ABBS-SC 2021

16th ASIAN BIOHYDROGEN AND BIOREFINERY SYMPOSIUM & SUSTAINABILITY CHALLENGE 2021

Navigating the Future Through Circular Bioeconomy

15th -17th DECEMBER 2021

PROGRAMME & ABSTRACT BOOK

Organised by

CESPRO

Universiti Kebangsaan Malaysia

YAYASAN Sime Darby

IKKP

APEC Research Center for Advanced Biohydrogen Technology (ACABT)

INSTITUT PERUBAHAN IKLIM
Institute of Climate Change
Universiti Kebangsaan Malaysia

ABBS-SC 2021

16th Asian Biohydrogen and Biorefinery Symposium (ABBS) & Sustainability Challenge 2021

Navigating the Future Through Circular Bioeconomy

INTRODUCTION TO ABBS-SC 2021

The Research Centre for Sustainable Process Technology (CESPRO) was established as a Research Centre of Excellence at the Faculty of Engineering and Built Environment in October 2012 in line with the effort by Malaysian government to address various sustainability issues faced by the country. The focus of CESPRO is on the development of innovative process technology that will enhance the quality of life in the processing industry. CESPRO has been established to provide an avenue for researchers who are interested in this focus area to work together on common multidisciplinary projects together with various stakeholders. The main aim of CESPRO is to coordinate research activities related to processes for sustainable development, and through this, information and knowledge can be disseminated among academics, researchers, students, and industry.

The Asian Biohydrogen and Biorefinery Symposium (ABBS) has become the most important research conference in the Asian region and even the global biohydrogen technology field. It has made outstanding contributions to the promotion of Asia biohydrogen technology and supported by representatives from all over the world for the past 14 years. The ABBS is an international research symposium organized annually around Asia including Taichung (Taiwan, 2006), Daejeon (Korea,2007), Harbin (China, 2008), Khon Kaen (Thailand, 2009), Taichung (Taiwan, 2010), Bogor (Indonesia, 2011), Chongqing (China, 2012), Osaka (Japan, 2013), Melaka (Malaysia, 2014), Kenting (Taiwan, 2015), Jeju (Korea, 2016), Khon Kaen (Thailand, 2017), Henan (China, 2018), Hanoi (Viet Nam, 2019), and again, Taichung (Taiwan, 2020).

In 2021, the ABBS symposium is held in Malaysia in close cooperation with Universiti Kebangsaan Malaysia (UKM). Hence, CESPRO is enthusiastic to organize and welcome all interested parties to join the "16th Asian Biohydrogen and Biorefinery Symposium & Sustainability Challenge (ABBS-SC 2021)", which is held from December 15 – 17, 2021. The 16th ABBS 2021 is an international conference for researchers, academicians, and industry players working in the fields of bioprocesses, bioenergy, bioresources, smart circular solution as well as socio-economy, environment, and policy. The event serves as a platform for sharing and discussion on the latest developments and innovations in biohydrogen technology, biorefinery, economics, and impact on social sustainability as well as the potential for converting biomass into high-value products.

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WELCOME MESSAGE

MINISTER OF SCIENCE, TECHNOLOGY AND INNOVATION (MOSTI)

Assalamualaikum W.B.T and Salam Keluarga Malaysia,
It is an honour and privilege for me to welcome all of you to the **16th Asian Biohydrogen and Biorefinery Symposium and Sustainability Challenge (ABBS-SC 2021) themed "Navigating the Future through Circular Bioeconomy".**

MOSTI wants to transform Malaysia into a high income, sustainable and inclusive economy country by the year 2030. To do this, we must emphasise on innovation and utilisation of biotechnology at a commercial scale to improve the value chain of the economy.

A circular economy covers a wide range of activities. For example, if we look at the circular aspect of renewable biological resources, we must first convert it into a product with a higher added value which is sustainable. The end result may be food, feed, bioenergy, biofuels and biochemical products. In line with Malaysia's aspiration towards sustainability, MOSTI encourages industry players to transition towards bioproducts from renewable resources to decrease carbon footprint and emissions.

The 12th Malaysia Plan recently announced by the Prime Minister, YAB Dato' Sri Ismail Sabri Yaakob, has highlighted the shared prosperity initiative by the government for the next five-year period (2021-2025) that has three aspects: economic empowerment, environmental sustainability and social re-engineering. Malaysia should and must focus on green technology, renewable energy as well as adaptation and mitigation of climate change. This is key for Malaysia to be a high developed nation by 2030.

What can we do in Malaysia and what can we achieve? According to the International Journal of Hydrogen Energy 2018, Malaysia will have the highest mean real output growth rate of the biohydrogen sector from year 2017 to 2040 at 5.12%, Korea at 4.4%, India at 4.35%, Japan at 3.8% and China at 2.88%. Malaysia's plan to make the green circular economy fundamental to socio-economic growth owing to the high availability of biomass and the ability of their relatively mature biotechnology sectors to generate bioenergy, which may support the development of circular economy.

The production of hydrogen from waste such as wastewater and biomass as an alternative for fossil fuel, will be in high demand in the future due to many applications of hydrogen. MOSTI believes that the discussion between all experts here will shed some light on the issues and challenges related to circular bioeconomy and sustainability in Malaysia and across the globe. MOSTI also believes that sharing of ideas among participants could lead to new knowledge, new R&D and technology to be implemented in Malaysia. Let's do this together. Remember, "If you want to walk fast, walk alone. But if you want to walk far, walk together!"

