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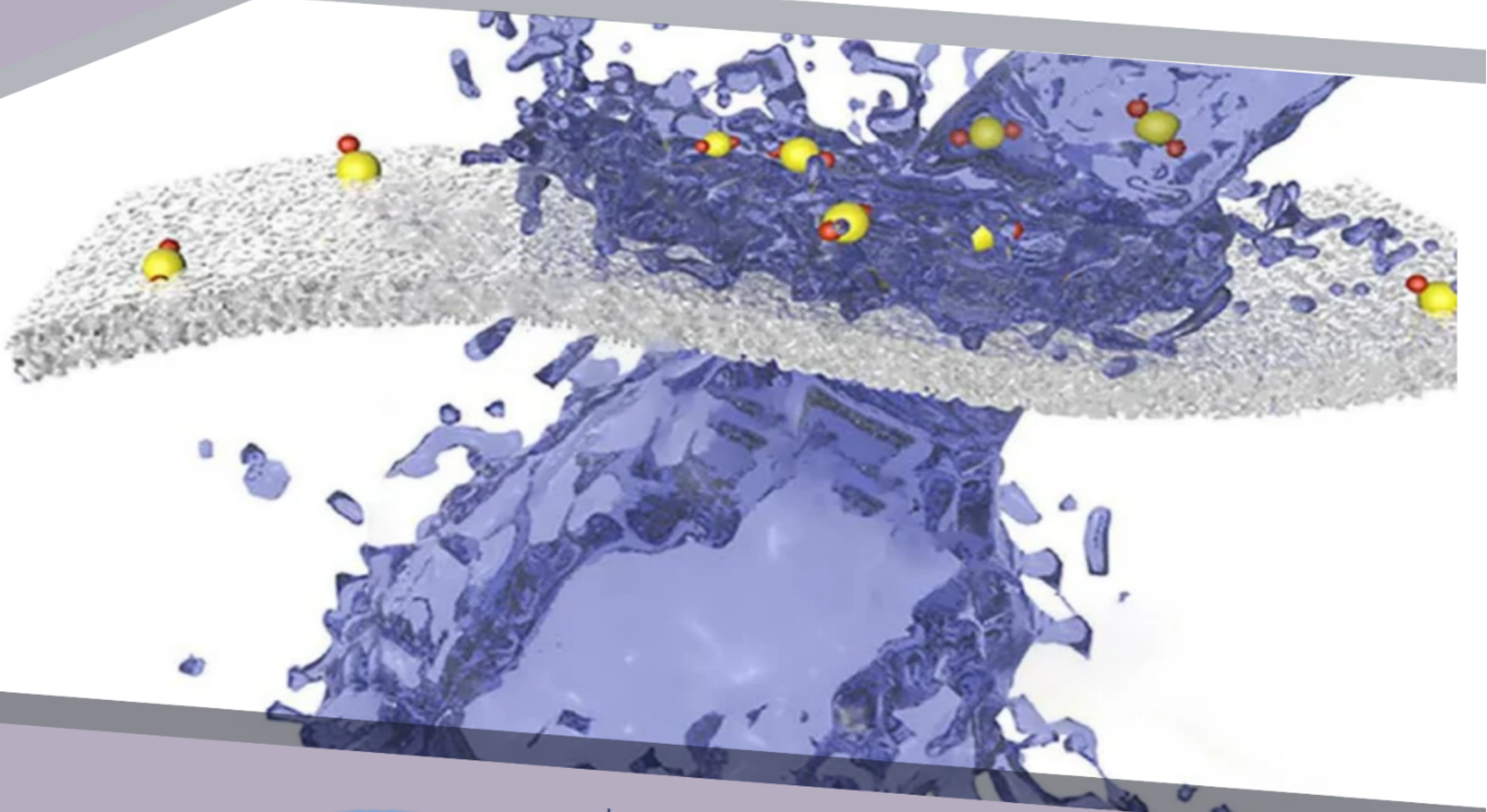
AMTEC
Advanced Membrane Technology Research Centre

ABSTRACT BOOK

2024



REGIONAL CONGRESS ON MEMBRANE TECHNOLOGY

RCOM 2024

30 Sept - 1 Oct 2024 I Impiana Hotel, Johor Bahru, Malaysia

Regional Congress on Membrane Technology
Organized by Advanced Membrane Technology Research Centre (AMTEC)

Published by:
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FOREWORD

PROF. DATUK IR. TS. DR. AHMAD FAUZI ISMAIL
Vice Chancellor
Universiti Teknologi Malaysia

Assalamualaikum warahmatullahi wabarakatuh
Alhamdulillah, with the grace of Allah Subhanahu Wa Ta'ala, we are gathered here, for the Regional Congress on Membrane Technology (RCOM) 2024.

It is my great pleasure to extend a warm welcome to all of you here in Johor Bahru. I am proud to acknowledge that the Advanced Membrane Technology Research Centre (AMTEC), a key research centre within UTM, in collaboration with the Frontiers Material Research Alliance (FMRA), is honoured to co-host this prestigious event. I would like to extend my heartfelt congratulations to the organizing committee, led by Assoc. Prof. Ts. Dr. Norhaniza Yusof, for their outstanding efforts in making this event a reality. This year's congress places strong emphasis on advancing the Sustainable Development Goals (SDGs), particularly in the areas of energy and water technologies. It is through such initiatives that we continue to explore innovative strategies that drive future research and industrial advancements. UTM wholeheartedly supports and encourages research and development efforts in these crucial fields.

As one of Malaysia's top institutions for technology and engineering, UTM takes pride in our active involvement in R&D. RCOM 2024 represents an excellent platform for meaningful discussions and knowledge sharing, providing attendees the opportunity to exchange ideas and expand the boundaries of their own research. I sincerely hope this conference fosters collaboration among local and international experts and technologists. Not only is it an opportunity to build lasting connections within your respective fields, but it is also a chance to explore the immense potential of membrane technology, a field ripe for further innovation. I trust the plenary sessions and break-out discussions will offer valuable insights for all participants.

As the president of MyMembrane, I also encourage you to join the Malaysian Membrane Society. The society aims to promote research and activities in membrane science and technology across Malaysia. We have been actively engaged in translational research that makes a tangible impact on society, ensuring our work addresses both national and global challenges. I am confident that these efforts contribute significantly not only to academia and research but also to industries and the general public, who are the ultimate beneficiaries.

FOREWORD

I am certain that RCOM 2024 will be an enriching and rewarding experience for everyone involved. I wish all delegates a productive and successful conference. May this congress be a resounding success. Thank you.

UTM, Innovating Solutions
In the Name of God for Mankind

PROF. DATUK IR. TS. DR. AHMAD FAUZI BIN ISMAIL
Vice-Chancellor
this congress be a resounding success. Thank you.

FOREWORD

Prof. Ts. Mohd Hafiz Dzarfan
Chair, Frontiers Material Research Alliance (FMRA), UTM

Assalamualaikum warahmatullahi wabarakatuh, and greetings,

It is with immense pride and honor that I extend my heartfelt congratulations to the organizing committee of the Regional Congress on Membrane Technology (RCOM) 2024. This event, co-hosted by the Advanced Membrane Technology Research Center (AMTEC) and the Frontiers Material Research Alliance (FMRA) of Universiti Teknologi Malaysia (UTM), represents a milestone in our collective efforts to advance membrane technology for the benefit of society and industry.

RCOM 2024 serves as a vital platform where experts, researchers, and practitioners come together to exchange insights, explore novel solutions, and address pressing challenges in the fields of membrane science and technology. This congress is particularly significant as it aligns with our ongoing commitment to support Sustainable Development Goals (SDGs) by fostering innovations that directly contribute to advancements in water and energy technologies, essential pillars for sustainable global development.

As Chair of FMRA, I am excited to witness the impactful research and collaborative efforts that will emerge from this congress. The partnerships forged here, both locally and internationally, will undoubtedly open new avenues for future breakthroughs, driving the development of cutting-edge membrane technologies and their real-world applications.

I would also like to take this opportunity to express my deepest appreciation to the distinguished speakers, contributors, and participants who have gathered here to share their knowledge and expertise. Your contributions are crucial in shaping the future of membrane technology, and I am confident that RCOM 2024 will be a rewarding experience for all.

On behalf of FMRA UTM, I wish RCOM 2024 great success and extend my best wishes to all attendees for an inspiring and productive conference.

Thank you.

FOREWORD

Prof. Ts. Dr. Juhana Jafaar
Director of AMTEC
Universiti Teknologi Malaysia

Assalamua'laikum and Sincere Greetings to All,

On behalf of organizing committee, I would like to wish our distinguished speakers, participants, and all delegates a warm welcome to the Regional Congress on Membrane Technology (RCOM) 2024. It is a great honour for the Advanced Membrane Technology Research Centre (AMTEC), Universiti Teknologi Malaysia (UTM) to be the host of this conference.

RCOM 2024 prioritizes the conduct and fulfilment of several Sustainable and Development Goals (SDGs). It brings about advances in energy, food, health, and water technology and innovative strategies to industrialize the upcoming research. With this conference, it is hoped that professionals, researchers, academicians, and industries in Malaysia and abroad would be able to share and generate interest in cutting-edge applications, challenges and practical solutions in membrane technology that could lead to monumental improvements to the environment and human well-being.

In addition, potential collaborations can be identified and nurtured to expedite the R&D&C of membrane technology to meet the demand in industries, including water treatment for domestic and industrial water supply, chemical, pharmaceutical, biotechnological, beverages, food, metallurgy, and other separation processes. Hence, attending this conference will keep the research interests fresh and drive new innovations and opportunities in education, research, and practice through transferring and exchanging ideas.

My special and sincere thanks to all the committee members for putting an endless effort in organizing RCOM 2024. Associate Professor Ts. Dr. Norhaniza Yusof and her team deserve compliments on their exceptional hard work. My sincere gratitude also goes to our fellow sponsors. Without your contribution, this event would not have been a success. Last but not least, I hope that RCOM 2024 would provide a wonderful and valuable experience to all honorable speakers and participants. Thank you.

FOREWORD

Associate Prof. Dr. Norhaniza Yusof
Chairman

Assalamua'laikum

First and foremost, I would like to extend a warm welcome to our distinguished speakers, participants, and delegates for taking part in the Regional Congress on Membrane Technology (RCOM) 2024

The RCOM 2024 with the theme of "Innovating Solutions for Water-Energy-Food-Health-Ecosystem Nexus towards Sustainable Future" is aims to prioritize the conduct and fulfilment of several Sustainable and Development Goals (SDGs). It is truly an honor to be the chair of this conference.

It is hoped that this conference would foster a platform for researchers, professionals, and industry partners worldwide to discuss and spark interest in innovative applications and tangible solutions related to the membrane and environmental technology field. The ultimate aim of this conference is to gather intellectual minds to contribute significantly to environmental enhancement and more sustainable future for all by 2030.

Furthermore, we hope that this conference offers a valuable opportunity to identify future potential collaborators to further accelerate research and development activities, as well as commercialization efforts in membrane and environmental technology field. It is our pleasure to provide this conference as a platform to transfer and exchange ideas to help revitalize research interests and stimulate new ideas and innovations.
Sponsorship is highly important to ensure the success of this event, so we would like to offer our sincere gratitude to our sponsors for their contribution. I would also like to thank the organizing committee for their unwavering dedication and hard work to make RCOM 2024 a resounding success.

Lastly, I would like to extend my best wishes to all speakers and participants for a valuable and fulfilling experience at this conference.

Thank you

ORGANIZING COMMITTEE

	Name	Committee members
1	**Prof. Datuk Ir. Ts. Dr. Ahmad Fauzi bin Ismail**	**Patron**
1	Prof. Ts. Dr. Mohd. Hafiz Dzarfan bin Othman	Advisor
2	Prof. Ts. Dr. Juhana bt. Jaafar	
3	Assoc. Prof. Ts. Dr.Norhaniza Yusof	Chairman
4	Assoc. Prof. Dr. Hasrinah Hasbullah	Co-Chairman
5	**Dr. Mohd. Zamri b. Mohd. Yusop (K)**	Secretary
6	Dr. Wan Norhayati bt. Wan Salleh	
7	Mrs. Zalinah bt. Mazlan	
8	Assoc. Prof. **Ts. Dr. Goh Pei Sean (K)**	Finance
9	Mrs. Ruhaidah bt. Kaprawi	
10	Mrs. Aiman Najwa bt. Zakaria	
11	Ms. Nurfirzanah binti Azman	
12	**Dr. Farhana Aziz (K)**	PR and Protocol
13	Mrs. Nuridayu bt. Abdul Rahman	
14	Ms. Siti Nurul Ezaty bt. Mohd. Bakri	

15	Ms. Nurul Khusna bt. Mohd. Salleh	
16	**Chm. Dr. Mohd. Akmali b. Mokhter (K)**	Registration
17	Mr. Rendy Muhamad Iqbal	
18	Ms. Nurul Fazlin bt. Hasnul Hafiz	
19	Ms. Nurul Khusna bt. Mohd. Salleh	
20	Mrs. Nor Asikin bt. Awang	
21	Ms. Siti Nurul Ezaty bt. Mohd. Bakri	
22	**Mr. Mohammad Abdul Razis b. Saidin (K)**	Logistics dan Food
23	Assoc. Prof. Dr. Muhammad Noorul Anam bin Mohd. Norddin	
24	Dr. Nuor Sariyan bt. Suhaimin	
25	Dr. Nor Akalili bt. Ahmad	
26	**Dr. Shahrizan Moslan (K)**	Multimedia and Publicity
27	Dr. Wong Tuck Whye	
28	Dr. Amir Asyraf b. Mohd. Hamzah	
29	Dr. Muhamad Zulhilmi b. Zailani	
30	Mr. Muhammad Hafizuddin Bin Hazaraimi	
31	Assoc. Prof. **Dr. Roswanira bt. Wahab (K)**	Publication

32	Prof. Ts. Dr. Mohd. Hafiz Dzarfan bin Othman	
33	Dr. Fatin Hazirah Bt. Abdullah	
34	Ms. Nuridayah Yusmaidi	
35	Mr. Roy Quah Zhi Ming	
36	**Assoc. Prof. Dr. Lau Woei Jye (K)**	Award
37	Mr. Rickson Chia Jun Jay	
38	Ms. Nadiene Salleha bt. Mohd. Nawi	
39	Ms. Lim En Qi	
40	Ms. Lee Wei Ann	
41	Ms. Khor Wan Yi	
42	**Ts. Dr. Ng Be Cheer (K)**	Technical
43	Ts. Dr. Mohd. Nazri b. Mohd. Sokri	
44	Tc. Mohd. Ariff b. Azali	
45	Tc. Muhammad Nizam b. Zainal Abidin	
46	Mr. Muhammad Nur Syahir b. Che Johan	
47	Mr. Chai Heng Yeng	
48	Mr. Alex Yong Zhi Yuan	

49	Ms. Liew Chia Ming	
50	Ms. Koo Kang Nee	
51	Mr. Nor Ikmal Zulhady Md. Nor	
52	Mr. Muhammad Ashraf Rushdan	
53	**Assoc. Prof. Dr. Mukhlis b. A. Rahman (K)**	Sponsorship
54	Ts. Mohd. Sohaimi b. Abdullah	
55	Dr. Nurafiqah bt. Rosman	
56	Dr. Shafizah bt. Sa'adon	
57	**Dr. Mohd. Hafiz b. Puteh (K)**	Pre workshop
58	Dr. Roziana bt. Kamaludin	
59	Dr. Suhaila bt. Borhamdin	
60	Dr. Siti Maryam bt. Jasman	
61	Dr. Nur Dhuhaa bt. Tajul Ariffin	
62	**Assoc. Prof. Dr. Hasrinah Hasbullah (K)**	Dinner
63	Dr. Nurul Jannah bt. Ismail	
64	Ms. Jasmine bt. Hamdan	
65	Ms. Nurul Natasya bt. Mohammad Jafri	
66	Mr. Ong Chun keat	

3rd Regional Congress on Membrane Technology (RCOM2024)

Innovating Solutions for Water-Energy-Food-Health-Ecosystem Nexus towards Sustainable Environment

Impiana Hotel, Senai, Johor Bahru, Malaysia
30 September - 01 October 2024

Day 1 - 30 September 2024 (Monday)	
8:00-8.30	**Registration**
8.30-8.50	**Arrival of VVIP, VIP and Guests (Usher: Mrs. Zalinah & Mrs. Ruhaidah)** Master of Ceremony: Mohamad Zahir Mohd Pauzi & Siti Nurul Ezaty Mohd Bakri Dua' Reciter: Muhammad Alif Muhaimin Mahasan
8.50-9.00	**Opening Remarks by Chair of Frontier Material Research Alliances UTM - Prof. Ts. Dr. Mohd Hafiz Dzarfan B. Othman** Souvenir presenter: Prof. Dr. Ts. Juhana Jaafar Usher: Nurul Khusna
9.00-9.05	**Promotion Video Presentation: AMTEC Corporate Video & AMST Video**
9:05-09:45	**Plenary Talk 1 (Main Hall) – Prof. Dr. Mustafa Ersoz, Selcuk University, Turkey** Venue: Hall 1 Maharani Chairman & Souvenir presenter: Assoc. Prof. Dr. Norhaniza Yusof Technical: Muhammad Nizam & Chai Hean Yean
9:45-10:20	**Plenary Talk 2 (Main Hall) – Prof. Ir. Yong Wai Fen, Xiamen University, Malaysia**

	Venue: Hall 1 Maharani Chairman & Souvenir presenter: Prof. Dr. Ts. Juhana Jaafar Technical:Muhammad Nizam & Chai Hean Yean
10:20-10:45	*Tea Break*
10:45-11:20	Keynote Talk 1 (Main Hall) - **Prof. Dr. Yusuf Wibisono,** Universitas Brawijaya, Indonesia Venue: Hall 1 Maharani Chairman & Souvenir presenter: Assoc. Prof. Dr. Goh Pei Sean Technical: Muhammad Nizam
11:20-11:50	Keynote Talk 2 (Main Hall) - **Mr. Mukhlis Jamatolail,** ITS-ENVILAB SDN. BHD., Malaysia **Title: Advances and Challenges in Industrial Effluent Treatment Systems in Malaysia** Venue: Hall 1 Maharani Chairman & Souvenir presenter: Dr. Farhana Aziz Technical: Muhammad Nizam
11:50-12:20	Keynote Talk 3 (Main Hall) - **Prof. Nurul Widiastuti,** Institut Teknologi Sepuluh Nopember (ITS), Indonesia Venue: Hall 1 Maharani Chairman & Souvenir presenter: Assoc. Prof. Dr. Lau Woei Jye Technical: Muhammad Nizam

12:20-14:00	*Lunch*		
14:00-17:00 *Afternoon Session*	Parallel Session 1 (Hall 1 Maharani) Membrane Materials, Fabrication & Designs	Parallel Session 2 (Hall 2 Endau) Membrane Applications	Parallel Session 3 (Hall 4 Mersing) Environment & Sustainable Management
	Chairman: Dr. Masoud Rahbari Sisakht (Assisted by Lee Wei Ann) Technical: Muhammad Nizam	Chairman: Dr. Mohd Amir Asyraf Mohd Hamzah (Assisted by Khor Wan Yi) Technical: Chai Hean Yean	Chairman: Dr. Deepa Suresh (Assisted by Nadiene Salleha) Technical: Mohd Ariff Azali
14:00-14:30	Invited Talk 1: **Ts. Dr. Ahmad Ilyas Bin Rushdan**, UTM Title: Nanocellulose-Based Materials for Advanced Water Treatment: Applications, Challenges, and Future Prospects	Invited Talk 2: **Dr. Muhammad Nidzhom Bin Zainol Abidin**, UM Title Radiation-Induced Graft Copolymerization: An Innovative Approach for Developing Antifouling Polymeric Membranes	Invited Talk 3: **Dr. Dayang Norafizan Binti Awang Chee**, UNIMAS Title: Harnessing ZIF-8 Membrane Combined with Sago Hampas-Derived Carbon Quantum Dots for Efficient Lead(II) Removal from Water
14:30-14:45	A004 - Eka Tiyas Anggraeni **Title: Green Anion Exchange Membrane Classification Using Deep Learning for Reverse Electrodialysis**	A009 – Hamdan Dwi Rizqi **Title: Review on Microbial Fuel Cell System for Simultaneous Energy Generator and Palm Oil Mill Effluent Waste Treatment**	A003 – Teshini A/P Hari Ram **Title: Adsorption of colour, TDS and COD from palm oil mill effluent (POME) using Magnetic OPEFB-NC/LDH Hybrid Nanocomposite**

