) were incorporated as functional nanofillers, with rGO enhancing electrical conductivity and ZnO providing mechanical reinforcement. The effects of ZnO/rGO loading, from 1 to 2.5 phr, were investigated using Fourier-Transform Infrared Spectroscopy (FTIR), swelling and gel fraction analysis, tensile performance, and conductivity. The results demonstrated that appropriate ZnO/rGO incorporation significantly improved gel fraction and tensile strength (0.26 ± 0.05 MPa) while maintaining high elongation, indicating enhanced resistance to mechanical damage under repeated deformation and exhibited adequate electrical conductivity (2.6 Sm^{-1}), which supports efficient charge transport. The findings provide a foundation for future studies to optimise nanofiller dispersion and electrochemical performance for practical supercapacitor and flexible energy device applications.

ID: 053-039

Enhanced Performance of Palm Oil Biomass Derived Activated Carbon-Graphite Electrode in Microbial Fuel Cells via Optimization of PVA: PVP Binder Formulation

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Abstract. Microbial fuel cells (MFCs) offer sustainable wastewater treatment and energy generation, but commercialization is hindered by expensive platinum cathodes and the "binder problem" in biomass alternatives, where polymeric binders block pores, insulate conductive particles, and impair mass transport. This study optimizes polyvinyl alcohol (PVA): polyvinylpyrrolidone (PVP) binder ratios for palm oil frond-derived activated carbon-graphite cathodes to enhance performance without costly catalysts. Four formulations (7:3, 6:4, 5:5, 8:2) were coated on carbon cloth, thermally treated at 130°C for 2 hours, and characterized via FTIR, BET, contact angle, and electrochemical impedance spectroscopy (EIS). The optimized 6:4 ratio (F2) achieved the highest surface area (420.76 m^2/g), optimal mesoporosity (7.90 nm), ideal wettability (75.85°), lowest charge-transfer resistance (7.57 Ω), and highest ionic conductivity (2.94×10^{-4} $S \cdot cm^{-1}$); a 46% reduction in resistance and 86% conductivity improvement over the poorest formulation. This innovation proves that strategic binder engineering, not expensive catalysts, unlocks superior performance from biomass electrodes, offering a 40–60% cost reduction over synthetic alternatives. The work delivers a scalable, sustainable cathode fabrication pathway aligned with Malaysia's National Biomass Strategy, transforming agricultural waste into high-value energy materials for MFCs and beyond.

ID: 054-040

Bioplastic from Rotten Cassava Starch Reinforced with Spent Coffee Ground as Filler

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Abstract. The growing environmental issues caused by traditional plastics have led to the creation of biodegradable materials from renewable and waste-based resources. This research investigates bioplastic produced from rotten cassava starch blended with spent coffee grounds (SCG). The bioplastic was prepared via the solution casting technique and subsequently analysed for its biodegradability, swelling behaviour, tensile properties, and thermal stability. Biodegradability was evaluated through soil burial weight loss, while swelling behaviour was assessed using water absorption tests. Mechanical performance was determined by measuring tensile strength and elongation at break, and thermal degradation behaviour was analysed using thermogravimetric analysis (TGA). In addition, Fourier Transform Infrared Spectroscopy with Attenuated Total Reflectance (FTIR-ATR) was conducted on SCG to identify functional groups and confirm its lignocellulosic composition. The effects of SCG content ranging from 0 to 5 Phr starch were investigated. Moderate SCG loading improved tensile strength, whereas excessive filler content reduced mechanical performance due to filler agglomeration. Swelling behaviour decreased with increasing SCG content which indicating enhanced water resistance, while biodegradation rates increased due to the biodegradable nature of SCG. TGA results revealed multi-stage thermal degradation associated with starch and lignocellulosic components. Overall, this study demonstrates the potential of rotten cassava starch and spent coffee grounds for sustainable bioplastic production, supporting SDG Il (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production) through waste valorisation and reduced environmental pollution.

ID: 055-041

Measurement of the Coating Thickness on Carbon Steel Using Ultrasonic Testing Method

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Abstract. Accurate measurement of polymer coating thickness on carbon steel is critical for corrosion prevention. Traditional destructive methods, such as cross-sectional microscopy, compromise the material. This study explores a non-destructive alternative using ultrasonic testing (UT) to determine a correlation between time of flight (ToF) of the ultrasonic wave with the thickness of polyvinyl chloride (PVC) coatings on carbon steel. Using an ultrasonic flaw detector with a 2 MHz transducer, measurements were taken on samples with known thicknesses from 0.2 mm to 2.0 mm. The calculated ultrasonic velocities, however, were inconsistent with the known properties of PVC. Analysis revealed that the long wavelength of the 2 MHz wave relative to the coating thickness prevented a valid measurement, causing the system to detect the steel substrate echo instead. Even though the correlation between ultrasonic velocity and ToF can be shown, the values do not correspond to that of PVC. This identifies a key constraint for industrial application: the ultrasonic probe wavelength must be shorter than the coating thickness for an accurate, viable nondestructive test.