MOSTI is proud to announce that numerous works have been done in our local universities and research institutes, on fundamental research of hydrogen production from waste, not only from palm oil industries, but also from other agro-industries. It is estimated that Malaysia produces 168 million tons of biomass annually. These include rice husks, timber, coconut oil and palm waste. These sustainable resources could be converted to the new bio-based products including bioenergy, biofertiliser and biomaterials.

MOSTI believes that Malaysia could increase the growth of economy by the efficient usage of biomass. According to the data by Malaysian Bioeconomy Development Corporation Sdn. Bhd., a stimulated 15% annual growth, is projected to grow from RM149.1 billion in 2020 to RM181.2 billion in 2030 respectively. MOSTI also congratulates the Research Centre for Sustainable Process Technology, Faculty of Engineering and Built Environment, UKM as the main organiser in making this event a huge success. My heartfelt thanks to co-organisers too. Thank you and congratulations!

To all the Malaysians and international participants, 'terima kasih' and thank you for taking your time in attending this very important symposium for the future of Keluarga Malaysia. With Bismillahirrahmanirrahim, I officiate the 16th Asian Biohydrogen and Biorefinery Symposium and Sustainability Challenge.

Yang Berbahagia
Dato' Sri Dr. Adham Baba
Minister of Science,
Technology and Innovation (MOSTI)

WELCOME MESSAGE

VICE CHANCELLOR OF UKM

It is my pleasure to welcome all the participants today to the 16th Asian Biohydrogen and Biorefinery Symposium & Sustainability Challenge 2021. I would like to take this opportunity to express my sincere appreciation to all distinguished Professors and Speakers, who are willing to share your knowledge and vast experience with the participants. I would also like to congratulate the organizer, Research Centre for Sustainable Process Technology (CESPRO), Faculty of Engineering and Built Environment UKM for making this event a success.

The theme of ABBS-SC 2021 this year, **"Navigating the Future through Circular Bioeconomy"** is an interesting topic to be explored. The bioeconomy is viewed as a critical component of sustainable consumption and production, which gains importance on national and global levels. In UKM, numerous works have been done in our faculties and research institutes on fundamental and application research in bioeconomy. Bioeconomy incorporates various aspects, including research and development of bioproducts, businesses, and policy making. For instance, the Sime Darby Palm Oil Tennamaram mill in Bestari Jaya, Selangor, is a pilot plant that demonstrates how to transform a conventional mill into a green technology factory using various technologies. It was developed by a research team at Universiti Kebangsaan Malaysia-Yayasan Sime Darby's (UKM-YSD) Chair for Sustainable Development of Zero-Waste Technology. The plant's construction has been completed, and trial runs have begun. This is an increasingly prominent economic prospect for Malaysia which has all the right building blocks for companies to grow in this area. Malaysia has a competitive advantage due to its abundance of sustainable and renewable biological resources such as biomass. The chemical industry, heavy road transport, marine and aviation sectors are all under pressure to transition away from fossil fuels.

I really hope this event will achieve its primary objective and provide a platform for like-minded scientists, academics, and industry players across different Asian countries to disseminate and discuss their recent findings in the current technology, economic value and social sustainability on the subject of bioeconomy.

Yang Berbahagia
Prof. Dato' Ts. Dr. Mohd Ekhwan Hj. Toriman
Vice-Chancellor
Universiti Kebangsaan Malaysia

WELCOME MESSAGE

CHAIRMAN OF ABBS-SC 2021

On behalf of the Organizing Committee, I would like to welcome all of you to the 16th Asian Biohydrogen and Biorefinery Symposium & Sustainability Challenge (ABBS-SC 2021) with themed "Navigating the Future through Circular Bioeconomy" held from December 15 to 17, 2021. Biohydrogen and biorefinery research symposium is important to provide a platform for scientists, academia and industry to present their current research findings in the fields of biohydrogen and biorefinery in the Asian region, and to strengthen networking opportunities and knowledge sharing between governments, public and private researchers. The Asian Biohydrogen and Biorefinery Symposiums (ABBS) were initiated by The Asia BioHyLinks (ABHL) and held annually around the Asian countries. It is an honor for the Universiti Kebangsaan Malaysia (UKM) to organize the ABBS this year again after 7 years, when the conference was organized in Melaka in the year 2014.

Regarding the conference activities, we are proud to present 2 plenary speakers, 6 keynote speakers, and 8 invited speakers. There are 5 parallel sessions covering topics on bioprocess, bioenergy, bioresources, socio-economy, environment and policy, and smart circular solution, with the participation of 41 oral presenters. I sincerely hope that this event will bring together researchers and engineers to meet and discuss their achievements and share their ideas.

Meanwhile, Sustainability Challenge 2021 is the fourth series innovation and invention competition organized by the UKM It is our hope that this event could be a platform to explore and develop innovative ideas for the sustainable practice in bioeconomy. Out of 56 submissions, we are pleased to gather 28 teams for the final live pitching session for school and university categories.
Lastly, I would like to thank co-organizers, all the participants and sponsors of the ABBS-SC 2021, without the support it would be difficult to organize a successful conference. Your contributions are greatly appreciated.