14.45-15.00	A011 – Musawira Iftikhar **Title: MOF as fillers in membrane technology**	A010 – Kenny Looi Soon Ken **Title:Review on Limitations of Organic Ion Exchange Membrane in Microbial Fuel Cell and The Potential of Ceramic Ion Exchange Membrane in The Application**	A015 – Susi Rokhmatul Ummah **Title: Hydroxyapatite-based bioceramic membrane from Undulate Venus clamshell waste (Paratapes undulatus) for dialysate purification**
15:00-15:15	A014 – Asmat Ullah **Title: Tailoring Polymeric Hollow Fiber Membranes for Selective Separation: An In-Depth Review of Surface Modification Techniques**	A012 – Mustapha Salisu Muhammad **Title: Characterization of Biofouling Bacterial Strain in Membrane Water Treatment Systems**	A016 - Rachma Alfiana Rizqi **Title: Utilization of waste cigarette butt as cellulose acetate in phase-inverted polymer blend membrane for river water filtration**
15:15-15:30	A017 – Mustafa Kamal **Title: Fundamentals Characteristics of Polymer Electrolyte Membranes for Fuel Cells- A Mini review**	A013 - Dikianur Alvianto **Title: Ultrafiltration of Juices: Enhancing Membrane Properties with Green Solvent and Microcrystalline Cellulose Reinforcement**	A026 – Nur Ain Shazwani Binti Roslee Ab. Jamal **Title: limitation and challenges in membrane distillation: wetting and fouling of membranes: a mini review**
15:30-15:45	**Poster Presentation and Judging Session (Assisted by Khor Wan Yi) Venue: Main Hall 1 Maharani Panels: (1) Dr Dayang (UNIMAS) (2) Dr Surmani (USM)**	A025 – Nurina Adriana Binti Abdul Razak **Title: Characteristics and Performance of Thin Layer ZSM-5 Membrane Supported on Alumina Tube for Pervaporation Desalination**	A001 - Tahir Shah (virtual) **Title: Predicting Membrane Flux in Ultrafiltration Process: A New Approach Using Neural Network and Response Surface Methodology for Modeling and Sensitivity Analysis**
15:45-16:00		A028 – Muhammad Hakimi Bin Khairuddin **Title: Fabrication and Characterization of H2 selective**	A046 – Mohd Hazarel Zairy Bin Mohd Harun (virtual) **Title: Integration of Supported Ionic Liquid Membrane and**

	(5 Poster Presentations)	**Nickel-Based Membranes Supported on Alumina Tubes for Enhanced Syngas Production**	**Adsorption Techniques in the Stripping Phase for Removal of Sulfamethoxazole from Wastewater**
16:00-17:00	*Tea Break & End of Day 1*		
20:00-22.00	***Grand Dinner and Engagement (Grand Ball Room)***		
Day 2 - 01 October 2024 (Tuesday)			
8:20-8:40	**Arrival of Participants**		
8:40-9:25	**Plenary Talk 3 (Main Hall) - Prof. Emeritus Dr. Takeshi Matsuura, University of Ottawa, Canada (Virtual)** **Title: Recent Progress in Membrane Characterization and Fabrication** Venue: Hall 1 Maharani Chairman: Assoc. Prof. Dr. Hasrinah Hasbullah Technical: Muhammad Nizam & Liew Chia Ming		
9:25-10:00	**Plenary Talk 4 (Main Hall) - Prof. Dr. Mikihiro Nomura, Shibaura Institute of Technology, Japan (Virtual)** Venue: Hall 1 Maharani Chairman: Dr. Mohd Zamri Yusop Technical: Muhammad Nizam & Liew Chia Ming		
10:00-10:15	*Tea break*		
10:15-12:45 *Morning Session*	Parallel Session 1 (Hall 1 Maharani) Membrane Materials, Fabrication & Designs	Parallel Session 2 (Hall 2 Endau) Membrane Applications	Parallel Session 3 (Hall 4 Mersing) Environment & Sustainable Management

	Chairman: Dr. Mohamad Zulhilmi Zailani (Assisted by Lee Wei Ann) Technical:Muhammad Nur Syahir	Chairman: Dr. Muhammad Irfan (Assisted by Nadiene Salleha) Technical: Liew Chia Ming	Chairman: Dr. Wan Norharyati Wan Salleh (Assisted by Khor Wan Yi) Technical: Mohd Ariff Azali
10:15-10:45	Invited Talk 4: **Prof. Dr. Arun Mohan Isloor** National Institute of Technology Karnataka Title: Tailormade Zwitterionic Polymeric Nanoparticles incorporated Membranes Revolutionizing Separation Technology	Invited Talk 5: **Dr. Norfazliana Binti Abdullah**, UMS Title: Synthesis of Fluorinated Zirconia-based Metal-Organic Framework by using Solvothermal Synthesis for Oil Spill Cleaning	Invited Talk 6: **Dr. Sumarni Binti Mansur**, USM Title: Advancement of Dual Layer Hollow Fibre Membrane for Blood Purification
11:15-11:30	A022- Zeeshan Khan **Title: Advancements in Semiconductor Photoactive Materials for Efficient Photodegradation of Organic Contaminants in Water Treatment: A Mini-Review**	A023- Nadiene Salleha Binti Mohd Nawi **Title: Solvent-free Polyester TFC Membrane for Saline Water Recovery**	A019 - Khor Wan Yi **Title: Natural and green materials for sustainable TFC membrane fabrication – A review**
11:30-11:45	A024 – Chai Heng Yean **Title: Recent trend of TFN membrane incorporated using hollow nanofillers**	A006 – Mohd Amir Asyraf Mohd Hamzah **Title: Utilization of palm oil fuel ash (POFA) for dye wastewater remediation**	A029 – Khairul Anwar Mohamad Said **Title: Anti-Fouling PVDF Ultra-Filtration with Graphene Nanoplatelet for Peat Water Treatment**

11:45-12:00	A030 – Evia Salma Zaurida **Title: Deconvolution of Pluronic P123 Coated onto PVDF Hollow Fiber Membrane**	A027 – Tai Li Jia **Title: Improving desalination antibacterial and antifouling performance of polyamine thin film composite reverse osmosis membrane via direct grafting gallic acid**	A032 – Muhammad Hafizuddin Bin Hazaraimi **Title: Enhancing g-C3N4 Photocatalyst with Spent Battery Waste for Efficient Degradation of Rhodamine B Dye**
12:00-12:15	A031 – Zahratunnisa **Title: Novel Hybrid Pectin-TiO2 Membrane of Nylon 66: Roughness Enhancement**	A035 – Kamil Kayode Katibi **Title: Development of Hollow Fibre Nanocomposite Membrane Enhanced with Functionalized Iron Oxide Nanoparticles for The Removal of Bisphenol S from Aqueous Solution: Fouling and Permeability Studies**	A037 – Muhammad Alif Muhaimin Bin Mahasan **Title: Chicken Feather Waste as Synergistic Filler in Mixed Matrix Hollow Fiber Membrane for Biogas Upgrading**
12:15-12:30	A034 – Siti Nurul Ezaty Binti Mohd Bakri **Title: Synthesis and Characterization of Temperature and Light Responsive Composite Nanogel and its Properties as Smart Anti-fouling and Self-cleaning in Membrane**	A039 – Dr. Md Rezaur Rahman **Title: TiO2 Grafted Bamboo derivate Nanocellulose Polyvinylidene Fluoride (PVDF) Nanocomposite Membrane to Intensified the Antifouling, Water Flux, and Dye Removal**	A040 – Al Allysha Binti AlKhadi **Title: Enhancing Anaerobic Digestion of Palm Oil Mill Effluent with Carbon Fibre**
12:30-12:45	A036 – Siti Zubaidah Binti Muhamad Zafir **Title:Single-step Mass Production of Graphene Powder from Palm Kernel Shell at 500 °C and Its Properties**	A018 – Lee Wei Ann **Title: A mini review on the progress of UF membranes with enhanced fouling and abrasion resistance for water treatment**	A050 – Norfarhana Binti Abdul Samad **Title: Effect of Cellulose Nanofiber of Sugar Palm (Arenga Pinnata) Incorporated in Rubber-based Composite Membrane for Palm Oil Mill Effluent Treatment**

12:45-14:00	*Lunch*		
14:00-14:30 *Afternoon Session*	Parallel Session 1 (Hall 1 Maharani) Membrane Materials, Fabrication & Designs	Parallel Session 2 (Hall 2 Endau) Membrane Applications	Parallel Session 3 (Hall 4 Mersing) Environment & Sustainable Management
	Chairman: Dr. Mohd Akmali Mokhter (Assisted by Nadiene Salleha) Technical: Muhammad Nur Syahir	Chairman: Ts. Dr. Mohd Nazri Mohd Sokri (Assisted by Lee Wei Ann) Technical: Liew Chia Ming	Chairman: Dr. Nor Akalili (Assisted by Khor Wan Yi) Technical: Chai Hean Yean
14:00-14:30	Invited Talk 7: **Assoc. Prof. Dr. Suichi Sato**, University of Louisiana LaFayette Title: Effects of Heat, Solvent, Photo, and Filler-Induced Structure Control of Polylactic Acid on Gas and Vapor Barrier Properties	Invited Talk 8: **Dr. Triyanda Gunawan,** ITS	Invited Talk 9: **Prof. Jiang Lan Ying**, Central South University, China Title: Developing PVA/CNT/PTFE composite membranes for Membrane Distillation
14:30-14:45	A042 – Iqbal Shalahuddin	A043- Parvin a/p Asogan **Title: Omniphobic Photothermal Dual Layer Hollow Fibre Membrane**	Invited Talk 10:

	Title: Blended-Cyrene: An Eco-Friendly Solvent for Sustainable Polyvinylidene Fluoride Membrane	**via Etching for Membrane Distillation**	**Dr. Mohd Haiqal Bin Abd Aziz**, UTHM Title: Unraveling the Surface: The Crucial Role of Topography and Chemistry in Membrane Wettability
14:45-15:00	A047 – Nurul Afiqah Bin Arbain **Title: Effect of Laser Power on the Wettability Behaviour of 3D Printed Polymer Membrane with Candle Soot Coating**	A045 – Fahad Mir **Title: Advancements in Photocatalytic Membrane Treatment for the Degradation and Removal of Organic Contaminants: A Concise Review and Future Directions**	
15:00-15:15	A051 – Thisha Abirami Sivasankar **Title: A Bibliometric and Visual Analysis of the Utilization of Waste Materials for the Development of Membrane Across Various Sectors: Insights from the Scopus Database**	A049 – Riza Lydia Liyana Binti Rizalmen **Title: Efficient Heterogeneous Activation of Hydrogen Peroxide by Mn-substituted Cu-based Perovskite: A Promising Approach for Caffeine Degradation**	A008 - Ong Chun Keat **Title: Optimization Of Pyrolysis Condition For Production Of Biochar From Empty Fruit Bunch**
15:15-15:30	A054 – Nurul Fazlin Binti Hasnul Hafiz **Title: The Effects of Solvent Type and Alumina Weight Loading on the Surface Morphology and Mechanical Strength of Flat Sheet Ceramic Membranes**	A055 – Hamdan Ihsan **Title: Various Gas Adsorption Study On CuO@Zeolit-Y**	A020 – Liew Chia Ming **Title: Rice Husk Derived Photothermal Materials for Improved Membrane Distillation**
15:30-15:45	A063 – Abdul Aziz Azhari Bin Abdul Ramli **Title: Effect of Temperature of Copra Biochar and the Adsorption of Chromium (Vi) with PVDF Membrane Application**	A057 – Fauziah Marpani **Title: Enzyme Immobilization Assessment on Reverse Asymmetric Membrane with Synchronous Biocatalysis**	A056 – Lau Hui Shen **Title: Advancements in Membrane Technology: Optimizing Polymers of Intrinsic Microporosity (PIMs) for Carbon Capture**

15:45-16:00	A064 – Nurul Khusna Bin Mohd Salleh **Title: Antimicrobial Activity and Durability Study of Cu_2O/TiO_2 Thin Film: Effect of Coating Layer**	A058 – Sadaki Samitsu **Title: Three-dimensional Characterization of Macrovoids using X-ray Microcomputed Tomography**	A062 – Irma Fitriani **Title: Keratin from Hair Waste as a Zeolite 13X Templated Carbon: Synthesis and Characterization**
15:45-16:15	*Tea break*		
16:15-16:25	**Closing Remarks by Director of AMTEC- Prof. Dr. Ts. Juhana Jaafar** Master of Ceremony: Mohamad Zahir Mohd Pauzi & Siti Nurul Ezaty Mohd Bakri Venue: Hall 1 Maharani		
16:25-16:45	***Award Presentation Ceremony*** ****Best Oral Presenters (Parallel Session) x 9*** Award Presenter: Prof. Dr. Ts. Juhana Jaafar ****ACS Best Oral Presenters (Conference) x 4*** ****ACS Best Poster Presenter x 1*** Award Presenter: Assoc. Prof. Dr. Hasrinah Hasbullah ****MyMembrane Young Scientists Awards x 3*** Award Presenter: Assoc. Prof. Dr. Norhaniza Yusof Venue: Hall 1 Maharani		
16:45-17:00	***Group Photo Session***		


PLENARY SPEAKER

PLENARY SPEAKER 1

Biography
Prof. Dr. Mustafa Ersoz

Prof. Dr. Mustafa Ersoz is a distinguished academic in the field of chemistry, currently serving in the Department of Chemistry at Selçuk University, Turkey. With a robust educational background, he has made significant contributions to both teaching and research within the scientific community. His research interests primarily focus on analytical chemistry, specifically in areas such as environmental analysis and the development of novel analytical methods. Prof. Ersoz has authored numerous publications that have garnered attention in various scientific journals, reflecting his expertise and commitment to advancing the field. He has been instrumental in mentoring students and fostering a collaborative research environment, encouraging young scientists to engage in innovative projects. Prof. Ersoz is also known for his participation in various national and international conferences, where he shares his findings and collaborates with fellow researchers. His dedication to education is evident through his involvement in curriculum development and his efforts to enhance laboratory experiences for students. In addition to his academic responsibilities, Prof. Ersoz actively contributes to the scientific community through peer review and editorial roles in several reputable journals. His work not only enriches the academic landscape at Selçuk University but also contributes to broader scientific advancements in chemistry. Through his research and teaching, Prof. Dr. Mustafa Ersoz continues to inspire future generations of chemists in Turkey and beyond.

Controlled Pore Formation for Advanced Membrane Development and Applications

Mustafa ERSOZ
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The development of membranes with controlled pore formation is critical for improving membrane performance in applications such as water treatment, gas separation, and filtration. Despite the success of conventional polymeric membranes, precise control of nanopore size and distribution is critical for enhancing the performance of these membranes, particularly in terms of selectivity, flux, and durability. Controlled nanopore formation aims to address these issues by enhancing membrane selectivity, flux, and stability. Various strategies, including nanoparticle-enhanced membranes (NeMs), block copolymer (BCP) self-assembly, and the incorporation of two-dimensional (2D) materials have shown promise in achieving these goals.

The integration of nanoparticles like carbon nanotubes (CNTs), graphene oxide (GO), titanium dioxide (TiO_2), and silver (Ag) into membrane matrices is a leading strategy to improve performance by enhancing mechanical strength, selectivity, and resistance to fouling. The development of nano-activated and nano-enhanced membranes is crucial for achieving higher efficiency in selective separations. Additionally, BCP self assembly enables the creation of periodic nanostructures with controlled pore size distribution. Through the self-assembly of BCPs into distinct microphases, well-defined porous structures are formed, which can be tailored by adjusting molecular weights, compositions, and surface interactions for applications in microelectronics and filtration. Research into 2D materials such as graphene, graphene oxide, hexagonal boron nitride (h-BN), and transition metal dichalcogenides (TMDs) has also shown promise in membrane development. These materials offer precise pore sizes, high mechanical strength, and chemical stability, making them ideal candidates for many applications and separation processes. The development of membranes by using of nanoparticles, BCP Self assemble including 2D materials is highlighted as a promising future direction with potential industrial applications of the membranes

PLENARY SPEAKER 2

Biography
Prof. Ir. Dr. Yong Wai Fen

Ir. Dr. Yong Wai Fen is a Professor and Head of Postgraduate Programmes (Chemical Engineering) at School of Energy and Chemical Engineering, Xiamen University Malaysia. She received her Ph.D. in Chemical and Biomolecular Engineering from National University of Singapore in 2014 and continued working as a postdoctoral fellow with Prof. Tai-Shung Chung, Neal until 2017. Her research interests focus on sustainable, green materials, and membrane technologies for biogas separation, CO_2 capture, industrial air purification and water purification to promote renewable energy and environmental sustainability. She received several prestigious awards, including the 2024 International Congress on Separation and Purification Technology (ISPT) 2024 Distinguished Women Scientist Award, 2023 World's Top 2% Scientists by Stanford University, Green Talents and being named one of the Top 50 outstanding Green Talents alumni from the German Federal Ministry of Education and Research (BMBF). Additionally, she was a Finalist for the Carbon Capture Future Leader Award, Carbon Capture Science and Technology (CCST), Ireland, and a Finalist for the Energy and Sustainability Awards from the IChemE Singapore. She is a Chartered Engineer (CEng) with the Institution of Chemical Engineers (IChemE), UK, and a Professional Engineer (PEng) with the Board of Engineers Malaysia. Furthermore, she also served as a Youth Editorial Board Member or Early Career Editorial Board for various internationally reputable journals such as Advanced Membranes, Nano Research Energy, Results in Engineering, and Separation and Purification Technology.

Link to speaker's web page:
https://sites.google.com/view/wfyongmembraneresearch/home

Development of membranes for gas and liquid separation

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The increasing awareness of global warming has led to a growing demand for sustainable and advanced purification and separation technologies. Polymers are particularly attractive materials in the membrane industry due to their diversity, simple fabrication methods, and ease of scale-up. Membrane separation, with its advantages of being environmentally benign, highly energy-efficient, and having a small footprint, is one of the most competitive and emerging technologies for gas and liquid purification and separation. Numerous studies have focused on developing membranes with desirable chemistry and morphology, as well as enhanced separation performance, from the perspective of membrane preparation. In this talk, recent progress and developments in polymeric membranes for gas and liquid separation from the "Membranes: Sustainable Materials, Advanced Research and Technology (MEMSMART)" group at Xiamen University Malaysia will be presented. Various modification strategies, including green synthesis, incorporation of nanomaterials, and the environmental impact and economic evaluation of membrane preparation through life cycle assessment (LCA) and techno-economic analysis (TEA), will also be discussed.

PLENARY SPEAKER 3

Biography
Prof. Dr. Takeshi Matsuraa

Emeritus Prof. Dr. Takeshi Matsuura was born in Shizuoka, Japan, in 1936. He received his B.Sc. (1961) and M.Sc. (1963) degrees from the Department of Applied Chemistry at the Faculty of Engineering, University of Tokyo. He went to Germany to pursue his doctoral studies at the Institute of Chemical Technology of the Technical University of Berlin and received Doktor-Ingenieur in 1965.

After working at the Department of Synthetic Chemistry of University of Tokyo as a staff assistant and at the Department of Chemical Engineering of the University of California as a postdoctorate research associate, he joined the National Research Council of Canada in 1969. He came to the University of Ottawa in 1992 as a professor and the chairholder of British (Consumers) Gas/ NSERC Industrial Research Chair. Currently, he is professor of the Department of Chemical Engineering and the director of the Industrial Membrane Research Institute (IMRI).

The Industrial Membrane Institute headed by Dr. Matsuura has received, or is receiving, financial supports from a number of industries and governments. Some examples are: Air Products, AQUASEP Purification, Inc., British Gas, Esso Petroleum Canada, Environmental Science and Technology Alliance of Canada, Fielding Chemicals, Ion Exchange India, Materials and Manufacturing Ontario, National Research Council of Canada, Natural Resources Canada, Ontario Ministry of Education and Training (URIF Grant), Nippon D.
Dr. Matsuura's research interest covers all aspects of Membrane Science and Technology. In particular, the following subjects are currently being studied at his laboratory:

-Polymer surface modification
-Membrane surface modification
-Development of composite membranes
-Development of hollow fibers and hollow fiber modules
-Development of inorganic membranes
-Development of heat and pH resistant membranes
-Membrane characterization by Plasma ablation
-SEM, AFM, ESR and Raman Spectroscopy
-Membrane transport
-Reverse Osmosis
-Nanofiltration
-Ultrafiltration
-Microfiltration
-Membrane gas and vapour separation
-Pervaporation
-Membrane Battery Separation

Recent Progress in Membrane Characterization and Fabrication

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The presentation consists of the following two parts.