ID: 056-042

Zero Waste Approach to Palm Oil Mill Waste Combustion Engineering

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Abstract. Empty Fruit Bunches (EFB) are the primary biomass residue generated by the palm oil industry, with volumes continuously increasing alongside the global expansion of palm oil production. The utilization of EFB through combustion as an alternative energy source often generates smoke emissions containing fine particulate matter, volatile organic compounds, and tar fractions, which may contribute to air pollution and environmental degradation. This challenge necessitates an engineering approach that not only enhances energy efficiency but also adopts zero-waste principles through systematic and integrated emission control. This study focuses on the development of an equipment-based emission mitigation system through the integration of a condensation unit and a wet scrubber within the EFB combustion process. The condensation unit is designed to reduce flue gas temperature, enabling the separation of condensable components such as water vapor and tar before the gas proceeds to further purification stages. Subsequently, the wet scrubber captures fine particulates and soluble gases through liquid absorption and diffusion mechanisms. System performance was evaluated based on flue gas temperature, smoke opacity, and particulate concentration before and after treatment. The results demonstrate that the integrated condensation–wet scrubber system significantly reduces smoke intensity and particulate concentration without compromising the thermal stability of the combustion process. This approach shows strong potential as an effective, scalable, and zero-waste-oriented technical solution in EFB combustion engineering. Therefore, the developed system supports more environmentally sustainable palm oil waste management practices and aligns with international industrial emission standards.

ID: 049-043

Synthesis of a Biobased Shape Memory Polyester

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Abstract. Shape memory polymers (SMPs) are a class of stimuli-responsive materials that can fix a temporary shape and recover their original form upon thermal activation. In biomedical applications, the ideal transition temperature (TTrans) should be near physiological temperature (37°C) to enable safe, body-triggered actuation. This study focuses on the synthesis of a biobased shape memory polyester via step-growth polycondensation of multifunctional diols, triols, and diacids, followed by thermal and UV curing to form a prepolymer into a crosslinked network. The network architecture systematically varied the molar ratio of linear diol to branched triol (0.3:0.7 to 0.6:0.4), thereby controlling crosslink density and chain packing. Fourier Transform Infrared Spectroscopy (FTIR) analysis showed that the degree of curing (DOC) increased with diol content, reaching a maximum of 91.23% at an optimal 0.5:0.5 ratio, before slightly decreasing at higher diol compositions. Differential Scanning Calorimetry (DSC) revealed that increasing diol content enhanced crystallization and melting temperatures, reflecting improved molecular ordering. All formulations exhibited thermal transition temperatures below 37 °C, enabling effective body-temperature-triggered shape recovery. Gel fraction and swelling ratio analysis confirmed that the optimized formulation achieved the most stable network structure, while the 0.4:0.6 composition exhibited the most balanced shapememory performance, achieving perfect shape fixity and high recovery efficiency at 37 °C. Overall, this work demonstrates that tunable network design in biobased polyesters enables precise control of thermal and shape-memory behavior, highlighting their strong potential for biomedical applications requiring reliable physiological activation.

ID: 057-044

Thermally Calcined Waste Concrete as a High-Performance Adsorbent for Phosphate Removal: Adsorption Isotherm and Kinetic Evaluation

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Abstract. Phosphate (PO_4^{3-}) contamination in municipal wastewater is a critical environmental concern due to its contribution to eutrophication. At the same time, Malaysia faces increasing challenges in managing construction and demolition waste (CDW), particularly waste concrete. This study proposes a sustainable valorization pathway by converting waste concrete into an efficient adsorbent for phosphate removal. Crushed waste concrete was thermally treated at 550 °C to produce calcined crushed waste concrete (CCWC), and its (CWC) adsorption performance was evaluated in batch systems. X-ray fluorescence (XRF) analysis confirmed that calcination enhanced the surface reactivity and increased the content of active oxides, notably magnesium oxide (MgO), calcium oxide (CaO), and aluminium oxide (Al_2O_3), which facilitate phosphate adsorption. Comparative results showed that CCWC achieved 73% PO_4^{3-} removal within 2 hours, significantly higher than raw CWC (21%). Optimization of calcination duration (5–60 minutes) identified 15 minutes as the optimum treatment time. Batch adsorption experiments further evaluated the effects of contact time (1–7 h), particle size (0–2 mm, 2–5 mm, 5–10 mm), adsorbent dosage (1–20 g), and initial phosphate concentration (0.1–15 mg/L). More than 90% removal efficiency was achieved at equilibrium within 5 hours using 10 g of CCWC (2–5 mm) at an initial phosphate concentration of 2 mg/L. Adsorption behaviour was best described by the Langmuir isotherm model (R^2 = 0.9995), indicating monolayer adsorption with a maximum capacity of 29.76 mg/g. Kinetic analysis followed a pseudo-second-order model (R^2 = 0.9932), suggesting that chemisorption governs the adsorption process, preceded by electrostatic interactions. Overall, CCWC demonstrates strong potential as a low-cost and high-efficiency adsorbent for phosphate removal from municipal wastewater. Further investigation on desorption behaviour is recommended to evaluate phosphate recovery potential and support sustainable reuse of this non-renewable material.

ID: 012-045

Thorium Removal from Nuclear-Related Wastewater: Progress in Polymer-Engineered and Biomass-Derived Adsorbents

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Abstract. Wastewater containing thorium generated from nuclear fuel cycle operations, ore processing, and mining activities poses significant risks to human health and the environment due to its radiotoxicity and persistence. Although adsorption has been widely investigated for thorium removal, current approaches are often limited by poor selectivity in multi-component systems, insufficient long-term stability, and limited scalability for industrial deployment. Consequently, there is a pressing need to develop advanced, high-performance adsorptive materials compatible with nuclear wastewater treatment infrastructure. This review critically examines recent advances in thorium removal technologies, with a particular focus on ionimprinted polymers, surface grafting, and irradiation-assisted modification techniques using oil palm empty fruit bunch (EFB) biomass as a sustainable substrate. Peer-reviewed articles were systematically collected from major scientific databases and evaluated based on predefined inclusion and performance criteria. The analysis shows that engineered polymer-based and hybrid adsorbents, especially ion-imprinted and radiation-grafted systems, demonstrate superior adsorption capacity, selectivity, and stability in complex aqueous matrices. In addition, when combined with advanced surface functionalization strategies, biomass-derived materials offer improved regeneration performance, cost efficiency, and environmental sustainability. Overall, this review identifies key technological gaps, including scale-up challenges, regeneration efficiency, and real wastewater validation, and highlights future research priorities for the development of robust and sustainable adsorptive systems. The findings support the development of efficient thorium-removal technologies to enhance safety in nuclear energy production and long-term environmental protection.