Associate Professor Ir. Dr. Hassimi Abu Hasan
Chairman, ABBS-SC 2021, Universiti Kebangsaan Malaysia

TECHNICAL PROGRAMME DAY 1

TIME	MAIN CHANNEL	CH 1: BIOPROCESS (BP)	CH 2: BIOENERGY 1 (BE 1)	CH3: BIOENERGY 2 (BE 2)	CH 4: BIORESOURCES (BR)	CH 5: SOCIO-ECONOMY, ENVIRONMENT & POLICY (SE)/ SMART CIRCULAR SOLUTION (SC)
8:30-9:00 A.M.	**Registration Online**					
9:00-9:30 A.M.	Opening Ceremony MC: Encik Muhaimin Bin Sabron 1. Welcoming remark by Conference Chair (AP Ir. Dr. Hassimi Abu Hasan) 2. Vice Chancellor UKM (YBhg. Prof. Dato' Ts. Dr. Mohd Ekhwan Hj. Toriman) 3. MOSTI Minister (YB Dato' Sri Dr. Adham Bin Baba)					
9:30-10:15 A.M.	**Plenary Speaker 1:** **Professor Dr. Ashok Pandey** (Centre for Innovation and Translational Research, CSIR-Indian Institute of Toxicology Research, Lucknow, India) Title: Biowaste-to-bioenergy: A circular bioeconomy perspectives Chairperson: Assoc. Prof. Ir. Dr. Shuhaida Harun					
10:15-10:20 A.M.	**Photo session 1**					
10:20-10:30 A.M.	**Break**					
10:30-11:00 A.M.	**Keynote 1:** **Professor Dr. Jamaliah Md. Jahim** (Universiti Kebangsaan Malaysia, Malaysia) Title: Generation of Bioenergy from Palm Oil Mill Effluent and Utilization of Palm Oil Residues for Value-added Products Chairperson: Dr Peer Mohamed					
10:30-11:00 A.M.	**Keynote 2:** **Professor Datuk Dr. Azizan Baharuddin** (Chair Holder of UKM-YSD Chair for Sustainability, Malaysia) Title: Circular Economy Capitalising on the Wealth of Religions Chairperson: Dr Peer Mohamed					
10:30-11:00 A.M.		Chairperson: Dr. Sharifah Nabihah Syed Jaafar Time Keeper: Mrs. Norzatul 'Ezzah Hasan	Chairperson: Dr. Thien Khanh Tran Time Keeper: Mrs. Asmawati Maaroff	Chairperson: Dr. Sureewan Sittijunda (Yes) Time Keeper: Mrs. Emillia Bt Abd Aziz @ Ghafar	Chairperson: Dr. Mohd Nur Ikhmal Salehmin Time Keeper: Mrs. Nik Haryanie Jaafar	Chairperson: Ir. Dr. Nor Yuliana Yuhana (yes) Time Keeper: Mr. Wiryuazren Abdul Hamid
11:30-11:50 A.M.		**Speaker 1 (invited)** **Assoc. Prof. Chyi-How Lay** (Feng Chia University, Taiwan) **BP-IS-01**: Optimizing the co-fermentation ratio of organic matters in biogas production from chicken manure	**Speaker 1 (invited)** **Prof. Dr. Rizalinda L. de Leon** (University of the Philippines Diliman,Philiphine) **BE-IS-03:** Enhanced Hydrogen Production By Visible Light Photocatalysis With 2D MoS2 / 2D CdS Composite	**Speaker 1 (invited)** **Dr. Swee Su Lim** (Universiti Kebangsaan Malaysia, Malaysia) **BE-IS-02:** Microbial Fuel Cell-Based Sensor For Microbial Activity Monitoring During Enterobacter Sp. Kbh6958 Biohydrogen Production	**Speaker 1 (invited)** **Dr. Nantharat Wongfaed** (Khon Kaen University, Thailand) **BR-OS-04:** Bio-Methane Potential From Wilted Sugarcane Leaves Ensiled With Methanogenic And Hydrogenic Effluent	**Speaker 1 (invited)** **Prof. Dr. Duu-Hwa Lee** (National Taiwan Ocean University, Taiwan) **SE-IS-01:** Production Efficiency And Economic Benefit Evaluation Of Biohydrogen Using Microalgae As A Biomass Feedstock In Asian Circular Economies
11:50- 12:05 A.M.		**Speaker 2** **Dr. Kristian July R. Yap** (University of the Philippines Diliman,Philiphine) **BP-OS-11:** Functional Groups Evaluation And Temperature Effects On Anion Exchange Membrane (AEM) Electrolyzer Performance For H_2 Production	**Speaker 2** **Dr. Mimi Hani Abu Bakar** (Universiti Kebangsaan Malaysia, Malaysia) **BE-OS-14:** Wira Mfc – Designing A Stem Game Apps For School-Aged Children In Microbial Fuel Cell And Composting	**Speaker 2** **Dr. Prawit Kongjan** (Prince of Songkla University, Thailand) **BE-OS-15:** Dark fermentation and microbial electrolysis cell for gaseous bio-fuel production from co-fermentation of distillery wastewater with glycerol wast	**Speaker 2** **Ms. Nina Farhana Mohd Jamaludin** (Universiti Putra Malaysia, Malaysia) **BR-OS-02:** Optimization Of Biogas Production With Utilization Of Magnetite Granular Activated Carbon From Coconut Shell	**Speaker 2** **Dr. Yoke Kin Wan** (University of Nottingham Malaysia, Malaysia) **SE-OS-02:** Techno-Economic Analysis Of A Palm Oil Mill Effluent To Biomethanol Plant
12:05- 12:20 A.M.		**Speaker 3** **Mr. Hwijin Seo** (Gyeongsang National University, South Korea) **BP-OS-03:** Effect Of Pretreated Primary Sewage Sludge For Enhancing Methane Production In Microbial Electrolysis Cell	**Speaker 3** **Ms. Kuntima Krekkeitsakul** (Silpakorn University, Thailand) **BE-OS-02:** The Influence Of Additions Of Metal Oxide And Alkali Solution In Dark Fermentative Biohydrogen Production From Molasses	**Speaker 3** **Ms. Jimin Kim** (Inha University, Republic of Korea) **BE-OS-16:** New Approach For Raising Biohydrogen Production From Organic Wastes Via The Reformation Of Ammonia Stripped From Anaerobic	**Speaker 3** **Ms. Nuraishah Abd Rahim** (Universiti Kebangsaan Malaysia, Malaysia) **BR-OS-03 :** Oil Palm Biomass Pre-treatment And Hydrolysis: A Recent Biotechnological Venture Towards Bio-Based Lactic Acid Production	**Speaker 3** **Ms. Noor Irdiana Hj Ngadiman** (Universiti Kebangsaan Malaysia, Malaysia) **SE-OS-01:** Reverse Logistics In Circular Economy: A Literature Of Review