1. Recent progress in membrane characterization
2. Fabrication of ultrahigh flux membrane

Membrane characterization: There has been a long debate on the presence or absence of pores in the skin layer of reverse osmosis membrane. Various advanced instrumental techniques revealed that there were sub-nanometer pores that demonstrate multiple distributions. The molecular dynamics simulation also revealed that clusters of water moved through the channels formed in the skin layer of the membrane.

Membrane fabrication: Attempts are being made to fabricate ultrahigh flux reverse osmosis membranes based on carbon nanotubes, graphene and graphene oxide, aquaporin, and fluorous oligoamide nanorings. The stages in their advancement are briefly outlined and the challenges to overcome for their commercial applications are discussed.

PLENARY SPEAKER 4

Biography
Prof. Dr. Mikihiro Nomura

Mikihiro Nomura is a prominent professor in the Department of Applied Chemistry at Shibaura Institute of Technology, where he specializes in Regional Environment Systems. With a robust academic background, he earned his Ph.D. in Applied Chemistry, which has propelled him into a successful career focused on addressing critical environmental challenges through innovative chemical research. His work primarily revolves around sustainable materials and processes, emphasizing the need for environmentally friendly solutions that mitigate ecological impact. Professor Nomura is widely recognized for his contributions to the field, having published numerous peer-reviewed articles that explore the intersections of chemistry and environmental science. His research not only advances theoretical knowledge but also translates into practical applications that benefit society. In addition to his research endeavors, Professor Nomura is deeply committed to education and mentorship, inspiring students through his engaging teaching methods and dedication to their academic success. He actively encourages students to explore interdisciplinary approaches to problem-solving, fostering a collaborative learning environment. Beyond academia, he collaborates with various organizations and institutions, both locally and internationally, to promote sustainable practices and address regional environmental issues. His leadership in projects related to environmental systems exemplifies his commitment to bridging the gap between scientific research and real-world applications. As a respected figure in applied chemistry, Mikihiro Nomura continues to make significant contributions to the field while inspiring future generations of scientists to pursue innovative solutions for a sustainable future. His work serves as a testament to the vital role of chemistry in addressing contemporary environmental challenges.

KEYNOTE SPEAKERS

KEYNOTE SPEAKER 1

Biography
Prof. Dr. Yusuf Wibisono

Prof. Dr. Ir. Yusuf Wibisono is a leading figure in the field of Bioprocess Engineering, currently serving as a faculty member at the University of Brawijaya in Indonesia. He has a strong academic background, holding a Doctorate in Bioprocess Engineering, which underpins his extensive research and expertise in membrane processes, bioseparation engineering, and water treatment technologies. Wibisono has authored numerous influential publications, with notable works including "Two-phase flow in membrane processes" and "Recent progress in integrated fixed-film activated sludge process for wastewater treatment," which have significantly impacted the academic community and industry practices. His research focuses on innovative solutions for fouling mitigation and the sustainable integration of bioprocesses with renewable energy systems. Prof. Wibisono is also recognized for his collaborative projects that aim to enhance wastewater treatment and resource recovery, contributing to environmental sustainability. His dedication to education is evident through his mentorship of students and involvement in various academic initiatives. Additionally, he has participated in international conferences, sharing insights on advancements in bioprocess technology. Through his commitment to research and education, Prof. Dr. Ir. Yusuf Wibisono continues to influence the field of Bioprocess Engineering, driving forward initiatives that align with global sustainability goals while fostering the next generation of engineers equipped to tackle pressing environmental challenges.

KEYNOTE SPEAKER 2

Biography
Mohamad Mukhlis bin Mohamad Jamatolail

Mohamad Mukhlis bin Mohamad Jamatolail is a skilled chemical engineer with a Bachelor of Science in Chemical Engineering degree from the University of Colorado Boulder, where he graduated with Second Class Upper honors. He has built a robust career since 2016, currently serving as a Project Engineer at ITS-Envilab Sdn. Bhd. in Johor Bahru. In this role, he specializes in the design and implementation of industrial effluent treatment systems, leading projects that include advanced oxidation processes for high-concentration acrylonitrile destruction and waste treatment expansions. His expertise encompasses detailed process design, equipment procurement, and performance monitoring, contributing to significant capital cost savings and environmental sustainability in various projects. Prior to this, he worked as a Technical Engineer, focusing on system validations and commissioning for various industrial applications. Noteworthy accomplishments include the successful design of a geotextile sludge dewatering system that achieved 70% capital cost savings and the development of a mobile-scale gas-to-liquid processing plant during his capstone project. Mukhlis is also involved in research collaborations aimed at applying synthetic modified engineering polymers to industrial wastewater treatment. His technical proficiency spans software tools for process simulation, numerical analysis, and 3D CAD design, complemented by programming skills in languages such as C++ and Python. His commitment to engineering excellence is further evidenced by his active participation in community service initiatives, including projects aimed at providing sustainable solutions for developing regions.

Advances and Challenges in Industrial Effluent Treatment Systems in Malaysia

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The treatment of industrial effluents is a critical environmental and regulatory challenge in Malaysia, governed by stringent standards under the Environmental Quality Act 1974. This paper provides an overview of industrial effluent treatment systems commonly used across various industries, including pre-treatment, primary, secondary, and tertiary processes. Key stages such as pH adjustment, coagulation, flocculation, biological treatment, and advanced filtration are highlighted. The role of hybrid technologies, including filtration systems and advanced oxidation processes (AOPs), is also discussed. Additionally, sludge management techniques, compliance with Malaysian discharge regulations, and innovations for improving treatment efficiency are examined. This overview aims to offer insights into the operational strategies and evolving technologies in the field of wastewater management in Malaysia, while addressing the challenges of industrial pollution control and sustainability.

KEYNOTE SPEAKER 3

Biography
Prof. Dr. Nurul Widiastuti

Nurul Widiastuti is a Professor in the Department of Chemistry at Institut Teknologi Sepuluh Nopember (ITS) in Indonesia, where she has established herself as a leading researcher in the development of membrane and adsorbent materials for energy and environmental applications. She earned her PhD from the Department of Chemical Engineering at Curtin University, Australia, in 2008, following her Master's degree from Institut Teknologi Bandung (ITB) in 1998 and her undergraduate degree from ITS in 1994. Her research focuses on synthesizing and enhancing the performance of various membrane materials, including mixed matrix membranes (MMM), carbon membranes, and polymeric membranes. These materials are crucial for applications such as fuel cells, gas separation, wastewater treatment, and food processing. In addition to her work on membranes, Prof. Widiastuti has made significant strides in developing adsorbent materials like zeolites and composite-based adsorbents derived from industrial waste and biomass. Her research addresses critical issues such as gas adsorption, CO2 capture, hydrogen storage, and wastewater treatment, contributing to sustainable solutions for environmental challenges. She actively engages in mentoring students and collaborating on interdisciplinary projects that bridge chemistry with practical applications in industry. Prof. Widiastuti's contributions to science are recognized through numerous publications in high-impact journals, reflecting her commitment to advancing knowledge in the field of chemistry and engineering while promoting sustainable practices for a better future.


INVITED SPEAKER

INVITED SPEAKERS 1

Biography
Ts. Dr. Ahmad Ilyas Rushdan

Ahmad Ilyas Rushdan is a distinguished academic and researcher in the field of chemical and energy engineering, currently serving as a Senior Lecturer at the Faculty of Chemical and Energy Engineering at Universiti Teknologi Malaysia (UTM). Born on February 5, 1991, in Malaysia, he has made significant contributions to materials science, particularly in nanocellulose and biocomposites. With over 267 publications, including 181 indexed in reputable journals, Ahmad Ilyas's research focuses on isolating and characterizing nanocellulose from natural sources, developing sustainable biocomposites using natural fibers, and exploring polymer engineering. His notable works include studies on the characterization of nanocrystalline cellulose derived from sugar palm fibers and the creation of biocomposites utilizing polylactic acid (PLA) for advanced applications across various industries. In addition to his teaching responsibilities, he supervises seven PhD students and actively participates in several national grants aimed at enhancing research in environmental sustainability and material science. Ahmad Ilyas's contributions have garnered recognition, leading to his appointment as a member of the Young Scientists Network under the Academy of Sciences Malaysia for the 2022/2023 term. This reflects his commitment to promoting scientific advancements among young researchers. Overall, Ahmad Ilyas Rushdan is a dedicated educator whose work significantly impacts chemical engineering and sustainable materials, with ongoing research that continues to advance environmentally friendly technologies and inspire future generations in the field.

Nanocellulose-Based Materials for Advanced Water Treatment: Applications, Challenges, and Future Prospects

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ABSTRACT

Nanocellulose and its derivatives have emerged as promising bio-based materials for water treatment, attributed to their high surface area, strength, and renewable nature [1]. The presence of hydroxyl groups on cellulose nanocrystals (CNCs) and cellulose nanofibrils (CNFs) facilitates various surface modifications, leading to nanocomposites with customizable properties [2]. This review investigates into the applications of nanocellulose-based materials in adsorption, catalysis, filtration, and flocculation, with a focus on removing heavy metals, dyes, and pharmaceutical compounds from water. Additionally, it examines nanocellulose's role in environmental sustainability, particularly in wastewater remediation through adsorption, filtration, catalysis, and pollutant sensing [3]. The review also highlights recent advancements in the production of nanocellulose-based adsorbents and membranes, emphasizing synthesis techniques, surface modifications, and durability, which bolster their potential for commercial application in cleaner wastewater treatment technologies. This comprehensive overview addresses the challenges and future prospects for the industrial use of nanocellulose in environmental remediation, underlining its importance in tackling global concerns related to resource depletion and harmful contaminants.

INVITED SPEAKERS 2

Biography
Dr. Muhammad Nidzhom Zainol Abidin

Dr. Muhammad Nidzhom Zainol Abidin is a senior lecturer in the Department of Chemistry at Universiti Malaya (UM), Malaysia, where he has made significant contributions to the field of membrane technology. He earned his PhD from Universiti Teknologi Malaysia (UTM) in 2021, receiving the prestigious Best Postgraduate Student Award from the Faculty of Engineering for his outstanding research. Prior to his doctoral studies, he completed a Master of Philosophy in 2017 at UTM and obtained a Bachelor of Science (Hons.) in Chemistry (Forensic Analysis) in 2014 from Universiti Teknologi MARA, graduating with first-class honors and the Vice Chancellor's Award. Dr. Nidzhom joined UM in December 2021 after serving as a research officer and post-doctoral researcher at UTM, and from 2022 to 2023, he was a research fellow at Universitas Airlangga, Indonesia. With over a decade of experience in membrane technology, he specializes in the preparation of hollow fiber membranes for applications such as hemodialysis and dialysis fluid regeneration. His current research interests include ion-exchange membranes, radiation-grafted membranes, and membrane-based sensors. Dr. Nidzhom has published extensively in reputable journals and is recognized for his active participation as a speaker and judge at scientific events. He also serves as a reviewer for more than 15 journals and examines MSc and PhD candidates. Currently, he supervises two PhD students and one MSc student by research, while three MSc students have successfully completed their studies under his guidance, reflecting his commitment to nurturing future scientists.

Radiation-Induced Graft Copolymerization: An Innovative Approach for Developing Antifouling Polymeric Membranes

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Abstract
Fouling is arguably the main hindrance to the wider implementation of polymeric membranes, particularly in pressure-driven membrane processes, resulting in higher energy, operation, and maintenance costs. Radiation-induced graft copolymerization (RIGC) is a powerful and versatile technique for covalently imparting selected chemical functionalities to membrane surfaces, providing a potential solution to fouling problems. Therefore, it is of great importance to systematically review the progress in modifications of polymeric membranes by RIGC of polar monomers onto membranes using various low- and high-energy radiation sources (UV, plasma, γ-ray, and electron beam) for fouling prevention. The feasibility of the modification method with respect to the physicochemical and antifouling properties of the membrane is discussed. Furthermore, the major challenges to the modified membranes in terms of sustainability are outlined, and the future research directions are also highlighted. The merits of using RIGC for modifying polymeric membranes to mitigate the fouling issue would increase membrane lifespan and enhance membrane system efficiency.
Keywords: Organic fouling; pressure driven membrane processes; polymeric membranes; radiation induced graft copolymerization; biofilm formation; antifouling properties

INVITED SPEAKERS 3

Biography
Dr. Dayang Norafizan binti Awang Chee

Dr. Dayang Norafizan binti Awang Chee is a senior lecturer and researcher at the Faculty of Resource Science and Technology, Universiti Malaysia Sarawak (UNIMAS). She obtained her PhD in Chemical Engineering from Universiti Teknologi Malaysia (UTM) in 2021, where her project focused on advanced membrane technology. Prior to this, she earned a Master's degree in Inorganic Chemistry from UNIMAS in 2012 and a Bachelor's degree in 1994. Dr. Dayang's research interests encompass a wide range of chemical sciences, with a particular emphasis on nanomaterials, membrane technology, and environmental applications, specifically in water treatment. She has made significant strides in synthesizing advanced materials, notably developing membranes designed to remove pollutants such as heavy metals and dyes from water sources. Her leadership in research has led to innovative projects, including the synthesis of reduced graphene oxide from sago waste for membrane fabrication and the exploration of carbon dots-ZIF-8 membranes for heavy metal removal. Dr. Dayang has published extensively in high-impact journals, contributing valuable insights into the adsorptive properties of novel materials for industrial waste treatment. Her work has garnered several awards, including recognition for her leadership in projects funded by prestigious grants such as the Tun Openg Chair (Sago Chair) and the VC High Impact Research Grant. Additionally, she received the RISE@UNIMAS Award for young researchers, underscoring her active role in research and innovation. Beyond her research contributions, Dr. Dayang is dedicated to mentoring postgraduate students, nurturing the next generation of scientists committed to environmental sustainability.

Harnessing ZIF-8 Membrane Combined with Sago Hampas-Derived Carbon Quantum Dots for Efficient Lead(II) Removal from Water

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ABSTRACT

Carbon nanomaterials with a large surface area that are 10 nm in size are known as carbon quantum dots (CQDs). A brand-new class of carbon nanomaterial called carbon dots (CDs) is made up of distinct, practically spherical nanoparticles. As the human risk and ecological health can be presented by lead(II) in water. The removal of lead ions from water and wastewater requires the development of low-cost adsorbents. CDs prepared from sago *hampas* via simple hydrothermal synthesis processes at two different temperature; 200°C and 160°C, have been found to be compatible as one of the nanomaterials for a new hybrid membrane to removing lead (II) from wastewater. In this study, a novel composite (CDs@ZIF-8) based on carbon dots and zeolitic imidazolate framework (ZIF-8) on the alumina membrane support was successfully synthesized by incorporating CDs into the pores of ZIF-8 through a simple in-situ solvothermal method. The morphology and physicochemical properties of the hybrid membranes were characterized using the Ultraviolet–visible (UV-vis) spectrophotometer, field emission scanning electron microscope (FESEM), Energy-dispersive X-ray (EDX) spectroscopy, Fourier-Transform Infrared Spectrophotometer (FTIR). The synthesized 160°C CDs@ZIF-8 membrane have a greater adsorption performance as opposed to the 200°C CDs@ZIF-8 membrane, with maximum potential for absorption of lead(II) is 95.16 mg/g was obtained at 100 ppm Pb(II) aqueous solution and 95.16% removal. The adsorption mechanism of lead(II) onto the CDs@ZIF-8 membrane was best fitted to the Freundlich isotherm and pseudo-second order model. The findings of this study indicate a strong prospective for employing for CDs@ZIF-8 modified alumina membrane wastewater treatment systems for removing lead(II) metals.

Keywords: *Carbon dots; zeolitic imidazolate framework-8; alumina membrane;adsorption, lead(II) removal*

INVITED SPEAKERS 4

Biography
Prof. Dr. Arun Mohan Isloor

Dr. Arun Mohan Isloor is a Professor in the Department of Chemistry at the National Institute of Technology Karnataka (NITK), Surathkal, India, where he has been a faculty member since January 10, 2008. He holds a Ph.D. in Chemistry and has accumulated over 13 years of professional experience, with a focus on research and teaching in various areas of chemistry. Dr. Isloor's research interests include the development of advanced materials for energy applications, environmental remediation, and nanotechnology. He has published extensively in peer-reviewed journals and has contributed significantly to the scientific community through his work on membrane technology and its applications in wastewater treatment and gas separation processes. His innovative approach has led to several funded research projects and collaborations with industry partners. Dr. Isloor is also actively involved in mentoring students, guiding them through their academic pursuits and research projects. He has served on various academic committees and has played a crucial role in curriculum development within the department. His dedication to teaching excellence has earned him recognition among students and faculty alike. In addition to his academic responsibilities, Dr. Isloor participates in national and international conferences, sharing his expertise and insights with peers in the field. His commitment to advancing knowledge in chemistry while fostering a collaborative learning environment reflects his passion for education and research, making him a respected figure at NITK and in the broader scientific community.

Tailormade Zwitterionic Polymeric Nanoparticles incorporated Membranes Revolutionizing Separation Technology

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ABSTRACT

Zwitterionic entities contain equimolar quantities of positive and negative charges on the same molecule. Hence zwitterionic moieties can form a hydration layer via hydrogen bonding with water molecules. This hydration layer prevents the accumulation of molecules around the components possessing the zwitterionic moiety. Therefore, the nanoparticles containing these moieties have been widely utilized for drug delivery purposes, since the hydration layer prevents the attack by the body's immune system and thereby improves the blood circulation time ensuring effective treatment. Since zwitterionic nanoparticles are well known for their antifouling properties, it has been theorized that their incorporation into polymeric membranes could improve the membrane properties; especially its antifouling property apart from its hydrophilicity and permeability. There is scope for experimental work regarding this area and the efficiency of these modified membranes in the rejection of natural organic matter (NOM), dyes, heavy metals, pesticides and pharmaceuticals. Apart from the application of these nanoparticles in water treatment, they have also been used as biosensors, antifouling coatings, coating of biomedical implants and in cell imaging.

INVITED SPEAKERS 5

Biography
Dr. Norfazliana Binti Abdullah

Norfazliana Binti Abdullah is a Senior Lecturer in the Oil and Gas Engineering Program at Universiti Malaysia Sabah. She holds a Doctor of Philosophy in Chemical Engineering from Universiti Teknologi Malaysia (2021), where her research focused on developing advanced membrane technologies, specifically Zirconia-based Metal-Organic Frameworks for water purification. She also earned her Master of Gas Engineering (2016) and Bachelor of Chemical-Gas Engineering (2012) from the same university. Norfazliana's research interests lie in membrane technology, oil spill cleaning, and environmental engineering, reflected in her numerous publications and research projects. Her academic career is distinguished by multiple awards, including a Gold Award in a research poster competition for her work on fluorinated UiO-66 for oil spill cleanup. She has secured several internal and external research grants and has presented her work at various international conferences. In addition to her research, she teaches courses such as material engineering and oil and gas production operations and supervises both undergraduate and postgraduate research projects. Norfazliana is also involved in academia-industry collaborations and plays an active role in faculty management.

Synthesis of Fluorinated Zirconia-based Metal-Organic Framework by using Solvothermal Synthesis for Oil Spill Cleaning

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ABSTRACT
The oil spill is the issue of liquid petroleum hydrocarbon into the environment, for most marine ecosystems, because of human activities, and is a form of pollution [1]. Oil spills can be caused by an accident during the transportation or storage of oil, or the failure of pipelines, offshore drilling platforms, or through oil tankers. The oil can have harmful effects on wildlife, as well as on the habitats and economies of the affected areas. Cleaning up the oil spill can be a complex and difficult process, and may involve the utilization of chemical dispersants, adsorption methods, and bioremediation. Zirconia-based Metal-Organic Framework (Zr-MOF) is selected due to its remarkable thermal and chemical stability, large pore size (6Å-8Å), and tunable functional groups as an effective adsorbent for oil spill [2]. A study of fluorinated Zr-MOF synthesized using acetone as a solvent replacing dimethylformamide (DMF) as a common solvent is studied and used as an effective adsorbent for oil spill cleaning. A common solvothermal synthesis was utilized to synthesis fluorinated Zr-MOF under different synthesis parameters i.e. metal salt mass loading, synthesis period, and synthesis temperature. [3]. The effect of synthesis parameters on the material synthesized was studied and prepared using solvothermal synthesis. The fluorinated Zr-MOFs were characterized by BET, FTIR, and XRD to determine their physicochemical properties. To determine the effectiveness as an adsorbent for oil spill cleaning, an adsorption experiment and isotherm kinetic studies were conducted. The synthesis fluorinated Zr-MOF showed a good performance for oil emulsion adsorption as a performance for oil spill cleaning due to the abundant CF_3 functional groups attributed to high affinity toward oil molecules [4].