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An IoT-Integrated Photobioreactor for Enhanced Carbon Capture and Biomass Production in Microalgae-Based Aquaculture

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Abstract. Global food production systems are major contributors to greenhouse gas emissions and environmental degradation, thereby accelerating climate change and increasing the global carbon footprint. Sustainable, low-carbon production strategies are urgently needed to mitigate these impacts while meeting growing food demand. Microalgae represent a promising climatesmart solution due to their high photosynthetic efficiency, rapid biomass productivity, and strong carbon dioxide (CO_2) sequestration capacity. Unlike conventional agriculture, microalgae cultivation does not require arable land and can utilize wastewater or non-potable water, thereby reducing resource competition and environmental pressure. This study presents the design and development of an Internet of Things (IoT)-enabled photobioreactor for carbonconscious aquaculture, aimed at optimizing microalgae cultivation for enhanced CO_2 capture and biomass production. The system integrates a network of environmental sensors connected to an ESP32 microcontroller to continuously monitor key parameters affecting carbon fixation efficiency, including temperature, pH, dissolved oxygen, dissolved CO_2, turbidity, and salinity. Real-time data are transmitted via Wi-Fi to a cloud-based IoT platform for visualization, analysis, and remote system management. A Real-Time Clock (RTC) module ensures synchronized sampling intervals and supports automated system calibration. By enabling precise environmental monitoring, adaptive control, and early detection of suboptimal growth conditions, the proposed smart photobioreactor enhances photosynthetic performance and CO_2 assimilation while minimizing energy and resource consumption. The integration of datadriven monitoring with microalgae cultivation provides a scalable and sustainable pathway for reducing carbon emissions in aquaculture and food production systems, contributing to carbon neutrality and long-term climate resilience.

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Integrated Renewable–Electrolyser Systems for Green Hydrogen: A Quantitative Review

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Abstract. Hydrogen is increasingly recognised as a critical energy carrier in the pursuit of deep decarbonization, yet its classification and assessment remain inconsistent across the literature. Differential use of colour-based terminology, alongside system boundaries and technoeconomic assumptions, often makes direct comparisons between the different production pathways difficult. This review fills the gap in these inconsistencies by providing a structural and quantitative synthesis of hydrogen production routes, clarifying both colour-based and process-based classifications, and aligning life-cycle and performance metrics under consistent assumptions. Alkaline electrolysis operates at efficiencies from 62 to 70% on an HHV basis; PEM systems range from 60 to 68%, and SOECs, when high-temperature heat is well integrated, operate at 75 to 85%. Green hydrogen is commonly produced at $3-$6 USD/kg and $20-$60 USD/MWh for electricity, with levelized costs, using renewable electricity with representative capacity factors of 18-25% for solar PV and 30-60% for wind. Modelling these integrated renewable-SOEC systems with TES suggests additional benefits of 8-15% lower electrical demand, up to 12% higher efficiency, and 5-18% lower LCOH compared to non-integrated designs. Life-cycle assessment shows that the process can achieve reductions of 80-95% in carbon emissions compared with conventional steam methane reforming, depending on the grid intensity and boundary definition. Overall, this review provides a clear framework for technology selection, system optimisation, and further research into the large-scale, sustainable deployment of green hydrogen.

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Low Temperature Cracking and Leaching Study of Monazite with Sulfuric Acid for Thorium Recovery

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Abstract. Thorium is an alternative to replace the uranium fuel source. This study focuses on the investigation of low-temperature cracking and leaching behaviour of monazite using sulfuric acid to enhance thorium recovery. Monazite, a rare earth phosphate mineral, is a significant source of thorium and rare earth elements (REEs). In this research, monazite samples treated with 98% of concentrated sulfuric acid under controlled low-temperature ranges from 200 C to 240 °C for 3 hours conditions to assess the efficiency of thorium dissolution and leaching solution continued stirred at 400RPM speed for 2 hours with 6.5 mg/l of distilled water ratio. The lechated solution filtrated to obtained primary filtrate and residue. The primary filtrate then diluted with 1% of nitric acid (HNO3). Then, the first solution diluted again with 1% of nitric acid to reduces the viscosity and allowing the aqueous leachate to mix more effectively before send to analysis. The effects of temperature and solid-to-liquid ratio on leaching efficiency. That substantial thorium recovery can be achieved at temperatures ranges from 200 C to 240 °C, with optimized parameters improving leaching performance. This study offers a simpler and more affordable way to extract thorium, which could be useful for developing nuclear fuel and processing rare earth materials.