12:20- 12:35 A.M.		**Speaker 4** **Mr. Yeow Teck Ann** (Xiamen University Malaysia, Malaysia **BP-OS-13:** Mini Review On Reactive Solvent Extraction Of Fermentative 1,3-Propanediol	**Speaker 4** **Ms. Vi Ngoc Dan Nguyen** (Feng Chia University, Taiwan) **BE-OS-18:** Utilization Of TiO_2 Assisted Plasma For VOC Removal With H_2 Production	**Speaker 4** **Mr. Om Prakash** (Inha University, Republic of Korea) **BE-OS-17:** Auto-Generative High-Pressure (AHPD) Technology For High Calorific Hydrogen Production	**Speaker 4** **Ms. Yi-Hsuan Wu** (Feng Chia University, Taiwan) **BR-OS-08:** Effect of Coagulants on the Structure of Biocellulose Aerogel	
12:35-2:00 P.M.	**Break**					
2:00-2:30 P.M.	**Keynote 3:** **Professor Dr. Shu-Yii Wu** (Feng Chia University, Taiwan) Title: Green synergy solutions for renewable energy Chairperson: Dr. Ebrahim Mahmoudi					
2:30-3:00 P.M.	**Keynote 4:** **Professor Dr. Simon Lord** (Adjunct Professor at UKM-YSD Chair for Sustainability,Malaysia) Title: Circular Economy: The Need to Transition Chairperson: Dr. Ebrahim Mahmoudi					
		Chairperson: Dr. Kristian July R. Yap Time Keeper: Mr. Mohamad Hisyam Abdul Rahman	Chairperson: Dr. Ang Wei Lun Time Keeper: Mrs. Hanisah Haris	Chairperson: Dr. Muhammad Zulhaziman Mat Salleh Time Keeper: Mrs. Nur Zuraidah Binti Rahim	Chairperson: Dr Ahmad Razi Time Keeper: Mrs. Noor Hidayu Sukma Salleh	
3:00-3:15 P.M.		**Speaker 1** **Dr. Sharifah Nabihah Syed Jaafar** (Universiti Kebangsaan Malaysia, Malaysia) **BP-OS-09:** Improved Methyl Levulinate Synthesis From Core Oil Palm Trunk Sap Through Microwave-Assisted Reaction	**Speaker 1** **Miss Kuei Lin Chang** (Feng Chia University, Taiwan) **BE-OS-25:** Photo Biohydrogen Production by Cellulosic Aerogel Immobilized Mixed Culture	**Speaker 1** **Dr. Thien Khanh Tran** (Institute for Circular Economy Development (ICED), Vietnam National University, Vietnam) **BE-OS-21:** The utilization of rice straw (Oryza Sativa L.) as a green catalyst in the production of hydrogen via catalytic pyrolysis of shrimp farm sludge	**Speaker 1** **Dr. Mohd Nur Ikhmal Salehmin** (Universiti Kebangsaan Malaysia, Malaysia) **BR-OS-01:** Pushing microbial desalination cells towards field application: Prevailing challenges, potential mitigation strategies, and future prospects	
3:15-3:30 P.M.		**Speaker 2** **Dr. Anna Joicy** (Gyeongsang National University, India **BP-OS-02:** Enhancing Methane Production From Pretreated Was In Mec-Ad System: Performance, Microbial Activity, And Implications At Different Applied Voltage	**Speaker 2** **Ms. Li Yang** (University Putra Malaysia, Malaysia) **BE-OS-11:** Renewable Energy Scenarios For Sustainable Electricity In Malaysia	**Speaker 2** **Ms. Cut Ulfah Nihayati Sholeha** (Universiti Kebangsaan Malaysia, Malaysia) **BE-OS-09:** Review On Crispr Technologies As Strategy To Improve Dark Fermentative Biohydrogen Production Using Clostridium Spp	**Speaker 2** **Mrs. Norzila Mohd** (Universiti Kebangsaan Malaysia, Malaysia) **BR-OS-06:** A Comparative Study Of The Morphological, Biomass And Lipid Production Of Native Microalgae Cultured In Anaerobic Pome	
3:30 - 3:45 P.M.		**Speaker 3** **Ms. Adila Fazliyana Aili Hamzah** (Universiti Putra Malaysia, Malaysia) **BP-OS-10:** Kinetic Study On Biogas Production Through Anaerobic Mesopholic Co-Digestion Of Pineapple Waste And Cow Dung At Different Substrate Ratio	**Speaker 3** **Ms. Kuntima Krekkeitsakul** (Silpakorn University, Thailand) **BE-OS-13:** Application Of Biohydrogen By Reverse Water Gas Shift (Rwgs) Reaction For Biomethanol Synthesis	**Speaker 3** **Mr. Feng Li** (Chongqing University, China) **BE-OS-08:** Continuous Photoenzymatic Decarboxylation Of Fatty Acids For Alkane Fuels Production In A Microfluidic Photobioreactor	**Speaker 3** **Ms. Siti Noor Khaleeda binti Mhd Syahri** (Universiti Kebangsaan Malaysia, Malaysia) **BR-OS-05:** Biogas Production Under Different Inoculum To Palm Oil Mill Effluent Ratio	
3:45- 4:00 P.M.		**Speaker 4** **Dr. Jia-Hong Kuo** (National United University, Taiwan) **BP-OS-17 :**Thermal resistant Pt-Ni/CeO2/Al2O3 bimetallic catalyst for hydrogen production using microwave-assisted atom-trapping method in a fluidized bed gasification	**Speaker 4** **Mr. Marco Torre** (National Research Council of Italy, Italy) **BE-OS-10:** Biogas Production From Recycled Absorbent Hygiene Products	**Speaker 4** **Ms. Norsyahira Saffiee** (Universiti Kebangsaan Malaysia, Malaysia) **BE-OS-12:** Biogas Purification And Upgrading Using Metal-Organic Framework		
4:00-6:00 P.M.	ABHL Meeting (For Invited Members only)					