Keywords*: oil spill, MOF, zirconia, UiO-66, solvothermal*

INVITED SPEAKERS 6

Biography
Dr. Sumarni Mansur

Dr. Sumarni Mansur is a senior lecturer in the Bioresource Technology Division, School of Industrial Technology, Universiti Sains Malaysia (USM). She received her PhD in October 2021 from the Faculty of Engineering, Universiti Teknologi Malaysia (UTM). She graduated with a Master of Philosophy in 2017 from UTM, where she received the Best Postgraduate Student Award. She completed her degree in Bachelor of Biomedical Sciences (Hons.) in 2014 at International Islamic University Malaysia. She worked as a research officer at UTM and post-doctoral researcher at Universiti Kebangsaan Malaysia before joining USM in November 2023. Her areas of interest include haemodialysis membranes, functional materials, biomass and bioresources, and water and wastewater treatment. In addition to her published works in journals and books, she has received recognition in her profession, as evidenced by her role as a speaker at seminars, conferences, and competitions. Among the awards are the Young Investigator Award by YSN-ASN in 2017, the Academic Publication Award (Top-tier Q1 Journal) in 2019, the Best Invention Award in INATEX, and the Best Oral and Poster Presenter Awards in conferences. Currently, she passionately educates new researchers in the field of membrane technology by giving talks and workshops on membrane fabrication and applications. She has also collaborated with the industry and schools in promoting sustainable development goals and STEM programs to the primary and secondary students by involving in various community programs.

Advancement of Dual Layer Hollow Fibre Membrane for Blood Purification

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Abstract
Hollow fibre membranes have been employed to purify blood from within the heart of the haemodialysis process, namely the dialyzer. These membranes can remove waste products and excess fluids from the blood, mimicking the natural filtration process of the kidneys to maintain the body's fluid and electrolyte balance. In the past decade, the interest in the utilisation of dual layer hollow fibre (DLHF) membranes has arisen due to the innovative idea of combining adsorption and diffusion processes into one step. By incorporating both processes, DLHF membranes can effectively remove a wider range of toxins and waste products from the blood, leading to better outcomes for haemodialysis patients. Here, the advancement of DLHF membranes for haemodialysis treatment is outlined. The motivation and the outcome from the first and second generation DLHF haemodialysis membranes are discussed. In addition, the use of DLHF membranes in other blood purification applications is presented. This short review would provide a perspective for membranologists to recognise the issues in DLHF haemodialysis membranes and to work their way to finding innovative solutions.

Keywords: dual layer hollow fibre membrane; haemodialysis; mixed matrix membrane; adsorption process; diffusion process

INVITED SPEAKERS 7

Biography
Dr. Shuichi Sato

Dr. Shuichi Sato is an Associate Professor in the Department of Electronic Engineering at Tokyo Denki University, Japan, where he has significantly advanced the field of electronic materials and devices. He earned his Bachelor's and Master's degrees in Industrial Chemistry from Meiji University in 2004 and 2006, respectively, followed by a Ph.D. in Engineering from the Department of Applied Chemistry at Meiji University in 2012. Dr. Sato's research encompasses a diverse array of topics, including opto-functional materials, electrochemical devices, applied plasma science, advanced polymer materials, eco-friendly plastics, and barrier technologies. His innovative work has led to the development of cutting-edge materials and technologies that address critical challenges in these fields. With over 50 peer-reviewed journal articles and book chapters to his name, Dr. Sato is recognized as an expert in his domain. His contributions have earned him several prestigious awards, including the Outstanding Poster Paper Award at IDW/AD '12 and the Engineering Graduate School Dean's Award for Research Excellence from Tokyo Denki University in 2023. Beyond his research endeavors, Dr. Sato is deeply committed to education and mentorship. He actively supervises student projects that have received accolades and participates in outreach activities aimed at inspiring future generations in science and technology. His dedication to fostering talent in the field is evident through his involvement in various educational initiatives and scientific events, making him a respected figure within both academic and professional communities.

Effects of Heat, Solvent, Photo, and Filler-Induced Structure Control of Polylactic Acid on Gas and Vapor Barrier Properties

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ABSTRACT

Bioplastics, particularly biodegradable polymers derived from renewable resources such as polylactic acid (PLA), have gained significant attention as a potential solution to environmental issues caused by conventional petroleum-based plastics. For packaging applications, gas barrier properties are crucial for maintaining product quality and shelf life. This study discusses the relationship between the higher-order structure and gas barrier properties of PLA films. Gas permeability in polymers is described by the solution-diffusion mechanism, where gas molecules dissolve into the polymer matrix, diffuse through the free volume, and desorb from the opposite side. The permeability coefficient (P) is the product of the diffusion coefficient (D) and the solubility coefficient (S). Controlling the higher-order structure of PLA can significantly influence its gas barrier properties. Our research group has investigated various methods to control the crystalline structure of PLA films, including thermal treatment (heat-induced crystallization)[1)], organic solvent treatment (solvent-induced crystallization)[2)], vacuum ultraviolet irradiation (photo-induced crystallization)[3)], and additive incorporation (nucleating agent-induced crystallization)[4)]. The resulting PLA films were characterized using polarized optical microscopy (POM) and scanning electron microscopy (SEM) to observe the crystal domain size, dispersion, and surface morphology. Interestingly, the gas barrier properties of PLA films exhibit a unique behaviour compared to conventional polymers. In the low crystallinity range (0-25%), gas permeability and diffusivity are not significantly affected by the crystalline structure. This is attributed to the presence of an interfacial phase between the crystalline and amorphous regions, which acts as a bypass for gas diffusion. However, at higher crystallinity levels (>40%), the continuity of the crystalline structure effectively hinders gas diffusion, leading to improved gas barrier properties. In conclusion, understanding the relationship between the higher-order structure and gas barrier properties of bioplastics is crucial for developing high-performance packaging materials. As new bioplastics are developed and introduced in response to the growing demand for sustainable materials, further research on structure-property relationships and the development of new theoretical models for gas transport in these materials will be essential for driving innovation.

INVITED SPEAKERS 8

Biography
Dr. Triyanda Gunawan

Triyanda Gunawan is a prominent academic and researcher affiliated with the Institut Teknologi Sepuluh Nopember (ITS) in Surabaya, Indonesia. He holds a Doctorate in Chemistry and is known for his significant contributions to the fields of gas separation using membrane technology. Triyanda has published numerous papers in reputable journals and conferences, establishing himself as a thought leader in his areas of expertise. He is actively involved in mentoring students and collaborating with industry partners to bridge the gap between theoretical research and practical applications. In addition to his research activities, Triyanda participates in various academic committees and contributes to the development of educational programs at ITS, aiming to foster innovation and technological advancement in Indonesia. His work not only advances academic knowledge but also addresses real-world challenges in membrane science and energy sectors, making him a valuable asset to both the academic community and the industry. Through his dedication to research and education, Triyanda Gunawan continues to inspire future generations of engineers and researchers in Indonesia and beyond.

INVITED SPEAKERS 9

Biography
Prof. Dr. Jiang Lanying

Dr. Jiang Lanying is a distinguished Professor at the School of Metallurgy and Environment at Central South University (CSU) in China, where she has made significant contributions to the field of membrane-based separations. She began her academic journey with a Bachelor of Science degree in Environmental Science from Wuhan University in 1997, followed by a Master-Doctorate program at the National University of Singapore (NUS), where she earned her Ph.D. in Chemical and Biomolecular Engineering in 2006. Dr. Jiang's research interests encompass the science and engineering of membranes, focusing on their formation and application in bioenergy, metallurgical, and petrochemical industries. Currently, her work is centered on membrane distillation for desalination and energy recovery, addressing critical environmental challenges. As a principal investigator, she leads eight research projects funded by various prestigious organizations, including the National Natural Science Foundation of China. With over 40 publications in peer-reviewed journals, Dr. Jiang has also served as chief editor for two professional books on membrane separation and contributed to several book chapters. Her active participation in the scientific community includes delivering more than 40 oral presentations at national and international conferences, where she has also chaired sessions. In addition to her research endeavors, she is committed to education, leading three undergraduate courses and three graduate courses, and has received the Excellent Teaching Award from CSU multiple times since 2017, reflecting her dedication to fostering the next generation of engineers and scientists.

Developing PVA/CNT/PTFE composite membranes for Membrane Distillation

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Keywords: Membrane distillation; Janus membrane; Oil resistance; Anti-wetting.

Membrane distillation is a water treatment technology featuring with low footprint, energy flexibility etc. Conventional hydrophobic membrane distillation is challenged by many serious problems and hydrophilic/hydrophobic Janus membrane emerges as a potential solution. In current work, a polyvinyl alcohol (PVAc)/carbon nanotube (CNT)/polytetrafluoroethylene (PTFE) Janus membrane (Figure 1) was developed for direct contact membrane distillation (DCMD). Vacuum filtration was used to suck the CNT particles unto the PTFE substrate and proved an efficient way to obtain homogenous and dense CNT layer. The follow-up steps include PVAc dip coating, glut aldehyde (GA) crosslinking and thermal annealing. The resultant membrane showed obvious anti-oil fouling property, in contrast with the original PTFE membrane (Figure 2). Water molecules effectively adsorb on the PVAc/CNT layer to prevent adhesion of oil droplet with membrane. Although having a thick PVAc/CNT composite hydrophilic layer, the Janus membrane exhibited flux similar to that of the original PTFE membrane (Figure 2). This phenomenon is attributed to the highly rough surface of PVAc/CNT structure and the excellent thermal conductivity of CNT. The first factor diminishes the temperature polarization at membrane/feed interface, whereas the second factor makes the temperature at the vapor/liquid interface inside membrane approach those of feed solution. In the long term performance test using oil-containing saline water, the Janus membrane failed on the third day (Figure 3). The probable reason is that the CNT layer cracked due to the continuous asymmetric swelling of the PTFE substrate in DCMD. Various characterizations were conducted to support our discussions in this work.

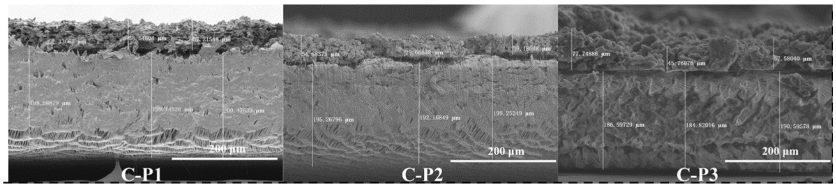

Figure 1. Cross-sectional morphology for PVA/CNT-modified PTFE membrane (C-P-1 to C-P-3 used different CNT).

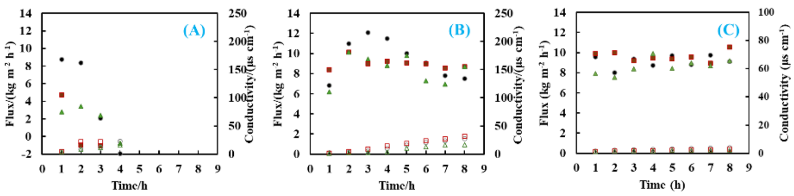

Figure 2. DCMD performance in treating oily saline (oil 0.5g/L, NaCl 3.5wt.%): (A) original PTFE membrane; (B) PVA coated membrane; (C) PVA-CNT coated membrane.

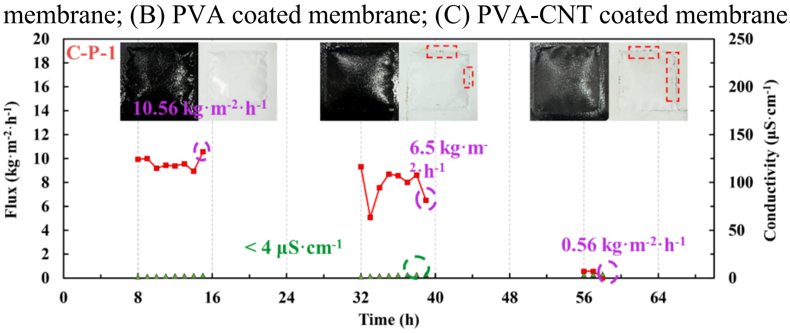

Figure 3. DCMD Long-term performance of PVA/CNT/PTFE(C-P-1) in treating oily saline (oil 0.5g/L, NaCl 3.5wt.%).

INVITED SPEAKERS 10

Biography
Dr. Mohd Haiqal Bin Abd Aziz

Dr. Mohd Haiqal Bin Abd Aziz is the Head of the Biotechnology-Sustainable Material (B-SMAT) Research Group at Universiti Tun Hussein Onn Malaysia (UTHM), where he leads innovative research aimed at advancing sustainable bioproduct technologies, wastewater treatment solutions, and renewable bio-composite materials. His research primarily focuses on surface interfacial sciences and the development of 2D materials, with a particular emphasis on enhancing membrane technology for molecular separation processes. As Chief Editor of Progress in Engineering Application and Technology, Dr. Haiqal plays a vital role in overseeing the editorial process, ensuring the quality and rigor of submissions while guiding authors through the peer review process. In addition to his editorial responsibilities, he serves as a Senior Lecturer in the Department of Chemical Engineering Technology at UTHM, where he teaches core subjects such as process plant design, process simulation, engineering drawing, process control, and chemical reaction engineering. Dr. Haiqal earned his PhD from Universiti Teknologi Malaysia and has a background as a production executive at BASF Petronas Chemicals Sdn Bhd prior to his academic career. His diverse expertise not only enriches his teaching but also enhances his research initiatives, positioning him as a key contributor to advancements in sustainable engineering practices. Through his leadership in research and education, Dr. Haiqal is dedicated to addressing pressing environmental challenges while fostering the next generation of engineers equipped with the skills necessary for sustainable development.

Unraveling the Surface: The Crucial Role of Topography and Chemistry in Membrane Wettability.

Dr. Mohd Haiqal Bin Abd Aziz

This presentation will elucidate the complex interplay between surface topography and chemistry in substrate's surface such as membranes and fabrics designed for thermal-based water treatments, such as membrane distillation and interfacial evaporation. The theory of hydrophilicity and hydrophobicity from a theoretical perspective, three important models to be considered: Young's equation, Wenzel's model, and Cassie-Baxter's model. This session discuss three prevalent methods of surface energy modification: pre-roughening followed by fluorination, pre-fluorination followed by roughening, and a one-step approach. The interplay between topographical features and chemical properties will be examined in relation to water permeability, fouling resistance, and overall system efficiency. Additionally, we will review recent innovations in membrane design, including nanostructured surfaces, which hold promise for optimizing water interactions. This overview aims to provide valuable insights into the mechanisms governing surface wettability and to inform future research efforts aimed at developing advanced membranes or fabrics for thermal-based water technologies.


ORAL PRESENTER

Paper ID : A001

Predicting Membrane Flux in Ultrafiltration Process: A New Approach Using Neural Network and Response Surface Methodology for Modeling and Sensitivity Analysis

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ABSTRACT

Ultrafiltration is a highly effective method for separating substances in processes such as desalination pretreatment, reverse osmosis pretreatment, wastewater reclamation, and drinking water production. Artificial neural networks (ANNs) and response surface methodology (RSM) are widely used for modeling and optimizing membrane processes. RSM necessitates data on a particular experimental design, but ANN does not have this requirement. This study introduces a novel strategy that combines artificial neural networks (ANN) with response surface methodology (RSM) to accurately forecast and enhance the membrane flux in the ultrafiltration process. The Artificial Neural Network (ANN) model, derived from an empirical investigation, is employed to forecast the experimental configuration's membrane flux and construct the Response Surface Methodology (RSM) model for optimization. A central composite design (CCD) is employed to construct a response surface design, whereby the artificial neural network (ANN) model assesses the replies. The input variables included the difference in osmotic pressure, the velocity of the feed solution (FS), the velocity of the draw solution (DS), the temperature of the feed solution (FS), and the temperature of the draw solution (DS). The coefficient of determination (R2) for the generated artificial neural network (ANN) model is 0.970304, while for the response surface methodology (RSM) model it is 0.9265. The ANN model weights and response surface plots were utilized to optimize and analyze the impact of operational circumstances on the membrane flux.

PURIFICATION OF PALYGORSKITE AND ITS EFFECT ON THE PERFORMANCE OF FORWARD OSMOSIS THIN FILM NANOCOMPOSITE MEMBRANE

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ABSTRACT

Palygorskite (PAL) is a type of environmental friendly natural nanoclay having a tubular structures and fibrous morphology, displaying chemical and thermal stability in addition to large specific surface area. The tubular structures of PAL have cross-sectional area of 0.37 × 0.63 nm^2, which facilitates the selective transports of water molecule. Studies have shown that purifications of PAL improve its interactions with polymer chain, which in turn facilitates nanofiller dispersion and enhances the properties. Nonetheless, the effects of purification of this material on thin film composite forward osmosis membranes specifically on the substrate layer have not yet been evaluated. In this present study, PAL powder, as supplied underwent purification via; 100 g of PAL as was supplied was mechanically dispersed with reverse osmosis (RO) water for a period of 1 h. Then, the slurry was filtered with a 70 mesh sieve (0.224 μ m, standard ASTM E 11-70) followed by addition of 100 ml hydrochloric acid solution to the PAL slurry and mechanically stirred for a period of1 h. It was thereafter washed severally till a p H 7 was attained. Lastly, the resultant purified PAL was dried in an oven at temperature of 100°C for a 24 h period and code named P-PAL. The membrane substrate was developed with P-PAL to enhance the flux of TFC forward osmosis membrane. The P-PAL used was 0.1 weight fraction (0.1 wt/wt %). For the fabrication of the membrane substrate, specified quantity of P-PAL was added into solvent and subjected to sonication for 30 mins at room temperature to ensure that the P-PAL fully dispersed. Thereafter, 15 % of PSF polymer was gradually introduced and stirred mechanically until it was dissolved completely. The prepared solution was kept at room temperature for a period of 24 hours for trapped air bubbles removal. Next, the prepared dope mix solution was cast on a clean glass plate using glass rod and immersed eventually into coagulation reverse osmosis water bath. Finally, the membrane substrates were peeled off and stored in RO water. The polyamide layer was formed via interfacial polymerization between m-phenylediamine and trimethylchloride. The nanocomposite membranes were named as Neat, U-PAL and

P-PAL correlating to neat membrane, un-purified PAL incorporated membranes and purified PAL embedded membrane respectively. The FO desalination performance of the resultant membrane was examined in active layer facing feed solution and active layer facing draw solution modes applying NaCL as draw solution. The wettability of the membrane was evaluated via conducting dynamic contact angle and RO water the probe liquid. The sessile drop method was used for the contact angle of water measurement on the dried surfaces of the membranes. When compared with the pristine membrane, the TFC membrane incorporated with A-PAL substrate showed improved water flux as well as lower structural parameter. The embedment of P-PAL led to an enhanced flux of 18.21 Lm^{-2} h^{-1} which is equivalent to enhancement by 92 % in comparison to that of neat membrane. During anti fouling test operation, A-PAL membrane recorded 92 % water recovery while the neat membrane recorded 89 % water recovery. It is concluded from the research findings that the addition of the A-PAL nanoparticles within substrate has substantial effects on the performance of the TFN-FO membrane.

Keywords: *Thin film nanocomposite membrane, palygorskite, substrate layer, desalination, Forward osmosis.*

Adsorption of colour, TDS and COD from palm oil mill effluent (POME) using Magnetic OPEFB-NC/LDH Hybrid Nanocomposite

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ABSRACT

The palm oil mill effluent (POME) is highly polluting, which requires effective treatment before it can be discharged into watercourses. POME can be treated with adsorption, which is a promising technology as it requires low adsorbent dosages, which is important in zero-emission systems. This study investigated the color removal efficiency, TDS and COD using a magnetic OPEFB-NC/LDH hybrid nanocomposite using nanocellulose extracted from oil palm empty fruit bunch (OPEFB), and magnetic layered double hydroxide (LDH) through the evaluation of the adsorption uptake as well as the adsorption kinetics and mechanism. The adsorption equilibrium was best represented by Langmuir and Freudlich isotherm model whilst the kinetics of adsorption was well described by pseudo-first-order model and the pseudo-second-order. The optimum condition for adsorption was at a dosage of 5g/L, 24-hour mixing time, and a speed of 200 rpm.