ID: 042-049

Review of Lifecycle Assessment Approach for Integration of Oscillating Water Columns with Marine Structures in Malaysia

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Abstract. This review examines the Life Cycle Assessment (LCA) of Oscillating Water Column (OWC) wave energy converters for integration with coastal and offshore marine structures in Malaysia. Evaluation of the carbon footprint as well as broader environmental impacts to align with low-carbon coastal infrastructure and island electrification is the main motivation of the paper. The paper surveys existing OWC and wave energy LCAs to identify common system boundaries, functional units, impact categories, data gaps, and methodological choices that drive result variability. The study maps the findings onto the specific techno-environmental context of Malaysian coastal deployments including wave climate, logistics, material supply chains, and island or offshore energy needs. Methodologically, the review synthesises cradle-to-grave and cradle-to-gate LCA practices, which discusses inventory sources, and outlines harmonised modelling choices utilizing functional units of kg CO_2-eq/kWh per structure lifetime. Key findings indicate that structural materials and manufacturing dominate life cycle impacts for OWC-integrated marine structures, while site capacity factor, device reliability, and end-of-life recycling strongly influence carbon intensity and payback periods. Integrating OWCs with coastal protection (breakwaters, port structures) and multi-use offshore platforms (aquaculture, decommissioned oil-platform repowering) can materially improve system-level sustainability by sharing infrastructure and reducing incremental material demands. The review proposes a Malaysia-tailored LCA framework that incorporates marine ecosystem impact indicators, logistics and installation emissions, O&M scenarios, and end-of-life recycling pathways, and it recommends coupling LCA with techno-economic analysis to inform policy and industry decisions for low-carbon transition of coastal and offshore energy hubs.

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Assessing Piper Seneca II Platform Wing Based on Aerodynamic Performance in Indonesia Pilot Civil Academy Banyuwangi

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Abstract. The choice of wing design is a fundamental aspect in selecting an aircraft as it affects various factors related to overall performance of the aircraft. Vorticity is one of the consequences of the choice of wing shape, which impacts the fluid flow over the upper surface of the wing. Although vorticity cannot be eliminated, it can be minimized to achieve optimal conditions on the wing. This research uses a Piper Seneca II wing with a NACA 65(2)-415 airfoil and investigating 12 distinct of angles of attack. This numerical simulation applies the realizable k-ε turbulence model with three observed configurations: plain wing, elliptical, and Schuemann. The research findings indicate that wing shape significantly influences the lift-to-drag ratio, the separation pattern on the upper surface of the wing, and the vorticity pattern behind the trailing edge of the wing. The Schuemann wing has the highest lift coefficient value at angles of attack α = 10° - 12° and also has the best stall angle of attack at α = 12°. The separation growth for each planform shows different patterns in the midspan and wingtip areas. In the wingtip region, the development of vorticity is influenced by the tip vortex phenomenon, which makes the vortex behind the wing larger compared to other areas. The size of the tip vortex is also affected by significant separation processes that impact its growth rate and evolution.

ID: 065-051

Aspen Plus Simulation and Experimental Evaluation of Pysicochemical Properties of Diol-Gasoline Blends

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Abstract. This study investigates the feasibility of diol-based oxygenated additives for enhancing gasoline fuel properties using an integrated computational-experimental approach. Commercial Malaysian RON95 gasoline was used as the base fuel to reflect realistic fuel conditions, addressing limitations in previous studies that relied on idealized gasoline surrogates. Aspen Plus simulation was employed to predict miscibility, phase behaviour and key physicochemical properties of gasoline blended with ethanol, solketal, propylene glycol and 2,3-butanediol at concentrations ranging from 1 to 5 vol%, using NRTL and UNIFAC thermodynamic models. Simulation results indicated that ethanol-gasoline and solketal-gasoline blends exhibited complete miscibility, while propylene glycol and 2,3-butanediol showed phase separation, which was subsequently confirmed through experimental stability tests. Experimental characterization of miscible blends focused on turbidity, density, viscosity, calorific value and stoichiometric air–fuel ratio (AFR). Results revealed that increasing additive concentration led to higher density and viscosity, while calorific value decreased relative to pure gasoline due to increased oxygen content. Combined ethanol-solketal blends demonstrated improved phase stability, moderate viscosity and AFR values closer to conventional gasoline, indicating favourable combustion compatibility. The close agreement between Aspen Plus predictions and experimental observations validates the use of thermodynamic simulation as an effective screening tool for fuel formulation. Overall, the findings highlight solketal, particularly in combination with ethanol, as a promising oxygenated additive for commercial gasoline, offering a balance between fuel stability, combustion characteristics and engine compatibility for spark ignition and aviation piston engine applications.

ID: 063-052

Deacidification of Diesel Through Extraction of Naphthenic Acid Using Betaine-Based Deep Eutectic Solvents

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Abstract. Naphthenic acids (NAs) present in crude oil pose significant challenges to the petroleum industry due to their corrosive nature, leading to increased maintenance costs and damage to refinery equipment. Traditional methods for NA removal, such as caustic washing, often face limitations in efficiency and environmental impact. While ionic liquids have shown promising extraction capabilities, their high cost and potential toxicity highlight the need for safer, more sustainable alternatives. This study investigates the use of Betaine-based Deep Eutectic Solvents (DESs) as a potential solution for NA removal from model oil systems. In these DESs, Betaine serves as the hydrogen bond acceptor (HBA), while ethylene glycol, phenol, thymol, and guaiacol function as the hydrogen bond donors (HBDs). The chemical structures of the DESs were confirmed through FTIR analysis. Viscosity plays a crucial role in the performance of Betaine-based DESs, with Betaine: Thymol showing the highest extraction efficiency due to its stronger hydrogen bonding network, while Betaine: Guaiacol's lower viscosity and weaker bonding result in lower extraction efficiency. Overall, Betaine-based DESs show significant potential as green and effective extractants for NA removal, providing a sustainable solution to mitigate corrosion problems in the petroleum industry, while offering an environmentally friendly alternative to conventional extraction methods.