TECHNICAL PROGRAMME DAY 2

TIME	MAIN CHANNEL	CH 1: BIOPROCESS (BP)	CH 2: BIOENERGY 1 (BE 1)	CH3: BIOENERGY 2 (BE 2)
9:00-9:45 A.M.	**Plenary Speaker 2:** **Dr. Harikrishna Kulaveerasingam** (Chief Research and Development Officer Sime Darby Plantation Berhad Title: Circular Bioeconomy For The Oil Palm Industry: Opportunities And Progress Chairperson: Assoc. Prof. Dr. Mohd Shahbudin Mastar@Masda			
9:45-9:50 A.M.	**Photo session 2**			
9:50-10:20 A.M.	**Keynote 5:** **Professor Dr. Chiu-Yue Lin** (Feng Chia University, Taiwan) Title: Advanced Education and Training in Bioenergy in Taiwan Chairperson: Ts. Dr. Abdullah Amru Indera Luthfi			
10:20-10:50 A.M.	**Keynote 6:** **Professor Dr. Alissara Reungsang** (Khon Kaen University, Thailand) Title: Pretreatment of lignocellulosic biomass for bio-hydrogen and methane production Chairperson: Ts. Dr. Abdullah Amru Indera Luthfi			
10:50-11:00 A.M.	**Break**			
		Chairperson: Dr. Anna Joicy Time Keeper: Siti Azliza Zakaria	Chairperson: Prof. Dr. Rizalinda L. de Leon (Yes) Time Keeper: Mohd Razif bin Maafol	Chairperson: Dr. Swee Su Lim Time Keeper: Muhammad Zamri Zulkafli
11:00-11:20 A.M.		**Speaker 1 (invited)** **Dr. Samikannu Prabu** (National Central University, Taiwan) **BP-IS-02:** Hydrogen energy yield and pollutants emission in co-gasification of paper mill sludge (PMS) and automobile shredder residues (ASRs)	**Speaker 1 (invited)** **Assoc. Prof. Chyi-How Lay** (Feng Chia University, Taiwan) **BE-IS-05:** Enhancement on the performance by current-powered solenoid magnetic field in microbial fuel cell	**Speaker 1 (invited)** **Dr. Sureewan Sittijunda** (Mahidol University, Thailand) **BE-OS-03:** Production of biohydrogen and methane from two-stage and one-stage co-digestion of vinasse and spent brewer's yeast
11:20- 11:35 A.M.		**Speaker 2** **Ms. Noppamas Chantawan** (Khon Kaen University, Thailand) **BP-OS-04:** High-Solid Dark Fermentation Of Cassava Pulp And Cassava Processing Wastewater For Bio-Hydrogen Production	**Speaker 2** **Dr. Nazlina Haiza Mohd Yasin** (Universiti Kebangsaan Malaysia, Malaysia) **BE-OS-23:** Photosynthetic Microbial Desalination Cell (Phmdc) For Electricity Production And Water Treatment	**Speaker 2** **Mr. Adam Mohd Izhan Bin Noor Azam** (Universiti Kebangsaan Malaysia, Malaysia) **BE-OS-20:** Parametric Study On Anion Exchange Membrane (AEM) Electrolysis Performance And Hydrogen Production
11:35- 11:50 A.M.		**Speaker 3** **Miss Ainul Husna Abdul Aziz** (International Islamic University Malaysia, Malalaysia) **BP-OS-05:** Comparison Between Hydrothermal And Co-Precipitation Method In Green Synthesis Of Magnetic Silver Nanoparticles	**Speaker 3** **Miss Prakaidao Pomdaeng** (Feng Chia University, Taiwan) **BE-OS-04:** The performance of single-stage and two-stage fermentative hydrogen and methane productions from Napier Grass	**Speaker 3** **Mrs. Nurul Noramelya Zulkefli** (Universiti Kebangsaan Malaysia, Malaysia) **BE-OS-19:** Dual Chemical Metal (DCM) Impregnation Synthesis On Activated Carbon For H^2S Capture In Adsorbtion-Desorption Cycle.
11:50- 12:05 P.M.		**Speaker 4** **Mr. Ji-Hwan Cha** (Chungbuk National University, Republic of Korea) **BP-OS-14:** Study of swine manure deodorization through analysis microorganism community	**Speaker 4** **Mr. Worapong Wongarmat** (Khon Kaen University, Thailand) **BE-OS-22:** Optimization Of Biogas Effluent And Filter Cake Proportions For Two-Stage Hydrogen And Methane Production	**Speaker 4** **Ms. Anongnart Wannapokin** (National Chung Hsing University, Taiwan) **BE-OS-27:** Improving Bio-hydrogen production of Multi-Walled Carbon Nanotubes Carboxylic Acid Functionalized (MWCNT-COOH) by Co-immobilization technique with Clostridium pasteurianum
12:05-12:20 P.M.		**Speaker 5** **Ms. Nur Afiqah Mohd Azhari** (Universiti Kebangsaan Malaysia, Malaysia) **BP-OS-15:** Effects Of CO^2 Flow Rate On Essential Oil Yield And Component Profile By Supercritical Fluid Extraction Of Polygonum Minus Root	**Speaker 5** **Mr. Hyeon-Myeong Yang** (Chungbuk National University, Republic of Korea) **BE-OS-24:** Performance Verification Of Bio-Electrochemical Reactor Adaption Types In Bench Scale	**Speaker 5** **Mr. Wen Xuan Woo** (Xiamen University Malaysia, Malaysia) **BE-OS-05:** Insights Of Immobilization Techniques For Enzymatic Hydrolysis And Subsequent Hydrogen Production