***Keywords**: Oil Palm Empty Fruit Bunch, Adsorption, Nanocomposite, Nanocellulose*

Paper ID : A004

Green Anion Exchange Membrane Classification Using Deep Learning for Reverse Electrodialysis

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ABSTRACT

This study introduces an innovative deep learning methodology focused on classifying green anion exchange membranes (AEMs) for reverse electrodialysis (RED) applications. AEMs play a vital role in electrochemical processes by regulating ion transport. In RED, a nascent technique for harnessing renewable energy from salinity gradients, AEMs facilitate the movement of negatively charged ions while impeding positively charged ions. Our approach utilizes advanced deep learning techniques, particularly convolutional neural networks (CNNs), to systematically analyze and categorize AEMs based on their eco-friendliness and suitability for RED. By commence with comprehensive data collection and preprocessing to compile a diverse dataset covering various AEM compositions and properties. Employing CNNs, essential features extracted from the AEM dataset, followed by rigorous training and validation to precisely classify AEMs according to their compatibility with RED processes. Our findings underscore the effectiveness of our deep learning framework in accurately categorizing eco-friendly AEMs tailored for RED, surpassing traditional machine learning methods. Moreover, our models provide insights into the underlying structure-property relationships of AEMs, aiding the discovery of materials optimized for eco-friendly RED processes. In conclusion, this research furnishes a robust tool for swiftly and efficiently classifying eco-friendly AEMs specific to RED, thereby contributing to the advancement of sustainable energy solutions and the global transition towards cleaner, more sustainable energy systems.

Keywords: *anion exchange membrane, convolutional neural networks, deep learning, energy generation, reverse electrodialys*

Paper ID : A006

Utilization of palm oil fuel ash (POFA) for dye wastewater remediation

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ABSRACT

Palm oil fuel ash (POFA) is a waste byproduct of combustion of palm oil biomass waste in power generation. The utilization of POFA is relatively low, where most of the POFA is disposed to the landfill. Although it does not have heavy metal leaching problem as found in coal fly ash, the generation of POFA impacts the cost and space for management of ash landfill. The potential utilization of POFA as a ready-made biosorbent will be able to reduce the disposal volume. In this study, the POFA was enhanced by incorporation with layered double hydroxide through co-precipitation and hydrothermal treatment. The hydrothermally-treated POFA-LDH served as an adsorbent for removing reactive orange 16 in a batch adsorption test. The chemical structure, surface area, and morphology analysis for the P-LDH were investigated by analyzing X-ray Diffraction (XRD), Fourier-transform Infrared Spectroscopy (FTIR), scanning electron microscope (SEM), energy dispersive X-ray spectroscopy (EDX) and Brunauer–Emmett–Teller (BET). The XRD and EDX analysis revealed the presence of finely crystalline LDH on the textured surfaces of the original POFA samples. Additionally, confirmation of the successful synthesis of LDH composites with POFA was established FTIR analysis. The removal of RO16 by the composite was studied by varying the POFA loading, pH, contact time, adsorbent dosage, initial dye concentration and salt concentration. The result reveals that the composite of POFA-LDH 1.0 displayed a synergistic effect on the adsorption of RO16 compared to LDH and POFA. The maximum adsorption capacity of POFA-LDH 1.0 was 164.51 mg/g at pH 7 for 200 mg/L of RO16. The adsorption was found to follow Langmuir and pseudo-second-order, respectively, according to both adsorption and kinetic isotherms models. Hence, the incorporation of LDH onto cost-effective POFA demonstrated superior adsorption efficiency for RO16 when compared to the unmodified POFA and LDH.

Paper ID : A008

Optimization of Pyrolysis Condition for Biochar Production from Empty Fruit Bunch

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Empty fruit bunch (EFB) is one of the major biomass wastes generated from Malaysia's palm oil industry. Activated carbon is one of the most used adsorbent materials in wastewater treatment. However, the high cost of activated carbon has limited its application in respective fields. Thus, the thermochemical conversion of biomass to produce biochar, a carbon-rich biomaterial that could be an alternative adsorbent material for pollutant adsorption. Pyrolysis is the most popular method to convert biomass to biochar. To enhance the yield of biochar, slow pyrolysis will be used where the temperature will be within the temperature range of 400-600oC and 1-3 hours. To optimize the pyrolysis condition, the response surface method (RSM) with faced central composite will be used with temperature and time as parameters, while biochar yield and percentage of dye removal will be used as the response. FESEM, XPS, FTIR, and XRD will be used to characterize the biochar to identify the parameters' effect on biochar adsorption. Biochar produced at higher temperature and longer time is expected to have better adsorption ability due to enhanced surface area and porosity. The optimized condition of biochar will be obtained through analysis of variance (ANOVA) with an expected R-squared value greater than 0.95 for accurate estimation of response from the model.

Paper ID: A009

Review on Microbial Fuel Cell System for Simultaneous Energy Generator and Palm Oil Mill Effluent Waste Treatment

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The industrial production of palm oil leads to the creation of massive quantities of palm oil mill effluent (POME), which is considered wastewater that has severe environmental impacts. Current attempts at POME treatment are considered to be lengthy and do not capitalize on all of the possible inherent resource values present in this waste stream. To this effect, MFC power could be presented as a workable solution to managing POME in a more sustainable manner since it is capable of treating wastewater, generating electricity, and may further boost biogas yields. In order to achieve these objectives this study seeks to literature studies, and examine the research on MFC advancement in treating POME and functioning as an energy generator. This work aims at presenting the current known literature on use of microbial fuel cell (MFC) for treating palm oil mill effluent (POME). They discuss the factors that define POME, its environmental effects, the need to treat POME wastes, and the possible products that can be developed from the treated wastes. This paper also provides information on the general principles of microbial fuel cells, some key aspects that influence the performance of microbial fuel cells, to the possibility of using POME waste in Microbial Fuel Cells. Moreover, this study also looks at the advancement of MFC technology which has been used previously in treating POME waste, the issues, and possibilities of employing MFCs in treating POME waste. Therefore, this review focuses on addressing the positivity of microbial fuel cell technology as an effective system for dealing with palm oil mill effluent, as well as its potential to produce electricity at the same time as treating wastewater, and potential added-value products.

Keywords: Microbial Fuel Cell; Palm Oil Mill Effluent; POME Treatment; Waste Treatment

Review on Limitations of Organic Ion Exchange Membrane in Microbial Fuel Cell and The Potential of Ceramic Ion Exchange Membrane in The Application

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Climate change has been globally concerned for decades due to urbanization and over-consumption of fossil fuels. In that case, introduction of renewable energy technologies is mandatory to overcome the issue. The types of renewable energy technologies are such as fuel cells, solar panels, hydropower generators, wind turbines, and others, relying on sustainable resources to generate electricity without greenhouse gas emissions. Among them, fuel cells are advanced renewable energy technologies known for consuming hydrogen and oxygen as underrated fuel sources, and providing fuel-energy conversion rate worth of 60%. The types of fuel cells are categorized based on several factors such as the fuel, electrolyte (membrane), anode and cathode catalyst, and operating temperature.

Utilizing biofuels with electroactive microorganisms in fuel cell technology is a promising approach to produce hydrogen ions for electrochemical fuel cell reactions. The fuel cell is known as microbial fuel cell (MFC) and it degrades the organic matter with the aid of electroactive microorganisms as biotic catalyst to produce electricity while cleansing the wastewater. The downside of MFC is that it is an infancy technology, leading to low power generation, frequent fouling issues, and substrate and oxygen crossovers. Importantly, MFC is widely utilizing expensive organic ion exchange membranes, typically Nafion, for higher power generation from the high proton conductivity but they increase the capital cost of the MFC. Another limitation of organic ion exchange membranes is that they are sensitive to harsh pH of wastewater and degrade easily during the MFC operation. To replace the expensive organic ion exchange membranes, ceramic membranes are a promising alternative as they have high chemical stability and cheap production cost. Therefore, this study is to investigate the flexibilities and advantages of ceramic membrane provided in MFC applications.

Adsorptive membrane for hemodialysis: Potential, Future Prospection and Limitation of MOF as Nanofillers

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Abstract

The field of membrane materials is the most dynamic due to the constantly evolving requirements advancement of materials, to address challenges such as biocompatibility, protein-bound uremic toxins, blood coagulation, auto-immune responses, oxidative stress, and poor clearance of uremic toxins. Hemodialysis is a membrane filtration processes that is currently necessary for daily living of the patients with ESRD. Tens of millions of people with ESRD have benefited from hemodialysis over the past 60–70 years, both in terms of safeguarding life and a longer lifespan. Beyond challenges associated with the efficiency and separative properties of the membranes, ensuring hemocompatibility, or the safe circulation of blood outside the body for four hours every two days, remains a persistent challenge. This review explores the ongoing field of metal–Organic Frameworks (MOFs) and their applications in hemodialysis, offering a comprehensive examination of various MOFs employed to address challenges inherent in traditional hemodialysis methodologies. this This review included includes the experimental work done with various MOFs as a filler such as UiO-66, HKUST-1, MIL-101, and ZIF-8, which together lead to improved adsorption capacities for a range of uremic toxins and proteins. Furthermore, this review highlights how effectively MOF-based hemodialysis membranes remove a variety of uremic toxins, including p-cresol, urea, creatinine, and indoxyl sulfate and potential filler choices for the future. Future research efforts should focus on refining synthesis techniques, enhancing toxin selectivity, and investigating the long-term durability of MOF-based membranes. With these considerations, MOFs emerge as transformative materials in the quest to develop advanced and efficient hemodialysis technologies, holding the promise to significantly enhance patient outcomes and redefine the landscape of renal therapy.

Paper ID: A012

CHARACTERIZATION OF BIOFOULING BACTERIAL STRAIN IN MEMBRANE WATER TREATMENT SYSTEMS

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ABSTRACT

The availability of clean and safe water for drinking is essential for human life and existence, which ideally should be suitable for consumption and not contain pathogenic microorganisms, or any contamination leading to pollution. Membrane water treatment systems are integral to modern water purification processes, yet they are frequently challenged by biofouling. Biofouling continues to be a major obstacle in membrane water treatment systems, resulting in decreased efficiency, higher energy usage, and increased operational expenses. Therefore, this study aimed to determine the bacteriological characteristics of drinking water by isolating and identifying bacterial strains from water samples contributing to biofouling. Samples were obtained from membrane water treatment systems (MWTS) at different locations in Malaysia. Selected isolates of unique bacterial strains were identified and assigned their accession numbers. Phylogenetic analysis revealed that these isolates were related to *Bacillus cereus*, *Stenotrophomonas maltophilia*, and *Stenotrophomonas pavanii* species, suggesting that deterioration in water quality from the source, human error, and technical failure may cause decline even if the most desirable treatment systems and disinfection procedures applied.

Keywords: Biofouling, Membrane water treatment systems, drinking water, Bacterial strain, System efficiency

Ultrafiltration of Juices: Enhancing Membrane Properties with Green Solvent and Microcrystalline Cellulose Reinforcement

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The ultrafiltration process in juice aims to remove the haze component (pectin) while maintaining the nutritional content of the juice. However, the main challenge in membrane technology is the inherent fragility of membranes, making them susceptible to damage and deformation due to pressure or mechanical loads. Incorporating microcrystalline cellulose (MCC) into membranes has shown the potential to increase mechanical strength and flexibility, thereby increasing resistance to fatigue and deformation. In this study, MCC is used as an additive in the production of cellulose acetate (CA) polymer membranes using green solvent (dimethyl sulfoxide, DMSO) and commercial solvent (dimethylacetamide, DMAc). Membranes were made using the phase inversion method with a target thickness of 0.3 mm. For the DMSO solvent, the MCC concentrations used were 0 %, 0.08 %, 0.16 %, 0.24 %, and 0.32 %. Scanning electron microscope (SEM) analysis revealed that the membrane exhibited microscopic structures. Water contact angle measurements showed a hydrophilicity of 57.88° for the 0.16 % MCC. Optimal tensile strength was achieved with 0.32 % MCC (0.41 MPa), while the highest thickness was observed at 0.24 % MCC (0.26 mm). In DMAc solvent, the MCC concentrations used were 0 %, 0.09 %, 0.18 %, 0.27 %, and 0.36 %. SEM analysis again shows the macroscopic structure of the membrane. Water contact angle measurements showed a hydrophilicity of 56.81° for the 0.36 % MCC. Optimal tensile strength and thickness were achieved using of 0.18 % MCC, reaching 0.659 MPa and 0.27 mm, respectively. The main goal is to use a plate frame system specially designed for clarifying orange juice. The combination of green solvent and MCC offers a promising strategy for sustainable, environmentally friendly and highly engineered membranes for orange juice clarification.

Keywords: Cellulose Acetate, Dimethylacetamide, Dimethyl Sulfoxide, Membrane, Microcrystalline Cellulose, Plate and Frame

Paper ID: A014

Tailoring Polymeric Hollow Fiber Membranes for Selective Separation: An In-Depth Review of Surface Modification Techniques

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Polymeric membranes have gained considerable attention as a competitive technology for liquid and gas separation applications due to their energy-efficiency, environmental friendliness and improved safety. The hollow fiber configuration is preferred over flat sheet designs due to its self-supporting structure, larger surface area and higher packing density. Surface modifications not only improve the separation performance of membranes, but also expand their use in a wider range of environmental applications. This review discusses the various surface modification techniques used to tailor membrane properties to meet specific operational requirements. Surface modifications such as coating, chemical cross-linking, interfacial polymerization, plasma treatment and grafting not only increase the membrane's separation efficiency but also improve its chemical and thermal stability. Each modification technique is briefly examined to reveal its effects on membrane performance, focusing on the integration of functionality without compromising the inherent properties of the base polymer. In addition, the analytical techniques used to quantify and characterize these modifications are discussed to better understand their effects at the molecular level. Finally, existing challenges such as fouling, chemical resistance and longevity are discussed. This comprehensive overview not only highlights the transformative potential of surface modifications of hollow fiber membranes but also provides an outlook on future research and development in this dynamic field.

Hydroxyapatite-based bioceramic membrane from Undulate Venus clamshell waste (*Paratapes undulatus)* for dialysate purification

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The effectiveness of dialysate in hemodialysis is less efficient due to its single use and the generation of a considerable quantity of waste. One potential solution to this issue is purification techniques based on membrane technology. The membrane materials used in dialysate purification must be biocompatible. In this study, hydroxyapatite is derived from marine waste used in biofilms. To enhance the characteristics of hydroxyapatite bio-ceramic membranes, a polyvinyl alcohol (PVA) polymer was incorporated as a cross-linking agent and membrane pore former. This study employed various methods to develop a sintering technique to fabricate bio-ceramic membranes, including the variation of hydroxyapatite material from shell waste using concentric ball milling (CBM) and planetary ball milling (PBM), as well as the variation of PVA polymer addition. The concentration of PVA polymer varied at 0%, 10%, and 20%. The morphology of the bio-ceramic membrane was analyzed using SEM. The results of density and porosity tests for the bio-ceramic membranes showed that as the concentration of PVA increased, the density decreased while the porosity increased. The membrane with PBM/PVA 0% showed the highest average Vickers hardness value at 210.8409 kg/mm^2. Furthermore, the highest average clean water flux was observed in the membrane containing PBM/PVA 20%, reaching 11,461.288 L/m^{2}H. This evidence suggests that the bio-ceramic hydroxyapatite membrane for the PBM process with the addition of PVA polymer has the potential to be an effective and environmentally friendly alternative for dialysate purification.

Keywords: hydroxyapatite, polyvinyl alcohol, bio-ceramic membrane, purification, dialysate

Utilization of waste cigarette butt as cellulose acetate in phase-inverted polymer blend membrane for river water filtration

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The growing prevalence of discarded cigarette waste has necessitated an urgent effort to address the pollution challenges arising from widespread cigarette littering worldwide. Cigarette filters are composed of up to 96% cellulose acetate (CA), a derivative of a natural polymer that has been extensively utilized in diverse material synthesis applications, particularly in membrane fabrication. CA has served as an environmentally sustainable alternative to synthetic polymers commonly used in membrane manufacturing, owing to its biodegradability and superior hydrophilic characteristics. Although the utilization of CA derived from waste cigarette butt has been explored in prior studies, its potential application in polymer blends for membrane fabrication has not yet been investigated. This study proposes a method to utilize waste cigarette butts as a source of CA to synthesize a phase-inverted membrane blended with polyvinylidene fluoride (PVDF), yielding synergistic properties for the filtration of river water. The fabricated membranes were then thoroughly characterized to evaluate their intrinsic properties and filtration efficiency using local river water with a high concentration of natural organic matter (NOM). The study findings indicate that incorporating CA from cigarette butts into polyvinylidene fluoride (PVDF) membranes can improve their hydrophilicity and wettability through polymer blending. This CA-PVDF blend exhibited enhanced clean water permeability compared to pure CA and PVDF membranes. However, the CA-PVDF blend membranes still experienced a significant degree of irreversible fouling and exhibited low NOM removal efficiency, suggesting the need for further improvements in membrane fouling mitigation. Overall, this research demonstrates a sustainable approach to utilizing cigarette butt waste as a resource for the fabrication of membranes, promoting a circular economy by converting waste into valuable products.

Keywords: cellulose acetate, cigarette waste, polymer blend, membrane fabrication, phase inversion, river water filtration

Fundamentals Characteristics of Polymer Electrolyte Membranes for Fuel Cells- A Mini review

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Abstract

Proton exchange membrane fuel cell (PEMFC) offers a promising solution to reduce energy consumption, minimize pollution emissions, and decrease our dependence on fossil fuels. PEMFC functions by converting fuel's chemical energy into electrical energy through electrochemical reactions that take place at the electrodes. The main advantages of fuel cell applications include their quick start-up, efficient operation, lack of harmful emissions, and modular design. It also offers the advantages of operating at low temperatures and achieving high energy efficiency. The PEMFC shows great potential as a viable alternative energy source for a variety of uses, including stationary equipment, portable power devices, and vehicles. Proton exchange membrane (PEM) is the main component of a PEMFC. Recent research indicates that the primary factors contributing to the decline in performance and limited lifespan of PEMFC are inadequate proton conduction, low ion exchange capacity (IEC), fuel crossover, and diminished chemical, mechanical, and thermal strength of the PEM. The limitations of the PEMs continue to hinder their widespread commercialization. Proton conduction and IEC play a vital role in enhancing the performance of PEMs, while the stability of the membranes in terms of chemical, mechanical, and thermal aspects extend the operational lifespan of the PEMs in PEMFC.

This review examines the fundamental characteristics of PEM that are essential for enhancing performance and durability in PEMFC. We aim to provide researchers in the field with a comprehensive understanding of the crucial issues that must be tackled to enhance the efficiency and lifespan of next-generation fuel cells. In the end, a thorough conclusion has been given, and future possibilities have been proposed.

Keywords: Fuel cells, Proton exchange membrane, Performance, Durability

Paper ID: A018

A mini review on the progress of UF membranes with enhanced fouling and abrasion resistance for water treatment

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Ultrafiltration (UF) membranes are extensively used in water treatment to remove impurities and contaminants from various sources. The cost-effectiveness and ease of production of polymeric membranes have driven their rapid growth and widespread adoption in water purification compared to inorganic alternatives. Beyond membrane fouling, challenges such as abrasion are significant as they can adversely affect filtration performance, leading to membrane flux decline, particularly under harsh conditions like desalination. To extend the application of membranes to more challenging water sources containing abrasive particles, membranes with enhanced physical durability are highly desirable. This article highlights the development of microporous membranes with improved fouling and abrasion properties for water treatment. Focus will be placed on the roles of nanomaterials in enhancing the characteristics of polymeric membranes to withstand more demanding environments. This article will also highlight the effectiveness of membrane fabrication and modification techniques in incorporating nanomaterials into or onto membranes.