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Carbon Dioxide Capture Using Amino Acid-Based Deep Eutectic Solvent (AADES)

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Abstract. This study focuses on the preparation, characterization, and carbon dioxide (CO_2) capture performance of amino acid-based deep eutectic solvents (AADES), specifically Betaine–EG–Urea, Betaine–Glycerol–Urea, Betaine–EG–MEA, and Betaine–Glycerol–MEA mixtures. These AADES formulations were synthesized through a green and simple heating method, followed by structural confirmation using Fourier Transform Infrared Spectroscopy (FTIR). Toxicity was evaluated via antimicrobial testing using Escherichia coli, and CO_2 absorption performance was measured using a rotating disc contactor (RDC) coupled with gas chromatography (GC). The results demonstrated that AADES exhibit low toxicity and effective CO_2 absorption through both physical dissolution and chemical interaction mechanisms, including carbamate formation. Key operational parameters such as solvent composition, molar ratio, temperature, viscosity, and contact time were identified as critical factors influencing absorption efficiency. Among the tested formulations, Betaine–Glycerol–Urea showed the best overall CO_2 absorption performance. This superior behaviour is attributed to the strong hydrogen-bonding network formed between betaine, glycerol, and urea, which enhances CO_2 solubility while maintaining low toxicity and good solvent stability. The multiple interaction sites provided by hydroxyl (–OH) and amide (–NH) groups promote physical absorption and intermolecular interactions with CO_2, leading to higher uptake compared to the MEA-based systems. In addition, the glycerol component contributes to improved structural stability of the DES matrix, allowing sustained absorption capacity throughout the contact period. The optimal operating conditions observed in this study correspond to lower operating pressure (0.5–1 bar), longer contact time up to 25 min, and increased solvent volume (60 mL), which collectively maximize available interaction sites and mass transfer efficiency. Under these conditions, the Betaine–Glycerol–Urea system consistently exhibited the highest absorption capacity among the tested solvents. Overall, this research highlights AADES as promising green solvents with potential industrial applications in sustainable CO_2 capture technologies, offering an environmentally friendly and cost-effective alternative to conventional amine-based solvents.

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Comparative Phase Stability of Methanol and Hexylene Glycol in AVGAS 100LL Gasoline

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Abstract. Methanol represents a promising low-carbon alternative fuel; however, its application is frequently hindered by severe phase separation issues, particularly in non-polar, iso-alkane-rich hydrocarbon environments. This study evaluates the solubility limits of Hexylene Glycol (2-methyl-2,4-pentanediol) as a superior alternative oxygenate, using Methanol as a comparative benchmark. To rigorously test thermodynamic stability, Aviation Gasoline (AVGAS 100LL) was selected as the solvent matrix due to its low aromatic content and high paraffinic nature, representing a "worst-case" scenario for polar solubility. Binary blends ranging from 5% to 20% (v/v) were tested using a modified ASTM D6422 apparatus to determine critical phase separation temperatures (Tps). Results indicated a fundamental divergence in solubility behavior. Methanol exhibited severe immiscibility, with Tps increasing monotonically from 28°C to 52°C as concentration increased, confirming the need for significant co-solvent intervention. In contrast, Hexylene Glycol demonstrated an "inverted" stability profile: increasing the concentration from 5% to 20% improved miscibility, lowering the Tps from 12°C to -4°C. These findings suggest that the branched, amphiphilic structure of Hexylene Glycol allows it to function as a self-stabilizing agent, bridging the polarity gap in paraffinic fuels and offering a viable solution to the stratification risks associated with traditional alcohol blending.

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A Brief Review of Rare Earth Elements (REEs) and Applications in Sustainable Energy

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Abstract. A group of 17 metallic elements, known as the rare earth elements (REEs), is highly sought after worldwide due to its continuous demand in clean energy technology, electronics, and defence. The word “rare” does not necessarily indicate low crustal abundance, but it refers to a concentration that is not sufficiently concentrated for economic mining. These critical elements have almost similar chemical behaviour, which makes them complex and challenging for separation and purification into individual elements. Other than bastnaesite, eudialyte, monazite and xenotime minerals, REEs can be extracted from ion-adsorption clay (IAC). Malaysia is one of the few countries that is blessed to inherit various mineral deposits like IAC, which is estimated at around 16 million tonnes of total rare earth elements (TREEs). However, having abundant REE resources does not guarantee national wealth if these resources are not processed into individual elements. For many years, China has remained the undisputed king of REEs, which controls the global REE production almost 70% and prices by leading in the mining and processing industry, roughly 90%. Even more painful, to date, China has firmly banned its REE separation technology export to the world. Therefore, relying on this technology beyond any doubt hinders the potential of these critical metals to be exploited, especially in some resource-rich countries of REEs. Recently, Malaysia has also transitioned its goal toward REE mining, focusing on IAC deposits as the main resource for economic growth. Thus, this paper briefly introduces the members of REEs, their discovery history and characteristics. The REEs production globally is also included by highlighting the most demanding elements among the REEs. Moreover, the REEs applications, including the permanent magnets, catalysts, displays, ceramics, batteries and electronics were discussed. The perspective of Malaysia on the importance of REEs emphasises the research and development reviewed in this paper.