TECHNICAL PROGRAMME DAY 3

SUSTAINABILITY CHALLENGE:
FINAL PITCHING

TIME	MAIN CHANNEL	CH1: SC BRIEFING	CH 2 - UNIVERSITY	CH 3- SCHOOL
7:30-8:00 A.M.	**Registration Online**			
8:00-8:30 A.M.		**Briefing: Jury** Assoc. Prof. Ir. Dr Hassimi Abu Hasan	**Briefing: SC University** Assoc. Prof. Dr. Masli Irwan Rosli	**Briefing: SC School** Assoc. Prof. Ir. Dr. Shuhaida Harun
			Parallel Pitching Session - UNIVERSITY MC: Nik Dania Azmira Binti Nik Mohd Azmi Time keeper: Goh Ellen	**Parallel Pitching Session - SCHOOL** MC: Chia Jan Feng Time keeper: Nasuha binti Mohamad Nasrol
8:30-8:45 A.M.			**University 1- Aquaman** (UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA	**School 1- AutoPES** (SMK LINGGIU, JOHOR)
8:45-9:00 A.M.			**University 2- SCS** (XIAMEN UNIVERSITY MALAYSIA, MALAYSIA)	**School 2- NIJA** (SMK SACRED HEART, SARAWAK)
9:00- 9:15 A.M.			**University 3- Evergreen** (UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA)	**School 3- De 3 Lions** (SM SUNG SIEW, SABAH)
9:15-9:30 A.M.			**University 4- Go Green** (UNIVERSITY OF SCIENCE MALAYSIA, MALAYSIA)	**School 4- The Amazing Gems** **(**SMA JAIM AL-ASYRAF, MELAKA)
9:30-9:45 A.M.			**University 5- Team Evergreen** (UNIVERSITY OF NOTTINGHAM MALAYSIA, MALAYSIA)	**School 5- S.A.T** (SMK(P)ST GEORGE, PULAU PINANG)
9:45-10:00 A.M.			**University 6- Inspector Hazard** (UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA)	**School 6- CodeMode** (SMK (P) SRI AMAN, SELANGOR)
10:00-10:15 A.M.			**University 7- Universitas Budi Luhur** (UNIVERSITAS BUDI LUHUR, INDONESIA)	**School 7- Phoenix** (SMK CONVENT IPOH, PERAK)
10:15-10:30 A.M.			**University 8- EcoCycle** (UNIVERSITI TEKNOLOGI PETRONAS, MALAYSIA)	**School 8- Dream Catchers** (RIAM ROAD SECONDARY SCHOOL, SARAWAK)
10:30-10:45 A.M.			**University 9- Green Is The New Black** (INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, MALAYSIA)	**School 9- The Elite** (SMK(P)ST GEORGE, PULAU PINANG)
10:45-11:00 A.M.			**University 10- The Future Team** (UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA)	**School 10- Drifters Duo** (SMK TAMAN BUKIT INDAH, JOHOR)
11:00-11:15 A.M.			**University 11- Eco-Friends** (UCSI UNIVERSITY, MALAYSIA)	**School 11- Water Hackers** (SMK BINTULU, SARAWAK)
11:15-11:30 A.M.			**University 12- Wastebusters** (UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA)	**School 12- Backstreet** (SMK ST ELIZABETH, SARAWAK)
11:30- 11:45 A.M.			**University 13- YMC Algae Tech** (XIAMEN UNIVERSITY MALAYSIA, MALAYSIA)	**School 13- STK Glorious 1** (SMK TINGGI KLUANG, JOHOR)
11:45-3.00 P.M	**Break**			
3.00-3.15 P.M			**University 14- Planeteers** (UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA)	
3.15-3.30 P.M.			**University 15- ROLKA pellets** (BIALYSTOK UNIVERSITY OF TECHNOLOGY, POLAND)	
3.30-4.00 P.M.	**Video Presentation**			
4.00-5.00 P.M.	**Awards & Closing Ceremony** MC: Encik Muhaimin Sabron 1. Event Speech by Conference Chair (AP Ir. Dr. Hassimi Abu Hasan) 2. Deputy Vice Chancellor UKM (YBhg. Prof. Dato' Ir. Dr. Abdul Wahab Mohammad) **Awards** 1. ABBS: Best Presenter 2. SC: a) Jury Introduction and comment from head of jury b) Winners: - Best video - Top 10 - Grand prize 3. Teaser Upcoming ABBS 4. Photography Session			