Keywords: ultrafiltration; nanomaterials; abrasion; fouling; water

Natural and green materials for sustainable TFC membrane fabrication – A review

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Over the past few decades, the unprecedented rise in population growth, rapid industrialization, climate change and urbanization had placed a heavy burden on the environment leading to the declining of water supply. The water scarcity raises concerns about the sustainability of clean water supplies to meet the increasing demand of clean water. Membrane technology as a powerful separation technique for water treatment offers an efficient and environmentally friendly solution for sufficient clean water supply by replenishing water from variety water or wastewater sources for reusable purpose. Thin-film composite (TFC) membranes integrating an ultrathin selective layer and a porous substrate layer has dominant place in the current commercial market for membrane technology due to their outstanding separation performance, reversible fouling properties and potential cost-effectiveness. Despite the satisfactory performance of TFC membranes, there are aspects in their manufacturing process being considered as low sustainability and cannot be defined as green. The TFC membrane manufacturing process depends heavily on the petrochemical industry including the uses of non-biodegradable and fossil fuel-based polymers and hazardous solvents, leading to unsustainability issues. To address the issues, investigations have been conducted to explore sustainable and environmentally friendly approaches for TFC membrane fabrication to satisfy the green chemistry principles. This paper aims to cover the recent works on the modification of interfacial polymerization (IP) process using green materials including natural/bio-based monomers and green solvent for synthesizing selective layer of TFC membrane. In separation process, the thin selective film is responsible to the membrane permeability and selectivity and commonly generated from monomers including piperazine (PIP), m-phenylenediamine (MPD) and solvents such as n-hexane, which are originated from non-renewable resources. These materials are not green and bring negative effects on human health and the environment.

Rice Husk Derived Photothermal Materials for Improved Membrane Distillation

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One of the contemporary breakthroughs in membrane distillation (MD) is the invention of photothermal membranes with the primary objective of tackling the challenges arising from the temperature polarization (TP) effect, specifically aiming for an augmentation in membrane permeate flux. Black carbonaceous materials are recognized as highly effective photothermal converters as they can absorb the entire light spectrum without spectral reflection, rendering them popular choices for integration into membranes for photothermal applications. However, research on using carbon-based biochar as a photothermal material is relatively scarce. This study represents a pioneering effort in utilizing carbon extracted from rice husk char (RHC) as photothermal materials, assessing their effectiveness in mitigating the (TP) effect in direct contact membrane distillation (DCMD). The best effective pyrolysis temperature for the production of RHC was determined to be 600°C. RHC generated at this temperature demonstrated optimal characteristics, including a particle size of 684 nm, a BET surface area of 266.08 m^2/g, and a total pore volume of 0.18 cm^3/g. Additionally, its surface carbon composition was measured at 65.6%, with 42.8% carbon content according to CHNS analysis. The reflectance of RHC was found to be less than 5%, and its surface temperature increased 89.6% after exposure to a full-spectrum light source for 90 minutes. The carbon particles (RHC 600-EC) were extracted from the RHC produced at 600°C, demonstrating enhancements in all aforementioned characteristics. The extraction yield was measured at 42.3%, while the particle size was determined to be 505.5 nm. Significant increases were observed in several key parameters, including a 66.3% increment in BET surface area, a 94.4% increment in pore volume, a 37.5% increment in surface carbon, and a remarkable 72.1% increment in CHNS carbon content. The reflectance value of RHC 600-EC measured less than 2% in both the visible (VIS) and near-infrared (NIR) regions, accompanied by a notable 118.4% increase in surface temperature under identical radiation conditions. The photothermal polymeric dual-layer hollow fiber (DLHF) membrane, containing 1 wt% RHC 600-EC, shows improved separation performance with a permeate flux increase of 1.27 kg/m²h (16.4%) and salt rejection over 99.6%. Compared to the pristine membrane, notable enhancements were observed in the TF factor, which rose from 92.9% to 96.2%, energy efficiency (13.6%), and solar utilization efficiency (23.6%). These results underscore the efficacy of biochar in photothermal membrane applications.

Enrichment of β-carotene by supercritical CO_2 fractionation assisted with a membrane

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We have designed a facile and efficient approach to enrich β-carotene to high content by combining supercritical CO_2 with the membrane. The influence of the squeezing pressure, temperature, loading basket volume and packing filter (membrane) on the yield and the content were examined, respectively. Using basket-1 with the membrane under the experimental conditions (pressure 40MPa, temperature 75°C and flow rate 3.5kg/h) beta-carotene was enriched 21.5% with the yield 18 wt%. While using basket-2 with the membrane under the pressure of 40MPa and the temperature of 75 °C, the yield of the extracted fraction (poor β-carotene content part) reached 87.6 wt%, while its β-carotene content was only 4.5%. The yield of the enriched fraction was 10 wt%, and its content reached up to 33.5%. It can be concluded from the experimental results that the space of loading basket affects the content and the yield of the beta-carotene significantly. Additionally, the use of polyvinyl microporous membrane (PVF) plays a very vital role too. In conclusion that supercritical CO_2 extraction of oil and waxes fraction to enrich beta-carotene using membrane assisted with specific stainless steel mesh filter and basket volume, were a unique approach to obtain a high concentration of the targeted compound.
Further, we found from an LC-MS analysis that different obtained portions mainly consisted of monoacylglycride (MAG), diacylglyceride (DAG) and triacylglyceride (TAG) having maximum concentration 88.5, 75.5 and 24.6%. While in the enriched fraction consisted only 13.02%. The TAG and DAG content in the sample affect its physical state significantly. The sample with less amount of TAG and DAG content is dry powder, while the sample with the content of TAG and DAG of 8.05 to 12.12 and 16.61 to 63.39% respectively are sticky and viscous nature. Whereas sample with the TAG and DAG content of 26.14 to 62.4% respectively, are soft and malleable oily characteristics.

Paper ID: A022

Advancements in Semiconductor Photoactive Materials for Efficient Photodegradation of Organic Contaminants in Water Treatment: A Mini-Review

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Abstract

Currently, the water supply receives unidentified and complex contaminants from the unprocessed and partially processed sewage from residential and commercial premises. These contaminants cause long-term environmental issues that harm humans and other living organisms. As environmental concerns grow, we need environmentally friendly methods to eliminate toxic substances from wastewater. The degradation of organic contaminants through the photocatalysis approach is considered advantageous due to its inexpensive treatment, ecological sustainability, and absence of secondary contamination. Photodegradation of contaminants through light irradiation in ambient conditions is a green technology. Various applications, including sewage treatment, CO_2 reduction, solar energy conversion, splitting H_2O molecules, hydrogen production, and photosynthesis, have extensively utilized semiconductor materials as promising photocatalysts. Semiconductor materials are beneficial for degrading contaminants due to their durability, low toxicity, high surface area, physical and chemical stability, low cost, and photostability. However, semiconductor catalysts large bandgap energies restrict their visible light absorption, reducing their photoactivity under solar light energy. This mini review discusses advances in semiconductor photoactive materials such as graphitic carbon nitride, titanium dioxide, perovskite, zinc oxide, and MOF. The different features of these semiconductor photocatalysts are explained and analyzed. Our article provides a comprehensive overview of existing research on the photodegradation of water contaminants and advancements in photocatalysis techniques. Furthermore, we discussed the mechanisms of photoreactions, which exhibit reduction and oxidation (redox) reactions that can degrade various contaminants into less harmful intermediates. This article is essential for advancing semiconductor materials by modifying their properties through various synthesis techniques, the introduction of metal dopants, and the use of co-catalysts for alteration.

Keywords: Photoredox reactions; intermediates; active species; bandgap; adsorption; desorption

Solvent-free Polyester TFC Membrane for Saline Water Recovery

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The rapid expansion of industrial processes such as textile and petrochemical generate a large volume of saline wastewater that offers opportunity for valorisation through saline water recovery, which can be potentially reuse in industrial processes. While thin film composite (TFC) nanofiltration (NF) membranes have emerged as a promising technology for saline water recovery, the usage of large amounts of organic solvent and unsustainable amine-based monomers during membrane manufacturing remains a major concern. Thus, a greener approach to prepare TFC membranes based on solvent-free trimesoyl chloride (TMC) monomer vaporization using sugar-based glucose as the aqueous monomer is presented in this work. By exploring various synthesis parameters, the optimized PE TFC membrane (PE VIP-0.60) can be developed at a glucose concentration of 5 wt% and NaOH concentration of 0.05 wt% at a contact time of 30 min. Our findings revealed that thinner and looser PE structure contributes to the improvement in pure water permeability (PWP) of PE VIP-0.60 membrane by 11 times as compared to the conventional PA TFC membrane (PA VIP-0.60), recording 28.27 L/m^2.h.bar. Most importantly, PE VIP-0.60 membrane achieved stable performance during the 8-h filtration of synthetic textile effluent and produced water, achieving >99% rejection of contaminants (i.e., Rose Bengal dye and crude oil) while recovering >83% of saline water. In addition, PE VIP-0.60 membrane also showed outstanding chlorine resistance after immersion in sodium hypochlorite (NaClO) solution for 24 h, preserving at least 90% of the original permeability while exhibiting no significant difference in organic solute rejection.

Recent trend of TFN membrane incorporated using hollow nanofillers

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Research on TFN membranes has continued unabated since its discovery, with a focus on enhancing permeation flux while maintaining selectivity by incorporating nanofillers into the active layer matrix. In addition to these improvements, TFN membranes are also known for their chlorine-resistance and antibacterial properties, achieved through surface modifications using nanofillers. However, challenges such as nanofiller agglomeration and leaching have emerged, leading to defects in the synthesized active layer. To address these issues, various interfacial polymerization methods like vacuum filtration, spin coating, and spray coating have been developed to ensure uniform nanofiller distribution. Furthermore, studies have shown that the dispersion medium used during the interfacial polymerization process can impact the final membrane surface morphology. Among the different types of nanofillers, hollow nanofillers have been found to create additional pathways through their void interior, resulting in increased permeation rates. Some commonly used hollow nanofillers such as metal & covalent organic frameworks and metal phenolic networks will be discussed. Despite the remarkable progress made in lab-scale research, there are still significant challenges that need to be addressed. Moreover, potential hurdles in the commercialization of TFN membranes are anticipated. Hence, the objective of this review is to emphasize recent advancements and efforts in overcoming these challenges and barriers, as well as to evaluate the possible applications of these membranes for molecular separation. The mechanisms responsible for the enhanced separation performance will be scrutinized, explained, and summarized to offer valuable insights into achieving an optimal interface morphology and separation efficiency of hollow nanofiller integrated TFN membranes.

Characteristics and Performance of Thin Layer ZSM-5 Membrane Supported on Alumina Tube for Pervaporation Desalination

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Pervaporation (PV) has emerged as a promising alternative to reverse osmosis (RO) for desalination, primarily because it effectively addresses the concentration polarization challenges associated with RO [1]. PV operates at lower pressures and involves the selective evaporation of water through a membrane, reducing the likelihood of fouling. Zeolite membranes, like ZSM-5, offer advantages in PV desalination due to their high selectivity, stability, and reduced susceptibility to swelling compared to polymeric membranes. ZSM-5 membranes are ideal for brine desalination due to their highly selective size exclusion and steric effects. In this work, a ZSM-5 membrane supported on a 30 cm α-Alumina tube was fabricated using hydrothermal treatment. Supported membranes enhance salt removal performance, structural stability, and scalable fabrication, making them suitable for seawater desalination applications. The hydrothermal treatment was conducted at 180 °C for 36 hours, resulting in a well-adhered ZSM-5 membrane on the porous alumina support. The fabricated membrane was characterized using various analytical techniques such as X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), mercury intrusion porosimetry, mechanical strength testing, and water contact angle measurements. These characterizations are essential for understanding the physicochemical properties of the membrane before PV desalination testing. The XRD confirmed the formation of a pure ZSM-5 phase on the alumina support, while FESEM imaging showed a uniform, well-intergrown membrane layer with a thickness of 90.34 μm. Mercury intrusion porosimetry revealed a reduction in macropores after ZSM-5 deposition, with an average pore size of 0.12 μm in the top separation layer. The mechanical strength of the membrane slightly decreased by 12.65% compared to the bare alumina support. The PV desalination performance was investigated using an in-house pervaporation system with varying feed temperatures (25 °C to 80 °C) and salt concentrations (17,500 ppm to 52,500 ppm). It is expected that the water flux of the membrane will increase with temperature due to its high hydrophilicity, which enhances wettability and water transport, as well as the vapor pressure and permeation rate. For varying salt concentrations, it is expected that water flux will increase with higher concentrations due to partial alterations in the membrane structure in a harsh salty environment. However, a significant decrease in salt rejection is expected at higher salt concentrations as changes in the protective electrically charged double layer within the zeolite pores can affect salt rejection. In general, the ZSM-5 membrane developed in this study is expected to demonstrate promising characteristics and performance in PV desalination, indicating its potential to contribute to efficient and sustainable water purification technologies, particularly in applications requiring high salt removal efficiency and energy efficiency.

Limitation and Challenges in Membrane Distillation: Wetting and Fouling of Membranes: A Mini Review

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Membrane distillation (MD) is one of the desalination techniques that utilizes a membrane to separate clean water from saline solutions using thermal energy. MD offers several advantages: minimal pressure, lower energy consumption compared to some traditional methods and can handle various feed water qualities. However, MD suffers from similar limitations as other membrane technologies which are fouling and wetting. Fouling happens when unwanted materials clog the membrane's surface and pores. This significantly hinders MD performance and can even lead to premature membrane replacement or shutdowns. There are many factors affecting membrane fouling: (a) foulant characteristics, (b) membrane properties, (c) operational conditions, and (d) feed water characteristics. To address this challenge, researchers are studying the various types of foulants, how they form, and potential mitigation strategies. Besides that, the membrane wetting also hampered the membrane's performance where the liquid gets squeezed into the pores of a membrane due to interactions between the liquid, gas, and solid membrane. This can partially or fully block the pores, reducing the flow of clean water or allowing contaminated liquid through, decreasing salt rejection. Unlike pressure-driven processes where wetting allows liquid passage, MD relies on vapor transport thus the intrusion of liquid into the membrane can deteriorate the permeation quality. Thus, in MD it is crucial to prevent liquid water from entering the membrane. Therefore, this mini review is intended to highlight the limitations and challenges in MD specifically on fouling and wetting and their reaction mechanisms. Finally, this review also aims to outline the recently proposed solutions for this issue and how the MD performance can be further improved and lastly sustained in a large scale of application.

Improving desalination antibacterial and antifouling performance of polyamine thin film composite reverse osmosis membrane via direct grafting gallic acid

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Reverse osmosis (RO) stands out as a prominent, promising, and widely used water treatment technology for water treatment and desalination. However, RO desalination is adversely affected by unavoidable membrane fouling. Membrane modifications via physical and chemical can effectively control membrane fouling while heightening the membrane performance in terms of ion rejection and water flux. This article studied the effect of direct grafting of gallic acid (GA) onto polyamine (PA) active layer of thin film composite (TFC) RO membrane. Direct grafting is the most convenient method among other membrane modification techniques by pouring modifier onto the membrane surface. After that, the physiochemical properties of membrane surface were characterized by Fourier Transform Infrared Spectroscopy (FTIR), Scanning electron microscopy (SEM), water contact angle (WCA), water intake content and zeta potential analysis. The antibacterial of GA grafted TFC membrane was evaluated by using disc diffusion technique (DDT). The membrane performance was examined by conducting a crossflow RO system with synthetic 2000 ppm NaCl salt solution. Besides, the anti-organic foulant ability of membrane was assessed using 1000 mg/L of sodium alginate (NaAlg) and bovine serum albumin (BSA) as model foulant. The antifouling and antibacterial TFC RO membrane prepared in this study serve as an attractive alternative for RO desalination industry.

Keywords: Reverse osmosis, Polyamine thin film composite, Gallic acid, Direct grafting, Anti organic fouling, Antibacterial.

Fabrication and Characterization of H_2 selective Nickel-Based Membranes Supported on Alumina Tubes for Enhanced Syngas Production

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Dry methane reforming (DMR) involves a reaction of methane (CH_4) and carbon dioxide (CO_2) to produce syngas, a mixture primarily composed of carbon monoxide (CO) and hydrogen (H_2). This process is gaining attention due to the dual benefits of utilizing greenhouse gas (CO_2 and CH_4), while also producing valuable syngas that can be used as a feedstock to produce synthetic fuels and chemicals. Traditional methods of DMR often involve catalysts packed in fixed-bed reactors. However, membrane reactors are emerging as a promising alternative. These reactors incorporate selective membranes that allow certain gases such as H_2 to selectively permeate through while retaining other gases within the reactor. The separation of H_2 from the reaction mixture could lead to improved yields of syngas and higher purity H_2. Membrane reactors could also enhance the reaction kinetics and efficiency by selectively permeating H_2, potentially lowering the operating temperatures and reducing the energy consumption compared to traditional methods. Palladium-based membranes have been widely used for hydrogen separation. However, their application is limited by the high cost of the precious metal. To reduce the cost, several researchers have considered the use of thin metal film membranes, as well as alternative low-cost metals such as NiO_2 for the application. The fabrication method of NiO_2 membranes is crucial as it can directly influence membrane properties such as morphology, crystallization behavior, mechanical strength, and wettability. In this work, two fabrication methods were explored i.e. dip-coating and hydrothermal methods. In the dip-coating method, alumina ceramic tube was first immersed in nickel nitrate, dried, and subsequently calcined. This process was repeated several times to achieve the desired membrane thickness. In contrast, the hydrothermal method involved a solution of urea, nickel nitrate, and water undergoing hydrothermal processing, followed by drying and calcination. The fabricated membranes were characterized using several techniques prior to using it further for DMR process. Morphological analysis was performed using field emission scanning electron microscopy (FESEM), and crystal properties were assessed via X-ray Diffraction (XRD). Mechanical strength was determined through compression testing, and wettability was evaluated by contact angle measurements. The characterization results provided insights into the optimal fabrication methods of NiO_2 membrane for future application in syngas production

Paper ID: A029

Anti-Fouling PVDF Ultra-Filtration with Graphene Nanoplatelet for Peat Water Treatment

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The findings demonstrated that the incorporation of 0.1 g of GNPs led to a significant enhancement in water flux when compared to the pristine PVDF membrane, hence improving the membrane's permeability. Water flux enhancement was further increased by increasing the dosage to 0.5 g of GNPs, and the water flux rate reached its highest point by 223.11 L/m2h, optimizing the ability of the PVDF membrane to allow water to pass through and improving its effectiveness. Even though the 0.5 g dose was more effective in treating peat water, the 1.0 g dosage was still respectable. The results of this research demonstrate that the performance of water flux and peat water treatment may be improved by increasing the dosage of GNPs in PVDF membranes. The optimal dosage for maximizing water flux and treatment effectiveness was found to be G/PVDF 0.5 g membrane. The efficacy of low GNPs concentrations was shown by the fact that the 0.1 g dose considerably enhanced the removal of pollutants from peat water treatment performance and contaminant rejection by 81.18% compared to the pristine PVDF only removed up to 29.19% of the humic acid in the peat water. The most effective dosage of 0.5 g for GNPs in water treatment applications was found to be the one that increased pollutant removal and rejection of humic acid efficiency the most by 84.57%, demonstrating that GNPs are dose dependent. The 1.0 g dose was not as effective as the 0.5 g dosage in purifying peat water and rejecting pollutants, but it was still rather good with 81.47%. Among the dosages tested, the G/PVDF membrane with 0.5 g of graphene nanoparticles exhibited the most balanced performance regarding antifouling efficiency and membrane permeability with the Rt of 47.00%, Rr of 43.55%, Rir with 3.45%, and flux recovery ratio FRR of 96.55%. Although the 1.0 g dosage provided higher antifouling resistance, it resulted in a slight reduction in water flux due to increased membrane thickness and potential nanoparticle aggregation. The G/PVDF membranes exhibited higher flux recovery ratios (FRR) (65.47%) and lower total fouling ratios (Rt) (52.96%) compared to the pristine PVDF membrane, indicating more sustainable operation with reduced cleaning frequency and operational downtime. Membranes incorporating 0.5 g and 1.0 g of graphene nanoparticles demonstrated notable enhancements in hydrophilicity, resulting in improved water flux and less fouling.