ID: 032-057

Simulation-Based Risk Analysis of Hydrogen Release Scenarios in Hydrogen Refueling Station

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Abstract. Hydrogen fuel cell vehicle (HFCV) adoption is accelerating globally, increasing the demand for safe and efficient hydrogen refueling stations (HRS). However, most international safety standards for HRS are developed under temperate environmental assumptions, raising concerns about their applicability in tropical regions such as Malaysia. This study performs a Quantitative Risk Assessment (QRA) based on consequence analysis and probability analysis on hydrogen leakage scenarios at refueling station layout based on Malaysia tropical temperature. The analysis integrates HyRAM, a simulation tool developed by Sandia National Laboratories, to perform consequence analysis for plume dispersion, jet flame development and heat radiation effects under varying leak hole diameters, operating pressure and wind condition. The simulations were conducted to evaluate how environmental factors influence hydrogen behaviour and the extent of flammable and thermal impact zones. For probability analysis FN curves and failure frequency data was simulated using RISKCURVE software to illustrate the societal risk potential of selected failure scenarios. This study integrates HyRAM and RISKCURVE simulations for tropical HRS, revealing that leak diameter and operating pressure under tropical conditions were dominant factors that influence hazard extent. The larger leak diameter at highest pressure produced flammable zones and thermal radiation surpassing minimum separation distances by international standard. Probability analysis revealed that confined spaces such as station rooms carry the highest individual risk of 2.56×10^{-5} fatalities/year compared to open space. For the cumulative fatalities shows that scenarios falling within the acceptable threshold limit and the number of fatalities per year less than 10. These findings highlight the urgent need to adapt hydrogen safety standards for tropical environments, ensuring safe, sustainable, and resilient deployment of hydrogen infrastructure in Malaysia and beyond.

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TRIGA Fuel Element Source Term and Decay Heat Prediction

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Abstract. The management of spent nuclear fuel is a critical aspect of nuclear energy production which requiring accurate decay heat power estimation to ensure safety and operational efficiency. However. the traditional methods often fall short due to their inability to account for complex interactions within the fuel and its environment and resulting in significant uncertainties. This study aimed to develop a computational MCNP model for TRIGA fuel elements, determine the decay heat for uranium weights of 8.5 wt%, 12 wt%, and 20 wt%, and analyse decay heat across air, water, concrete and lead as storage mediums. The methodology involved simulating the segmented TRIGA fuel rod into three axial sections, top (M5), middle (M6), and bottom (M7), over 13 times steps from 0 days to 10 years in the four different mediums. Parameters such as gamma strength, burn-up rate and decay heat were evaluated. The results showed that the middle section of the fuel rod at 12 wt% uranium weight exhibited the highest gamma strength with values such as 6.98E+14 γ/s for Iodine-135 at 0 days and 4.70E+11 γ/s for Cesium-137 at 10 years. Lead was identified as the optimum medium for decay heat management which retaining the highest decay heat at 6.824 cm and diminished at greater distances with 0.0 W at 21.824 cm and beyond after 5 and 10 years. This study provides essential knowledge into spent fuel management and contributing to the safe handling of nuclear waste. The findings will support future plans including the decommissioning of the RTP while enhancing the understanding storage medium optimization.

ID: 069-059

Determination the effect of Nickel Loading on Oil Palm Ash–Supported Catalyst for Polyethylene Pyrolysis by Thermogravimetric Analysis

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Abstract. The increasing accumulation of polyethylene (PE) waste poses serious environmental challenges while offering potential as an alternative hydrocarbon resource. Catalytic pyrolysis has emerged as a promising approach to improve PE thermal degradation. However, catalyst formulation, particularly in. metal loading, plays a crucial role in determining decomposition behaviour. The objective of this paper is to investigate the effect of nickel loading on oil palm ash (OPA)-supported catalysts for a pyrolysis of municipal polyethylene via thermogravimetric analysis (TGA). Non-catalytic PE pyrolysis was compared with catalytic systems containing 5, 10, and 20 wt% of Ni/OPA. The TGA was done from 25□C to 900 □C. The TG results indicate that the incorporation of Ni/OPA significantly influenced the thermal degradation of PE. A pronounced reduction in degradation onset temperature was observed with 5 wt% Ni/OPA, suggesting enhanced catalytic activity and earlier initiation of polymer chain scission. In contrast, increasing the nickel loading to 10 and 20 wt% resulted in degradation profiles closer to that of non-catalytic PE, indicating that diminishing catalytic benefits at higher metal content. The DTG analysis further revealed that PE degraded in the presence of 5 wt% Ni/OPA exhibited a broader degradation peak at lower temperatures, reflecting stronger polymer–catalyst interaction and more gradual cracking behaviour. However, higher nickel loadings did not demonstrate similar effects, likely due to reduced accessibility of active sites caused by metal agglomeration or pore blockage on the OPA support. Overall, the findings demonstrate that TGA is an effective screening tool for identifying suitable metal loading in supported catalysts and highlight the potential of low nickel loading Ni/OPA systems for more energy-efficient plastic waste conversion.

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A Study of Ca/OPA Catalyst in Polyethylene and Polystyrene Pyrolysis