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BE-KS-01	Pretreatment of Lignocellulosic Biomass for Bio-Hydrogen and Methane Production
BE-KS-02	Advanced Education and Training in Bioenergy in Taiwan
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BE-PS-01 (PLENARY SPEAKER)

BIOWASTE-TO-BIOENERGY: A CIRCULAR BIOECONOMY PERSPECTIVES

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ABSTRACT

Waste-to-energy concept has gained much momentum in recent years as on one hand, it offers unique opportunity to handle and dispose solid wastes (municipal waste as well as agro-industrial wastes), and simultaneously provides alternative sources of renewable energy. Solid waste treatment and management is a major issue worldwide. Several countries lack proper basic waste management infrastructure and awareness. Thus, waste-to-energy could be an attractive solution for resource recovery, which eventually offers potential benefits when works on principles of biorefinery. A biorefinery is a facility that integrates biomass conversion processes and equipment to produce bio-products, including biofuels and chemicals. It is analogous to todays' petroleum refinery. By producing several products, a biorefinery takes the advantages of various components present in the biomass and their intermediates, therefore maximizing the value derived from the biomass feedstock. They also help in complete or near-complete utilization of the feedstock and reduction in solid, liquid or gaseous wastes. Lignocellulosic biomass-based research has extensively progressed for the production of value-added products and biofuels. Potential application of such biomasses for the production of liquid and gaseous biofuels and other products on principle of biorefineries has gained more attention for possibilities of bioethanol, biobutanol, biodiesel and other high-value chemicals production, coupled with industrial wastewater treatment. Two major pathways for these include thermo-chemical conversion and biochemical conversion. However, process integration is key for the techno-economic success. The lecture will discuss the issues and perspectives.

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SE-PS-01 (PLENARY SPEAKER)

CIRCULAR BIOECONOMY FOR THE OIL PALM INDUSTRY: OPPORTUNITIES AND PROGRESS

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ABSTRACT

There is a Global realisation that climate change is real threat and that immediate carbon dioxide emissions reductions are essential to ensure that the planet remains habitable for humans. Given this, there has been increasing demand for renewable products that are sustainably produced and for alternative zero waste production systems to be adopted. Most agricultural production systems are operated in a linear fashion but have many opportunities to adopt a circular concept where wastes/low value products are fully recycled/utilised. The high yields of oil palm together with the high productivity of the industry has enabled Palm Oil to be the most productive vegetable oil globally. However, from a circular economy perspective there are many other potential products that can be produced sustainably and valorised from Oil Palm besides the vegetable oil. This offers many opportunities for deploying new technologies to leverage on some of the non-oil components to unlock new value and to enhance recyclability. These advanced technologies also provide a means to improve palm oil milling productivity and efficiency and offer an alternative route to enhancing the production of palm oil. Given that palm oil is a commodity product that is prone to global price fluctuations, the industry has been traditionally reluctant to invest in unproven technologies or to explore the utility of cellulosic biproducts until recently. Sime Darby Plantation has been investing in R&D since the 1920's and has initated many projects on palm oil milling, either improving productivity or reducing /treating waste products towards reducing the carbon and water footprint. We have tested many technological innovations at pilot scale, some of which have been progressed to be deployed and validated at industrial scale, supporting opportunities towards circularising the production process. The challenges and opportunities of industrial scale deployment of these various technological approaches in oil mills and the journey towards being fully circularised will be discussed.

BE-KS-01 (KEYNOTE SPEAKER)

PRETREATMENT OF LIGNOCELLULOSIC BIOMASS FOR BIO-HYDROGEN AND METHANE PRODUCTION

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ABSTRACT

Lignocellulosic biomass compose of cellulose, hemicellulose, and lignin. Cellulose and hemicellulose can be enzymatically hydrolyzed to fermentable sugars. These fermentable sugars such as glucose, xylose, and arabinose can be further used as a carbon source in bio-hydrogen and methane production. Lignin is the most recalcitrant component of the plant cell wall and plays the role of the plant structural support, impermeability, and resistance against microbial attack. Therefore, the composition, structure, and lignin content of lignocellulosic biomass limited its utilization for the biological process. To solve this problem, several pretreatment methods have been applied to improve enzymatic hydrolysis and fermentation efficiency of lignocellulosic biomass. This presentation will deliver the pretreatment methods for lignocellulosic biomass with the focus on the pretreatment of Napier grass and its silage. The effects of four pretreatment methods including physical (particle size reduction and hydration pretreatment), chemical (organosolv pretreatment), physicochemical (hydrothermal pretreatment, thermal- assisted hydration pretreatment), and biological (enzymatic hydrolysis) on Napier grass and its silage before further used as a substrate for bio-hydrogen and methane production will be covered. Additionally, energy balance analysis will be examined in order to evaluate the feasibility of the pretreatment methods.