Deconvolution of Pluronic P123 Coated onto PVDF Hollow Fiber Membrane

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Polyvinylidene fluoride (PVDF) - polymer based membranes are widely employed in various applications due to their desirable properties. Such as, thermal stability, high mechanical strength, and favourable processing characteristics. However, the inherent hydrophobicity of PVDF limits its performance in aqueous environments because of fouling problem. This study focuses on modifying the properties of PVDF membranes using Pluronic P123 as a coating agent to enhance their wettability and functionality. Then, the functional groups and deconvolution of pluronic P123 coated onto PVDF hollow fiber membranes were then investigated. The fabrication of PVDF hollow fiber membrane was prepared by dissolved 1,5% TiO_2 in 75,5% DMAC, 18% PVDF, and 5% PEG-400 until homogeneous at 70°C. Afterwards, the PVDF hollow fiber membrane was cast using the wet-spinning method with ID and OD sizes of 2.4 mm and 1.9 mm, respectively. Furthermore, the PVDF hollow fiber membrane was coated using Pluronic P123 solution and followed by characterization using Fourier Transform Infra Red (FTIR). The result of FTIR spectra indicated that functional groups, in addition to P123, have bands CO at ~1105 cm^{-1}. Peaks of -phase PVDF crystal appeared in all PVDF membrane types at ~875 and ~873 cm^{-1}. Deconvolution of FTIR shows that the coating of P123 has successfully improved the hydrophilic properties of the PVDF membranes.

Paper ID: A031

Novel Hybrid Pectin-TiO2 Membrane of Nylon 66: Roughness Enhancement

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Polymer membranes are readily amenable to modification. This research exemplifies the polimer by modifying the nylon 66 membrane with the additives in the form of organic and inorganic materials, namely pectin and titanium dioxide (TiO_2). The nylon 66 hybrid membrane was prepared by phase inversion technique using formic acid solvent. Morphology of membrane was analysed by scanning electron microscopy (SEM) to determine the morphological structure, roughness and porosity of the membrane. This work investigates the effect of pectin and TiO_2 as additives compare to the impact the antifouling properties, permeability and selectivity of polymeric membranes. Surface roughness significantly impacts the performance of polymer membranes. With these additives, the surface roughness increases and it effects the membrane properties such as permeability and antifouling characters. It is found that thesurface of the pectin-TiO_2 hybrid nylon66 membrane is relatively rough, with Ra and Rms values 10 times higher than those of the pure nylon 66 membrane. However, the hybrid membrane exhibited lower porosity, with a value of 48.44%, compared to the pure nylon 66 membrane, which had a porosity of 55.14%. This can be concluded that the presence of smaller pores in the hybrid membrane, exhibiting a spongy and asymmetric morphology.

Paper ID: A032

Enhancing $BiVO_4$ photocatalyst with spent battery waste for efficient degradation of Rhodamine B dye

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The rapid expansion of industrialization has caused extensive damage to the environment, particularly to the water ecosystem. The widespread use of industry related products such as synthetic dyes has resulted in significant wastewater contamination, as they are hazardous due to their complex structure, chemical stability and toxicity. In addition, solid waste is generated from consumable goods and electronic products, such as batteries, printer ink, laptops, and printed circuit boards. The recycling of these solid wastes represents a significant revenue as they contain precious metals that can serve as important resources. In this study, ZnO and $ZnFe_2O_4$ prepared from the spent battery were combined with g-C_3N_4 to form a ZnO/$ZnFe_2O_4$/g-C_3N_4 heterojunction photocatalyst for the decolourization of Rhodamine B dye. The photocatalysts were synthesized via hydrometallurgical and thermal condensation methods. The prepared photocatalysts were characterized using FTIR, UV-vis, and XRD to identify their functional groups, band gap energy, and crystallinity. The photocatalytic performance was examined through the degradation of Rhodamine B under visible light. This study is significant as it utilizes waste materials from spent batteries to modify photocatalysts, aiming to enhance their performance. It is anticipated that combining ZnO and ZnFe2O4 with g-C3N4 in a heterojunction photocatalyst will yield promising results in the degradation of Rhodamine B dye under visible light conditions.

Keywords: Photocatalysis; Spent batteries; wastewater treatment; Dye; $ZnFe_2O_4$

Paper ID: A033

Enhancing CO_2 Separation: Polyethersulfone Mixed-Matrix Membrane Incorporated with Dolomite

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The increasing carbon dioxide (CO_2) concentration in the atmosphere is a pressing global concern due to its significant contribution to climate change. Efficient separation and capture of CO_2 from various industrial processes have become essential to mitigate its adverse environmental impact, including the utilization of membrane separation technology. Polyethersulfone Mixed-Matrix Membranes (MMMs) incorporated with inorganic filler such as dolomite as an additive help increase the membrane adsorption performance and capacity for high-performance gas separation with the capability of porous fillers. Dolomite has been grounded to a micrometre size to increase the surface area for a better capture performance and undergo calcination process to ensure the particle fully decomposed. Polymer blending, permeability and selectivity were explored to determine the separation performance by using gas permeation test involving CO_2 and Nitrogen (N_2) gas along with other membrane characterisation tests such as FTIR, FESEM and Contact Angle. It was proven that the MMMs permeability and selectivity increased along with the dolomite composition until 0.5wt%. However, at 0.75wt% of dolomite, the selectivity of the MMM generally increases, whereas the permeability decreases due to particle agglomeration. The permeability and selectivity of CO_2 capture will increase as the weight loading of dolomite increases until a point where there is too much of dolomite which can cause agglomeration that leads to blockage of the pore which reduce the capture performance. Afterwards, MMMs with the best dolomite composition were refabricated with chemically-modified hydrophobic dolomite, of which has demonstrated significant improvements in the separation performance of the modified dolomite with MMMs. At the same weight loading of dolomite, hydrophobic dolomite has increased the selectivity of CO_2 up to 17.5% compared to unmodified MMMs. After all, modified MMMs have exhibited high CO_2 permeability and excellent selectivity, providing a promising pathway for efficient CO_2 separation and capture.

Keywords: Carbon dioxide separation, Mixed-Matrix Membranes, gas separation, dolomite

SYNTHESIS AND CHARACTERIZATION OF TEMPERATURE AND LIGHT RESPONSIVE COMPOSITE NANOGEL AND ITS PROPERTIES AS SMART ANTI-FOULING AND SELF-CLEANING IN MEMBRANE

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Abstract

In recent years, thermoresponsive hydrogel polymers have gained attention for their potential in wastewater treatment, particularly as smart-gating membranes. This review provides an overview of advancements in the field, focusing on synthesis, properties, and applications of these polymers in smart-gating membrane technology. It discusses the principles of smart-gating membranes and the importance of thermoresponsive behavior in controlling membrane permeability in response to temperature changes. Various synthesis methods, including conventional techniques and advanced approaches like click chemistry, are examined. Physicochemical properties such as swelling behavior, mechanical strength, and thermal stability are explored, along with their impact on membrane performance in wastewater treatment. Applications of thermoresponsive hydrogel-based smart-gating membranes in microfiltration, ultrafiltration, nanofiltration, and reverse osmosis are discussed. The review concludes with an outlook on future research directions and opportunities for advancing and optimizing these membranes for sustainable wastewater treatment.

Keywords: Thermoresponsive: Hydrogel; Nanogel; Smart-gating membrane; Water Treatment; Cross-linking; Zwitterionic Polymers; Antifouling

Development of hollow fibre nanocomposite membrane enhanced with functionalized iron oxide nanoparticles for the removal of Bisphenol S from aqueous solution: Fouling and permeability studies

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Abstract
The environmental threat posed by plastic waste, particularly Bisphenol S (BPS), necessitates innovative solutions for water treatment. This study presents the development and characterization of a novel hollow fibre nanocomposite membrane, augmented with functionalized hematite (Fe_2O_3) nanoparticles, for the effective removal of BPS from aqueous solutions. The Fe_2O_3 nanoparticles were synthesized using a sol-gel auto-combustion method and incorporated into a PVDF-PEG membrane matrix. The fabricated membranes were systematically characterized for their hydrophilicity, surface charge, porosity, morphological structure, and thermal stability. Performance evaluations revealed that the nanocomposite membrane containing 1.5 wt% Fe_2O_3 nanoparticles exhibited superior properties, including a highly negative zeta potential of -47.3 mV, a reduced contact angle of 49.3°, and an impressive BPS removal efficiency of 92.1%. Additionally, the membrane demonstrated a high water permeability flux of 171.53 $L/m^2 \cdot h$ and maintained excellent antifouling performance, with a flux recovery ratio of 80.57% after multiple filtration cycles. The integration of Fe_2O_3 nanoparticles significantly enhanced the membrane's performance, offering a cost-effective, environmentally friendly solution for mitigating BPS pollution in water sources. This study underscores the potential of nanoparticle-modified membranes in advancing water treatment technologies to address emerging environmental contaminants.

Keywords: Hollow fibre nanocomposite membrane, hematite nanoparticles, Bisphenol S removal, fouling, permeability, PVDF-PEG, water treatment.

Paper ID: A036

Single-step Mass Production of Graphene Powder from Palm Kernel Shell at 500 °C and Its Properties

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Agricultural sector constitutes an indispensable importance to people and has resulted in high yield production of different type of crops. According to a study, global oil palm plantations covered around 19.5 million hectares with 17.5 million hectares of the oil palm plantations are in Southeast Asia. However, the downside of the palm oil industry is it has generated a high amount of waste and is currently affecting the environment through deforestation, pollution, hazardous contamination, and landfilling. Palm kernel shell (PKS) is one of the by-products of palm oil industry that is primarily utilized as a solid fuel source for boilers; however, its high carbon density renders it an excellent source of graphene.

To the best of our knowledge, there has been no extensive research on the derivation of graphene from palm kernel shell using a simple and energy-efficient strategy. This study aims to demonstrate the combination of palm kernel shell with potassium hydroxide (KOH), an activating agent, through the carbonization process at a temperature of 500 °C. The produced materials are analyzed using high-resolution transmission electron microscopy (HRTEM), while the surface morphology is confirmed using a variable pressure scanning electron microscope (VPSEM). Crystalline graphitic layer intensity and disordered carbon peaks confirmed by Raman spectroscopy and CHNS elemental analysis of the synthesized materials were done to quantify the carbon content of PKS. The indication of 75.5% carbon content and significant I_{2D}/I_G ratio at 0.37, showing that the PKS possess promising carbon content and multi-layer graphene structure after carbonization with KOH. This project paves an efficient path to the fabrication of multilayer graphene and beneficially contributes to the development of fuel cell electrodes, which parallel with sustainable development goal (SDG), namely the assurance of energy sustainability.

Chicken Feather Waste as Synergistic Filler in Mixed Matrix Hollow Fiber Membrane for Biogas Upgrading

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Biogas upgrading is a multifaceted process that plays a pivotal role in transforming raw biogas into a more refined and valuable form, typically enriched in methane content. Mixed matrix membrane separation is an established method of the biogas upgrading that has been extensively employed for the gas separation. However, the current MMMs are still susceptible to permeability and selectivity trade off, plasticization and the polymer filler incompatibility. Incorporating the inorganic particles (activated carbon) improve the permeability, compatibility, mechanical strength and selectivity of the membrane. This study investigated the utilization of the chicken feathers as the precursor to produce the activated carbon as the selective layer for pressure driven membrane in the biogas purification. The research process includes characterizing the treated feathers and the resulting activated carbon, followed by incorporating the activated carbon into MMMs to evaluate their permeability, selectivity and compatibility. The research process includes the optimization of the carbonization parameters and conditions, as well as the membrane fabrication. The physiochemical properties of the membrane surface are characterized using characterization techniques such as Brunauer-emmet teller (BET) analysis, scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR). Besides, the gas separation is assessed using the gas permeation test at 1 bar, 3 bar and 5 bar to evaluate the structural and functional properties of the activated carbon and the resulting MMMs. The implementation of the membrane prepared in this study serve as an alternative to produce effective and environmentally MMMs, thus contributing towards sustainable goals.

Keywords: Biogas, Chicken feathers, Activated Carbon, Mixed Matrix Membranes (MMMs)

Paper ID: A039

TiO_2 Grafted Bamboo derivate Nanocellulose Polyvinylidene Fluoride (PVDF) nanocomposite membrane to intensified the Antifouling, Water Flux, and Dye Removal

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ABSTRACT

The escalating demands of efficient wastewater treatment drive this study which explores the development and characterization of polyvinylidene fluoride (PVDF) nanocomposite membranes enhanced with nanocellulose (NC) and titanium dioxide (TiO_2). The nanocomposites membranes were characterized by Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD) and Field emission scanning electron microscopy (FESEM). The integration of NC and TiO_2 nanoparticles into the PVDF matrix yielded notable improvements in the structural, mechanical, and functional properties of the membranes. The FT-IR analysis confirmed the presence of critical functional groups that facilitated improved interactions within the nanocomposite. The XRD analysis showed an increase in the crystallinity of the β-phase of PVDF, thus, enhancing mechanical stability and overall membrane functionality. The FESEM analysis revealed the uniform dispersion of TiO_2 and NC which prevented nanoparticle agglomeration and promoted the formation of a more porous and permeable membrane structure. The optimization of TiO_2 loading at 3 wt% notably enhanced pore formation and crystallinity, leading to a direct increase in water flux rates from 234.06 L/m²h to 270.23 L/m²h and achieving methylene blue (MB) dye rejection rates of up to 98%. Additionally, the photocatalytic properties of the membranes were significantly enhanced by the presence of NC and TiO_2, which accelerated the degradation of MB pollutants and effectively mitigated membrane fouling. These findings illustrated that the synergistic integration of NC and TiO_2 not only capitalized on the individual properties of each component but also significantly elevated overall membrane performance. This study represents a significant advancement in membrane technology, offering new avenues for sustainable and efficient environmental remediation and presenting robust solutions to challenges such as membrane fouling.

Keywords: Nanocomposite membranes, wastewater treatment, polyvinylidene fluoride (PVDF), titanium dioxide (TiO_2)

Paper ID: A040

Enhancing Anaerobic Digestion of Palm Oil Mill Effluent with Carbon Fibre

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This research examines the influence of carbon fibres on the anaerobic digestion (AD) of palm oil mill effluent (POME). POME, a byproduct of the palm oil milling process, is rich in organic material, making it a suitable feedstock for AD. Adding carbon fibres to the anaerobic digester increases the surface area for microbial attachment, enhancing digestion efficiency and methane yields. The study aims to assess whether adding carbon fibres to the anaerobic digester can improve the efficiency of the digestion process, enhance methane production, and prevent the formation of biofilms on the digester surfaces. Three replicates of anaerobic digesters with and without carbon fibres were prepared for comparison. Gas production was monitored using the airlock, and periodic sampling was conducted to evaluate effluent quality. The study demonstrates that using carbon fibres can increase methane production and prevent the accumulation of biofilms on the digester surfaces. The results indicate that incorporating carbon fibres in the AD of POME can enhance the overall efficiency of the process and maximise methane production.

Keywords: *Palm oil mill effluent (POME), Methane production, Anaerobic digestion (AD), Carbon Fibre, Renewable energy, Microbial electrochemical systems*

Paper ID: A041

A Study of CO_2 Removal by Silica/Polyimide based Ionic Liquid Mixed Matrix Membrane via the Molecular Dynamic Simulation Approach

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The separation of CO_2 from the natural gas reserve is imperative to prevent corrosion of the natural gas pipeline due to the formation of carbonic acid. Membrane technologies have been gaining popularity, but their utilisation is limited by several inherent weaknesses such as permeability-selectivity trade-off [1], [2], membrane plasticisation [3] and membrane operational stability. Approaches like the utilisation of mixed matrix membrane (MMM) portrayed limited ability to improve the membrane selectivity despite improving its mechanical and thermal strengths [4], [5], [6], [7]. Furthermore, filler incompatibility issues often resulted in filler agglomeration, significantly deteriorating its wide application in the industry [5], [8]. Fortunately, the incorporation of ionic liquid (IL) into the MMM forming ionic liquid mixed matrix membrane (ILMMM) depicted amelioration of membrane-filler adhesion, and the pairing of highly gas-selective ILs enables the MMMs to surpass their performance [9], [10], [11]. However, the research for IL-based MMMs was limited to experimental work with minimal framework developed for computational methods. Molecular simulation has proven useful in determining the properties of ionic liquids [12] and mixed matrix membranes [6], [7], [12], [13]. Hence, this research aimed to develop a framework that studies the impact of [BMIM][Tf2N], [EMIM][Tf2N] and [BMIM][PF_6] on the physical and gas separation properties of PI membranes via Material Studio software Version 8.0 through COMPASS forcefield. The properties studied were the density, fractional free volume (FFV), d-spacing (D-spacing), binding energy, gas solubility, diffusivity, permeability and selectivity. Material Studio and COMPASS forcefield are very effective, and they can accurately provide results that can be validated with experimental work [5], [6]. For instance, in this research, the properties of 6FDA-durene simulated presented minimal errors for density (0%), FFV (5.6%) and d-spacing (0%) compared to the experimental works [14]. The developed framework has also helped prove the IL incorporation lowered membrane binding energy, as indicated by lowering binding energy from -65.997 kcal/mol to -2034.91 kcal/mol. The study of the FFV and d-spacing indicated IL addition increased the free volume of membranes. The result of that has influenced the CO_2 sorption alongside its diffusivity. The permeability of CO_2 improved by 40% for [BMIM][PF_6] and almost twice for [EMIM][Tf2N]. The gas selectivity was elevated with the best performance by [EMIM][Tf2N] from 20.63 to 30.25. Hence, this research has proven the functionality of molecular simulation in estimating the properties of ILMMMs and providing valuable insights through an atomistical point of view.

Blended-Cyrene: An Eco-Friendly Solvent for Sustainable Polyvinylidene Fluoride Membrane

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Cyrene is a promising eco-friendly solvent that has been extensively tested and studied by numerous researchers in various applications. Besides Cyrene, dimethyl isosorbide (DMI) and dimethyl sulfoxide (DMSO) are also emerging as well-established alternative green solvents with high oral toxicity thresholds in rats and have both been utilized in the fabrication of polyvinylidene fluoride (PVDF) ultrafiltration (UF) and microfiltration (MF) membranes. In this study, the potential of Cyrene-DMI and Cyrene-DMSO blends as alternative green solvents will be investigated, particularly focusing on their role in the fabrication of PVDF membranes via non-solvent-induced phase separation. The study aims to explore the effectiveness of these solvent blends in producing PVDF membranes with desirable properties for various applications, including water treatment processes. The membranes will then be characterized for their morphology, wettability, porosity, thickness, pore size, and rejection rate. The ratio between the two solvents is 1:1, with a composition of 84% blended solvent, 13% PVDF polymer, and 3% polyethylene glycol (PEG) as an additive. The resulting membranes will be classified as either UF or MF membranes based on their intrinsic characteristics, particularly their pore sizes, and then further evaluated for their performance through filtration testing procedures.

Keywords: Cyrene, solvent blend, PVDF, membrane fabrication, phase inversion

Paper ID: A043

Omniphobic Photothermal Dual Layer Hollow Fibre Membrane via Etching for Membrane Distillation

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The global water shortage poses a major challenge affecting multiple areas, worsened by agricultural methods, population increase, climate shifts, and ineffective water control. Individuals worldwide continue to face risks of water scarcity or lack adequate access to safe drinking water. Membrane distillation removes solids and contaminants from water, producing high-quality effluent. Challenges include lack of high-performance membranes and high energy needs for feed heating. Therefore, this study aim is to fabricate a dual layer hollow fibre membrane with improved hydrophobicity that has an efficient photothermal effect to purify wastewater using membrane distillation. Silver nanoparticles (AgNps) with concentration 1wt% was incorporated in the outer layer of PVDF dual layer membrane as photothermal material to overcome the challenge of temperature polarization. Surface modification via etching method with different concentration (25wt%, 50wt% and 75wt%) of Dimethylacetemide solution(DMAc) and time (15s, 30s and 45s) and 2wt% FAS in ethanol solvent coating was used to improve hydrophobicity of membrane to allow superior antiwetting properties which ensure the efficiency of the membrane distillation process. Fabricated membrane was characterized using scanning electron microscopy (SEM), atomic force microscopy (AFM), water contact angle (WCA), liquid entry pressure (LEP), Energy dispersive X-ray (EDX). The membrane was best fabricated with etching condition of 50wt% DMAc solution for 15 seconds. The membrane possessed a contact angle of 122.49^o, LEP of 4.75 bar, and surface roughness of 22.79nm. The membrane produced have better performance and effective separation process due to its high hydrophobicity, high permeability, low fouling rate, and high mechanical stability. Results from this study made a significant impact on the application of membrane distillation for effective treatment of wastewater

Paper ID: A045

Advancements in Photocatalytic Membrane Treatment for the Degradation and Removal of Organic Contaminants: A Concise Review and Future Directions

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Abstract

The presence of organic pollutants poses significant threats to human health and ecosystems. Traditional treatment methods are often limited by inefficiency and poor selectivity. Photocatalysis, an advanced oxidation process (AOP), offers promising efficiency through semiconductor materials that generate reactive oxygen species to degrade pollutants. Photocatalytic Membrane Technology (PCMT), which integrates photocatalysts with membranes, enhances pollutant removal by addressing challenges and issues like catalyst recovery, efficiency limitations, and catalyst clamping. This review examines the advancements in MXene/TiO_2-based photocatalytic membranes, focusing on their applications, limitations, and performance optimization strategies. MXenes, with their large surface area, tunable functional groups, and high conductivity, significantly enhance TiO_2's photocatalytic efficiency. The review also highlights operational parameter optimization, such as pH, contaminant concentration, and flow rate, as well as the synergistic use of PCMT with other methods like adsorption to improve pollutant removal efficiency. The application of this technology for emerging contaminants, including antibiotics and microplastics, is discussed, showcasing its versatility and potential. Future research directions emphasize the need for continued innovation and interdisciplinary collaboration to enhance the efficiency and effectiveness of PCMT.