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Abstract. Traditional waste management methods involving garbage disposal and burning are less effective because they affect the ecosystem and the environment. Therefore, catalytic pyrolysis has provided an alternative method to manage plastic waste as it can increase the economy and benefit the environment. The objectives of this research are to study the physicochemical properties of the Ca/OPA catalyst and elucidate the Ca/OPA's effect on polyethylene (PE) and polystyrene (PS) pyrolysis product yields and product composition. The catalyst that contains 10 wt% of calcium and 90 wt% of the calcined palm oil ash was synthesized via wet impregnation and tested in a batch pyrolyser reactor system with a sample-to-catalyst weight ratio of 10:0 and 10:1. The liquid product yield was determined, and the liquid product was characterized. At the same temperature, it is found that 16% and 3.26% of liquid product yield were obtained when PS and PE were pyrolysed without a catalyst, respectively. When Ca/OPA was used, 58.81% and 20.62% of liquid product yield were achieved when PS and PE were pyrolysed, respectively. The density of the liquid product of PS pyrolysis was obtained at 0.83–0.86 g/mL, which lies in the range of commercial diesel, while 0.97–1.03 g/mL of liquid product density of PE pyrolysis was obtained. The higher heating value (HHV) of the liquid product of PS pyrolysis was 45.46 MJ/kg, and 39.23 MJ/kg of the liquid product's HHV was obtained when PE was pyrolysed. This indicates that the liquid product of PS pyrolysis shares similar properties with conventional fuels such as diesel (45.6 MJ/kg) and gasoline (46.4 MJ/kg). It can be seen that the presence of functional groups, such as aromatics, indicates that the catalyst enhances the production of light hydrocarbons in the diesel range (C5–C9) while reducing the heavier fractions (>C20). In conclusion, Ca/OPA successfully enhances the catalytic pyrolysis process by increasing the liquid oil yield for both PE and PS plastic waste pyrolysis.

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Corrosion Inhibitor Performance of Functionalized Amide-Based Compounds on Mild Steel in 1 M HCl at Elevated Temperatures

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Abstract. Corrosion of mild steel in acidic environments remains a major issue in energy and process industries, particularly in high-temperature operations such as oil and gas production and acid cleaning. Most conventional inhibitors lose effectiveness at elevated temperatures due to weak adsorption and limited thermal stability, underscoring the need for more robust, sustainable alternatives. This study evaluates the corrosion inhibition performance of functionalized amide-based compounds for mild steel in 1 M HCl, examining the effects of different concentrations (300-1200 ppm) and temperatures (25-80 °C) using the weight loss method. Surface characterization by FTIR and SEM-EDX was conducted to investigate adsorption behaviour and protective film formation. The results show that corrosion rates increased significantly with temperature in the uninhibited system, whereas increasing inhibitor concentration enhanced protection efficiency. Among the tested compounds, oleic acid diethanolamine (OADA) showed superior performance, reducing the corrosion rate from 154.64 mmpy (blank) to 18.00 mmpy at 25 °C and achieving up to 87% efficiency at 80 °C. Surface analysis confirmed the formation of a compact, thermally stable protective film attributed to the presence of amide and hydroxyl groups. Overall, the results showed that functionalized amide-based inhibitors demonstrate strong potential for corrosion protection under acidic conditions at elevated temperatures.

ID: 070-062

Effect of Polyalphaolefin (PAO) Molecular Weight on the Physicochemical and Sealing Performance of Synthetic Valve Sealant

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Abstract. Industrial valve sealants must maintain sealing performance under severe operating conditions involving pressure fluctuations, temperature variations, and corrosive environments, where conventional mineral oil–based sealants often exhibit limited thermal and oxidative stability. This study investigates the influence of polyalphaolefin (PAO) base oil molecular weight on the physicochemical, thermal, tribological, and corrosion protection performance of synthetic valve sealants formulated with low molecular weight (PAO-40) and high molecular weight (PAO-100). The sealant was prepared using a saponification process with lithium 12- hydroxystearate thickener and an identical additive. Flow behaviour was evaluated through density and viscosity measurements, while chemical structure and thermal stability were characterised using Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA). Tribological performance was examined using a Four- Ball Wear Test, and corrosion resistance was evaluated through Weight Loss Testing in 1M HCl, supported by Scanning Electron Microscopy (SEM). The formulated sealants exhibited lower density (0.9728–0.9877 g/cm³) and lower viscosity (145,355.6–147,198.2 cP) than the commercial grease (1.0057 g/cm³ and 152,257.4 cP) which indicates lower internal resistance and enhanced flow characteristics that are favourable for valve sealing applications. Thermogravimetric analysis showed that PAO-100 provided higher thermal stability than PAO-40 due to stronger intermolecular interactions which delayed thermal degradation. Meanwhile, corrosion inhibition efficiencies of the formulated sealant ranged from 86.59% to 98.14% exceeding the performance of the commercial sealant (94.21%). The Four- Ball Wear Test revealed that PAO100 (65%) achieved the lowest coefficient of friction due to improved lubricant mobility and additive transport. Overall, the results show that base oil molecular weight strongly affects sealant performance, and in this study PAO-100 is a promising base oil for high-performance valve sealants.

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Effect of Magnetization and Deep Eutectic Solvent Functionalization on Spent Coffee Ground Biochar for Enhanced CO_2 Capture

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Abstract. This study explores how different modification methods affect the physicochemical properties and CO_2 adsorption performance of biochar produced from spent coffee grounds (SCG). The biochar was synthesized by pyrolysis at 500 °C and then modified using magnetization and deep eutectic solvent functionalization. The samples were labelled as BC500 for unmodified biochar, BC500:D1 to BC500:D3 for DES modified biochar at ratios of 1:1, 1:2, and 1:3, respectively, and BC500:MgA and BC500:MgN for magnetized biochar prepared using magnesium acetate and magnesium nitrate. The best single modified biochar was further treated with combined magnetization and DES modification, resulting in the double modified biochar BC500:MgAD3. Characterization results confirmed that surface chemistry and porosity were altered by modification, which directly affected adsorption behaviour. Among all samples, BC500:D3 achieved the highest CO_2 uptake of 4.73 mmol g^{-1} at 25 °C and 2.5 bar, exceeding BC500:MgA (4.29 mmol g^{-1}) and BC500 (4.15 mmol g^{-1}). The adsorption capacity followed the order BC500:D3 > BC500:MgA > BC500 > BC500:MgAD3 > BC500:D2 > BC500:D1 > BC500:MgN. The enhanced performance of BC500:D3 is attributed to nitrogen enriched functional groups introduced during DES treatment that increased CO_2 affinity. Magnesium acetate modification also improved adsorption through formation of magnesium oxide species that promoted chemisorption and marginally increased surface area. In contrast, BC500:MgAD3 exhibited reduced uptake (4.03 mmol g^{-1}), suggesting pore blockage resulting from sequential modification. In term of BET surface area, BC500:MgA exhibited the highest (4.3964 m2 /g) compared to unmodified biochar (4.3200 m2 /g) which showing that magnesium acetate increases surface roughness. The surface morphology of BC500:MgA showed the significant larger holes joined with thin walls. Overall, the findings demonstrate that optimized single modification, particularly DES functionalization at a 1:3 ratio, significantly enhances CO_2 adsorption of SCG derived biochar, highlighting its potential as a sustainable and low cost adsorbent for carbon capture applications.