Keywords: Photocatalytic membrane, Oxidation process, Organic contaminants, Water treatment, Emerging contaminants removal

Paper ID: A046

Integration of Supported Ionic Liquid Membrane and Adsorption Techniques in the Stripping Phase for Removal of Sulfamethoxazole from Wastewater

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The removal of pharmaceutical contaminants such as sulfamethoxazole (SMX) from wastewater has become a significant environmental challenge due to their persistence and potential adverse effects on aquatic ecosystems and human health. This study presents an innovative approach integrating Supported Ionic Liquid Membrane (SILM) and adsorption techniques specifically in the stripping phase to enhance the removal efficiency and recyclability of stripping phase in the SILM system. In the proposed method, SILMs were synthesized using polyvinylidene fluoride (PVDF) as the support matrix, incorporating ionic liquids such as Aliquat 336. The synthesized membranes were characterized for their physicochemical properties, including morphology, porosity, and mechanical stability. Adsorption studies were conducted using various adsorbents to identify the most effective material for removal of SMX. The integration of SILM and adsorption techniques in the stripping phase was evaluated in a batch setup to optimize the removal process. Parameters such as adsorbent capacity, influence of pH and initial SMX concentration were systematically investigated. The combined system demonstrated a significant improvement in SMX extraction efficiency compared to standalone SILM or adsorption methods, with the added benefit of recyclability of the stripping phase. Furthermore, mechanistic studies using Material Studio software provided insights into the interactions between SMX, the ionic liquids, and the adsorbent materials in the stripping phase, elucidating the enhanced performance of the integrated system. The findings highlight the potential of this hybrid approach for efficient pharmaceutical removal from wastewater, offering a sustainable and scalable solution for environmental protection. This research underscores the importance of integrating membrane technology with adsorption techniques in the stripping phase to address complex wastewater treatment challenges, paving the way for future developments in environmental remediation strategies.

Paper ID: A047

Effect of laser power on the wettability behaviour of 3D printed polymer membrane with candle soot coating

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The application of selective laser sintering (SLS) 3D printing technology has gained a lot of interest among researchers in developing superhydrophobic surfaces, especially in membrane fabrication. Recently, researchers discovered the need to modify the parameters is mainly due to the impact of printing parameters on surface quality, roughness, and mechanical strength. Studies investigating process parameters such as laser power, hatch distance, and scanning speed have led to significant advancements in this field. However, there has been a lack of comprehensive research on the effects of surface wettability especially on membrane application. The purpose of this study was to investigate the influence of laser power on printed polymer membranes in terms of surface roughness and wettability. The laser powers used to fabricate the membranes were 70 W and 80 W utilizing virgin polyamide-12 (PA-12) powder. To develop a superhydrophobic surface, the printed polymer membrane was coated with 0.1%wt hydrophobic paraffin candle soot/hexane solution under sonication. The surface morphology, surface roughness, and contact angle of the printed membranes were assessed. The energy density (ED) transmitted during the printing process was calculated to describe the interaction between the laser power used and the surface properties. The lower laser power used resulted in approximately 3% higher roughness and contact angle values which enhance the hydrophobicity of the surface. A noticeable outcome was obtained for coated membranes with lower laser power (CM-70W) which resulted in the highest roughness and contact angle values with 14.489±0.705 µm and 150.653±1.809° respectively, exhibiting a superhydrophobic surface.

Efficient Heterogeneous Activation of Hydrogen Peroxide by Mn-substituted Cu-based Perovskite: A Promising Approach for Caffeine Degradation

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The substitution of B-site cations into perovskite structures can uniquely modify the activation of hydrogen peroxide (H_2O_2) into hydroxyl radicals (•OH) during heterogeneous catalysis. Herein, this study investigates the synergistic effect of manganese (Mn) substitution into pristine perovskite structure towards facile activation of H_2O_2 in oxidative degradation of caffeine micropollutants. The catalysts were synthesized using the modified EDTA-citric acid complexation method at different Mn loadings of x = 0, 0.5, and 1.0. The partial substitution of Mn into resultant Mn-substituted Cu-based perovskite ($CaMn_xCu_{1-x}O_3$; x=0.5) structure was confirmed by XRD analysis. The resultant catalyst comprises a mixture of perovskite and mixed oxide with a 96% perovskite phase purity. Interestingly, the substituted perovskite exhibited superior catalytic performance compared to the pristine perovskite, by achieving a complete degradation (100%) of caffeine within 90 minutes of reaction. On the contrary, the pristine perovskite catalysts ($CaMn_xCu_{1-x}O_3$; x=0 and x=1) demonstrated lower degradation rates of 91% and 40% in 240 minutes, respectively. The enhanced catalytic activity by the resultant Mn-substituted Cu-based perovskite ($CaMn_xCu_{1-x}O_3$; x=0.5) is attributed to the plausible synergistic interactions between the dual redox pairs of B-site active phases ($\equiv Mn^{2+}/\equiv Mn^{3+}$ and $\equiv Cu^{+}/\equiv Cu^{2+}$), which facilitate the facile activation of H_2O_2 into •OH radicals during heterogeneous catalysis. These findings reveal the promising insights of high-performance Mn-substituted perovskite catalysts for environmental remediation applications.

Effect of Cellulose Nanofiber of Sugar Palm (*Arenga Pinnata*) incorporated in Rubber-based Composite Membrane for Palm Oil Mill Effluent Treatment

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Rubber-based membranes are increasingly explored for water treatment applications due to their flexibility, durability, and chemical resistance. However, they inherently lack porous structures, which limits their permeability and overall effectiveness in filtration processes. This study investigates the progressive enhancement of palm oil mill effluent (POME) treatment through the incorporation of cellulose nanofiber from sugar palm (*Arenga Pinnata*) in rubber-based composite membrane. The incorporation process involved solution blending of sugar palm cellulose nanofiber (SPCNF) with the ENR/PVC matrix and phase inversion method, resulting in the development of composite membranes with improved structural and functional attributes. The inherent mechanical strength of SPCNF contributed significantly to the mechanical properties of the rubber-based composite membranes. Tensile strength and modulus exhibited remarkable improvements of 39.6% and 117.8% respectively at 7% SPCNF loading, in comparison to pristine ENR/PVC membranes. These enhancements are attributed to the reinforcing impact of SPCNF, developing a robust network within the membrane matrix that effectively mitigates stress dispersion and prevents the propagation of cracks. Beyond mechanical improvements, the introduction of SPCNF facilitated notable advancements in water treatment efficiency. The unique SPCNF structure of sugar palm allowed for the establishment of interconnected pathways, resulting in enhanced water absorption, porosity and hydrophilicity with the increasing of SPCNF loading up to 10%. The fabrication of ENR/PVC/SPNFC composite membranes exhibited 500% higher POME flux in comparison to standard ENR/PVC membranes, while retaining their separation efficiency. The rubber-based composite membrane shows outstanding performance in treating POME at an optimal SPCNF loading of 7%, attaining removal efficiencies of 40.00% for total suspended solids (TSS), 85.62% for chemical oxygen demand (COD), 44.16% for ammonia, and 72.55% for color. Synergistic incorporation of SPCNF improves morphology, thermal stability, mechanical properties, hydrophilicity, water flux, and porosity, paving the way for sustainable and efficient membrane alternatives in water treatment and purification processes.

Keywords: sugar palm fibre, cellulose nanofiber, rubber-based membrane, POME

A Bibliometric and Visual Analysis of the Utilization of Waste Materials for the Development of Membrane Across Various Sectors: Insights from the Scopus Database

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Utilizing biowaste or waste materials for membrane development not only curtails the production and waste disposal costs but also promote sustainability by providing value to the trash. A bibliometric and visual analysis has been employed in this study to fully comprehend the research topic and provide insights into the state of the art.

This study conducted in Scopus database between the year 2004 to 2024 and visualized using VOSviewer. Out of 415 records obtained from the suitable search string, 285 records were retrieved after complete refinement based on the relatability and language. The finding revealed that the year 2022 shows the maximum number of publication (n=49) and the year 2020 have reported to have the greatest number of citations at n= 1384. Scopus identified a strong correlation between "Chemistry" discipline attributed to the highest number of publications at n=111. This finding identified the most productive journals and *Journal of Cleaner Production* contributes to the maximum number of papers (n=9) which evident to have the greatest number of citations at n=547.

Moreover, China has the highest publications of 78 documents (1923 citations, 10 total link strength) followed by India and Malaysia. Co-authorship which shows the productivity of individual researchers suggest that the author, Mohd Hafiz Dzarfan Othman has the highest number of citations (8 publication with 66 total link strength). Finally, the co-occurrence of keywords revealed that the term "adsorption" appeared frequently together (Number of occurrences: 17, Total link strength: 12 and Centrality percentage: 36.36%) followed by "membrane", "wastewater treatment" and "circular economy". While the use of waste or biowaste materials in membrane fabrication is still a relatively new concept, it holds significant potential for advancements in the field of membrane technology.

Various Gas Adsorption Study On CuO@Zeolit-Y

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This study aims to optimize the adsorption properties of CuO@Zeolite-Y by investigating the influence of different CuO loading percentages on gas adsorption efficiency. The material was synthesized using a modified impregnation method with CuO loadings of 15%, 20%, 25%, and 30% by weight. Among these, the 20% CuO-loaded sample demonstrated the highest adsorption performance and was selected for further evaluation. Gas adsorption tests at 1 bar pressure and temperatures of 25°C, 40°C, and 50°C revealed that 20% CuO@Zeolite-Y exhibited enhanced adsorption capacities for N_2, CO_2, and CH_4, with increases of 24.6%, 67.73%, and 16.29% respectively, compared to unmodified Zeolite-Y.

Thermodynamic analysis indicated that physisorption predominates the adsorption process, particularly at lower temperatures, while kinetic studies confirmed a pseudo-first-order model. The superior CO_2 adsorption is attributed to the enhanced interaction between CO_2 molecules and CuO nanoparticles, driven by the strong polarizability of CO_2. Lastly, experimental results were corroborated with computational simulations, further validating the material's adsorption potential.

Advancements in membrane technology: Optimizing polymers of intrinsic microporosity (PIMs) for carbon capture

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The Industrial Revolution accelerated greenhouse gas emissions, exacerbating climate change and depleting resources. In response, various carbon capture technologies have emerged, with membrane technology standing out for its low energy consumption, simplicity, and scalability. Among these, ultra-permeable polymers of intrinsic microporosity (PIMs) have gained significant attention over the past two decades as gas membrane materials due to their workability, broad applications, and rigid structures. PIMs are distinct for their micro-scale porosity, induced by bulky and rigid spiro-center contortion sites in the polymer backbone. They are categorized into ladder, linear, and hyper-cross-linked PIMs. Unlike other microporous organic polymers, PIMs offer better solubility in common solvents, enabling versatile fabrication. Additionally, they show excellent compatibility with metal-organic frameworks, carbon-based fillers, and organic polymers. The development of highly microporous polymers has prompted extensive research into new PIMs with improved performance and efficiency. In this review, we have comprehensively elucidated the latest advancements in ladder PIMs, emphasizing strategies to redesign their intrinsic microstructure to meet carbon-related treaties. Key strategies include modifying polymer backbones constituents, functionalization of contortion sites, blending polymers, developing mixed matrix membranes (MMMs) with fillers, and refining membranes through post-treatment processes. This work transcends a summary of current research on PIMs for sustainability, while actively striving to pave the way for future optimization and innovations of these materials.

Enzyme Immobilization Assessment on Reverse Asymmetric Membrane with Synchronous Biocatalysis

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Integration of membrane filtration and biocatalysis has appealing benefits in terms of simultaneous substrate conversion and product separation in one reactor. Nevertheless, the interaction between enzymes and membrane is complex and the mechanism of enzyme docking on membrane is similar to membrane fouling. In this study, focus is given on the assessment of enzyme immobilization mechanism on reverse asymmetric polymer membrane based on the permeate flux data during the procedure. Evaluation of membrane performance in terms of its permeability, fouling mechanisms, enzyme loading, enzyme reusability and biocatalytic productivity were conducted. Alcohol Dehydrogenase (EC 1.1.1.1), able to catalyze formaldehyde to methanol with subsequent oxidation of NADH to NAD was selected as the model enzyme. Two commercial, asymmetric, flat sheet polymer membranes (PES and PVDF) were immobilized with the enzyme in the reverse mode. The sequence of enzyme immobilization (deposition) in the support layer of both polymer membranes is predicted by the phases of permeate flux trend during dead-end filtration. Molecular (enzyme) sorption and particle deposition dominating the initial phase (Phase 1), followed by the development of multi sublayers of enzymes in Phase 2 and reaching to sublayers rearrangement and stabilization in the final phase (Phase 3). Intermediate fouling is predicted from Hermia's model which corresponded to the higher reversible fouling estimated with flux recovery ratio (FRR) estimation. Combination of concentration polarization phenomenon and pressure driven filtration successfully immobilized almost 100% of the enzymes in the feed solutions. The biocatalytic membrane reactor recorded more than 90% conversion, stable permeate flux with no enzyme leaching even after 5 cycles. The technique showing promising results to be expanded to continuous membrane separation setup for repeated use of enzymes.

Development of Upcycled Ground Coffee-Derived Membrane for Treatment of Oilfield-Produced Water

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Oilfield-produced water is the largest wastewater stream generated during petroleum exploration and production. It consists of a mixture of water, hydrocarbons, various chemicals introduced into the well, and natural substances from the reservoir, which are hazardous and harmful to humans and the environment. Due to its volume, managing this produced water is a significant challenge in the oil and gas industry, and the discharge conditions must meet environmental standards. Membrane technology has emerged as a crucial method for treating oilfield-produced water due to its efficiency in separating contaminants and producing high-quality water for reuse or safe disposal. However, membrane fouling is still a concerning issue that can lead to less efficient OPW treatment. Therefore, this study aimed to enhance the membrane separation performance of OPW and improve its antifouling properties. In this study, polyvinylidene difluoride (PVDF) membranes were coated with lignin synthesized from upcycled ground coffee (CG) waste and calcium carbonate ($CaCO_3$) at concentrations of 1wt%, 3wt% and 7wt%. The resulting CG/$CaCO_3$ coated PVDF membranes were characterised by their physicochemical and thermal properties using FESEM, FTIR, XRD, contact angle analysis and TGA. The results showed that the hydrophilicity of the CG/$CaCO_3$ coated PVDF membrane was significantly improved as the water contact angle and porosity of the membranes increased from 26.70° to 75.60° and 50.2% to 76%, respectively. On top of that, the CG/$CaCO_3$ coated PVDF membranes also exhibited an OPW permeate flux of 5.76 L $m^{-2} h^{-1}$ and oil rejection at 83.1%. However, the OPW permeate flux was lower from pristine PVDF membranes (51.47 L $m^{-2} h^{-1}$), indicating the pore blockage by the oil droplets from OPW. Overall, this preliminary study highlighted the significant use of upcycled GC to enhance membrane separation performance in treating OPW and might as well become the future reference for the further development of CG/$CaCO_3$-coated PVDF membranes for multiple applications.

Transmission electron microscope characterization of metal encapsulated BN nanotubes and carbon nanotubes

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The inner cavities of nanotubes have garnered much attention for one-dimensional structures and their distinct properties. For enhancing its ionic transport and catalytic performance, hetero nanostructures were encapsulated within the nanotubes. However, the encapsulation of nano-metallic particles into nanotubes is still laborious, requiring lengthy sintering times and elevating temperatures. In this study, we fabricated the iron-encapsulated multi-walled carbon nanotubes (MWCNTs) and boron nitride nanotubes (BNNTs) through a low-complexity experimental setup. Within 60 minutes, the encapsulation was achieved through a continuous sliding motion between iron surface and nanotube-palm oil mixture at room temperature. From HRTEM observation and interpretation, we demonstrated successful encapsulation of Fe particles within MWCNTs and BNNTs, and the resulting Fe particles appeared as <110> single crystal with 1.988Å lattice spacing. This novel fabrication method paves a new way for the large-scale production of iron-encapsulated MWCNTs and BNNTs for functional catalysis applications.

Keratin from Hair Waste as a Zeolite 13X Templated Carbon: Synthesis and Characterization

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In this work, Zeolite Templated Carbon has been synthesized by keratin as a carbon precursor and Zeolite 13X as the sacrificed zeolite template and labeled as ZTC-13X. The hydrolyzing of keratin from human hair waste has been successfully confirmed by FTIR results followed by previous research. The diffractogram of XRD shows that the amorphous structure of ZTC-13X indicates the Zeolite template removal was successful. The hexagonal structure from the SEM image of ZTC indicates that the ZTC-13X has a template-like morphology. N_2 Isotherm Adsorption-Desorption characterization followed by pore distribution analysis shows 803,04 m^2 and 0,84 nm respectively, almost twice as large as the zeolite template. Based on the characterization and analysis results, the ZTC-13X has potentially developed as adsorption, photocatalyst, and modification in membrane separation.

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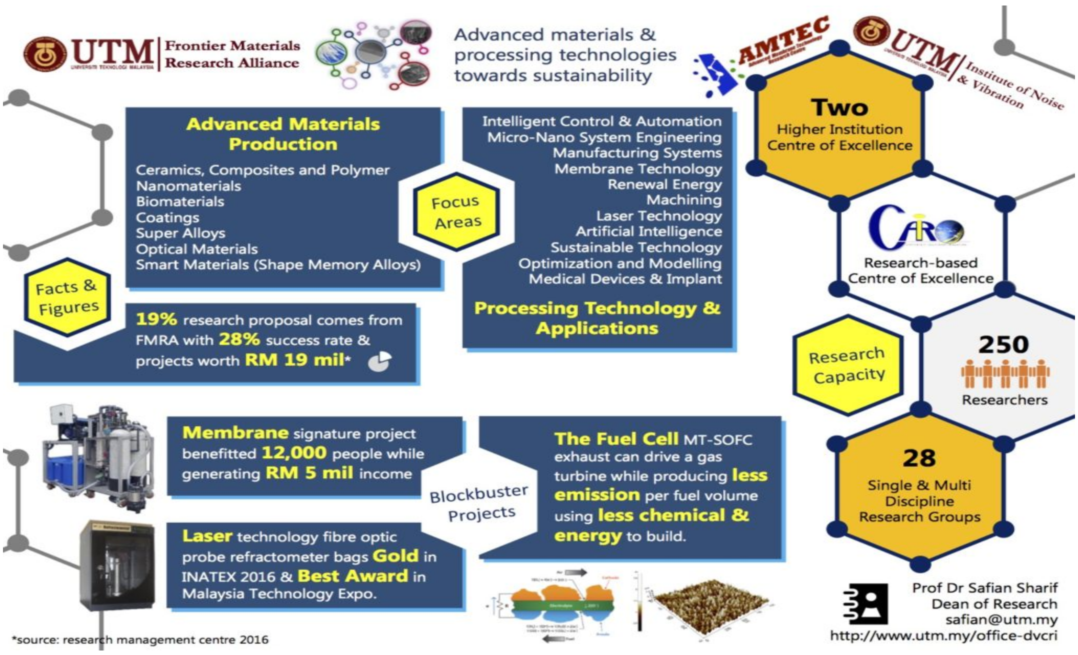

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MTMSB is a hub of membrane-based technology for water and waste water treatment separation processes for the industry and community application. The company is established to generate new and exciting projects in the field of membrane-based technology.

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