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Quantitative Risk Assessment (QRA) of Accidental Ammonia Release from Fuel Storage Tank to Humans and Environment on Ammonia-Fueled Ship

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Abstract. This research investigates the quantitative risk assessment of accidental ammonia release from onboard fuel storage tanks on ammonia-fueled ships under varied operational conditions. Using ALOHA software, nine (9) leak scenarios were simulated to evaluate toxic dispersion distances and thermal radiation impacts, particularly on human health and cargo ship environment. RISKCURVES software was applied to integrate these physical consequences with estimated failure frequencies to evaluate individual risk (IR) distributions as well as societal risk. Meteorological data of Port Klang using Windfinder was adopted to simulate the consequences analysis for both stationary and in-transit vessel states using a generic medium-sized cargo ship model. Results indicate that stagnant ship conditions and nighttime atmospheric stability significantly increased the downwind toxic exposure zones over 10 km, while catastrophic leaks from semi pressurized tanks showed more severe consequences than fully refrigerated ones. BLEVE scenarios demonstrate critical localized heat hazards, giving 8.0 psi overpressure, which causes the fatality threat over 0.4 kilometers. RISKCURVES analysis revealed that high-frequency medium leaks for Scenario 4 (S4) gave significant risk for onboard personnel, while societal risk shows all scenarios fall within the acceptable range. These findings provide essential insights for the safe implementation of ammonia as a maritime fuel and contribute to future quantitative risk assessments.

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Atmospheric Trajectory Analysis of Iodine-131 and Caesium-137 from Proposed Nuclear Power Plant Site in Singapore

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Abstract. Countries in the ASEAN region is actively pursuing the development of nuclear energy, including Singapore. Early atmospheric trajectories analysis is significantly important to thoroughly prepare the surrounding nations in the event of a nuclear accident ever occurs. With the supposition that Singapore wants to build a Nuclear Power Plant (NPP), it is significant to make the evaluation of the hypothetical incident at the proposed NPP to estimate the radiological effects to the main cities in Malaysia. The objectives of this study were to determine the atmospheric trajectories of radioactive Iodine-131 and Caesium-137 from the proposed NPP sites in Tekong Island, Singapore. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) modelling software was used to simulate the trajectory and estimate the effective dose from the postulated event. The meteorological data input are wind direction and speed for year 2021 extracted from NOAA, and the concentration of the radionuclides from Fukushima accident in 2011. The results show that in the months of April until October, the trajectories are shown to be traveling directly from Singapore towards Malaysia, and the remaining months showed otherwise. The maximum reading of ground deposition and air concentration are 7.6×10^{8} Bq/m^2 and 2.6×10^{5} Bq/m^3 respectively. The maximum effective dose rate that is calculated based on the air concentration and ground deposition are 1.38×10^{2} mSv/yr and 4.37×10^{2} mSv/yr respectively.

ID: 073-071

The Effect of Catalysts on Esterification of Pyrolysis Oil From Spent Coffee Ground on Acidity Reduction and Storage Stability

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Abstract. The objective of this study is to reduce the acid content of pyrolysis oil derived from spent coffee grounds (SCG) through an esterification process using Ni/HZSM-5 as a solid catalyst, with sulphuric acid (H_2SO_4) and hydrochloric acid (HCl) employed as liquid acid catalysts for comparison. Esterification was carried out using ethanol as the alcohol agent at a fixed pyrolysis oil to ethanol ratio under different catalyst loadings of 1, 3 and 5 wt%. The effectiveness of acid reduction and product stability were evaluated based on pH measurements before esterification, after esterification and during short-term storage. The results show that liquid acid catalysts produced a lower initial pH compared to the solid catalyst, with H_2SO_4 exhibiting the strongest acidity which ranged from 3.72 to 4.82, followed by HCl which ranged from 5.10 to 5.33 while Ni/HZSM-5 remained near neutral before reaction which approximately 6.14 to 6.15. After esterification, HCl and Ni/HZSM-5 showed moderate pH reduction, whereas H_2SO_4 maintained a consistently low pH due to its strong acid nature. During storage, HCl samples experienced the largest pH decline due to the larger slope indicating poorer storage stability, while H_2SO_4 showed limited pH variation or small pH change but remained highly acidic. In contrast, Ni/HZSM-5, particularly at 3 wt% to 5 wt%, exhibited the smallest pH decrease during storage, indicating improved stability. In conclusion, although liquid acids promote stronger acidity, Ni/HZSM-5 provides better control of acid reduction and superior short-term storage stability. The solid catalyst limits excessive acidity while promoting esterification, making it more suitable for bio-oil upgrading compared to HCl and H_2SO_4.

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