BE-KS-02 (KEYNOTE SPEAKER)

ADVANCED EDUCATION AND TRAINING IN BIOENERGY IN TAIWAN

Chiu-Yue Lin (Prof), Sin-Yi Lin, Hoang-Jyh Leu, Chyi-How Lay, Jane-Yii Wu
Chia-Hao Wu, Ting-Wei Wu

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ABSTRACT

"Energy Saving and Carbon Reduction Policy" is the environment-energy policy in Taiwan to face the problems of global climate change. In 2010-2022, Ministry of Education (MOE), Taiwan have initiated the green energy technology education programs to cultivate high quality talents in universities in energy-savings and energy technologies such as solar, wind, hydraulic, geothermal, marine and biomass energies. Bioenergy is one of the main renewable energy used in the world. In Taiwan the bioenergy-power is mainly from waste incineration and biomass such as black liquor, bagasse and biogas with values of 1.55 trillion kwh (1.37% of total power generation, 25.5% of renewable energy power) during Jan-May 2021. Bioenergy technology education issues have been included in the above programs. Feng Chia University (FCU) has (1) developed a biohydrogen energy technology (HyMeTek) with having a biohythane pilot-plant, a green-hydrogen gas-station, and a mobile bioenergy station for technique training, and (2) important international bioenergy networks such as Asia Bio-HyLinks (biohydrogen links) and APEC Research Center for Advanced Bioenergy Technology (https://apec-acabt.org/). Therefore, FCU has attended MOE's energy programs since 2011 through bidding. The main outcomes of executing these energy programs by FCU and other partner universities were (1) establishing 3 education working platforms of Bioenergy Resource Center, Education Alliance and Regional Energy Education Center; and (2) initiating many new courses, innovative practices, industry-academia projects and international activities in bioenergy.

SE-IS-01 (INVITED SPEAKER)

PRODUCTION EFFICIENCY AND ECONOMIC BENEFIT EVALUATION OF BIOHYDROGEN USING MICROALGAE AS A BIOMASS FEEDSTOCK IN ASIAN CIRCULAR ECONOMIES

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ABSTRACT

Biohydrogen is a promising alternative energy for a substantial mitigating climate change contribution[1]. Microalgae is one of the most productive biohydrogen system which mitigates global warming effects[2]. This study contributes to the literature on evaluating the first (to the best of author's knowledge) production efficiency of technology of biohydrogen production by microalgae biomass and their economic impacts in Asian circular economies including China, India, Japan, Korea, Malaysia and Taiwan, and tries to figure out which microalgae biohydrogen technology owns higher production efficiency, and the economic benefits generated by microalgae technology improving in circular economy. This study utilizes a confirmed soft-link methodology[3] which combines data envelopment analysis (DEA) model (for evaluating hydrogen yield efficiency which is rarely utilized by scientific literature[3]) and computer general equilibrium (CGE) model (for evaluating economic benefits) which incorporates circular economy mechanism (close loop, secondary materials) for evaluating of biohydrogen production efficiency from microalgae biomass for entire biohydrogen supply chain simultaneously. Biohydrogen production has various input factors, including bacteria type, pH, temperature, substrate concentration, the type of the bioreactor, hydraulic retention time (HRT), nutrient composition, partial pressure, and metabolite concentration[5], and the most important output is hydrogen production rate and hydrogen yield. Data of microalgae as biomass feedstock for generating biohydrogen by dark fermentation (batch and continuous mode) was collected from literature[5,6,7,8,9]. Numerous statistical tests and regression models are conducted to determine the causality relationships and which technology is significantly higher than others between the input factors and output of microalgae biohydrogen generation. This study provides rarely evaluation results of biohydrogen production efficiency from microalgae and their economic impacts in Asian circular bioeconomies, and compares results of biohydrogen generated by macroalgae[10] and other biomass sources[11]. Results could be critical and beneficial to decision makers for development of biohydrogen industry from microalgae and energy administration in the world

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BP-IS-01 (INVITED SPEAKER)

OPTIMIZING THE CO-FERMENTATION RATIO OF ORGANIC MATTERS IN BIOGAS PRODUCTION FROM CHICKEN MANURE

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ABSTRACT

Anaerobic fermentation has become an effective and mature technology to treat solid organic waste. Chicken manure is rich in nitrogen and organics and has the potential to be the feedstock of anaerobic digestion. Anaerobic microorganisms could convert organic matters including lipids, proteins and carbohydrates into CH_4 and CO_2 through hydrolysis, acidogenesis, acetogenesis and methanogenesis reactions. Many reports reveal that lipids, proteins and carbohydrates have methane yields of 1000 mL/g-VS (volatile solids), 480 mL/g-VS and 373 mL/g-VS[1], respectively. However, methane yield would be limited due to the inhibition from high concentration of ammonia nitrogen. Co-fermentation is a strategy that has been applied widely to enhance the biogas production[2]. A full-factorial central-composite experimental design was employed in planning the batch assays to optimize the lipid, protein and carbohydrate concentrations for efficient biogas production. Response surface methodology results show that peak methane production yield of 25±9 mL/g-VS and maximum methane production rate of 34±9 mL/L-d was obtained at adding extra glucose 534 mg COD/L, sunflower oil 1100 mg COD/L and

BE-IS-02 (INVITED SPEAKER)

MICROBIAL FUEL CELL-BASED SENSOR FOR MICROBIAL ACTIVITY MONITORING DURING ENTEROBACTER SP. KBH6958 BIOHYDROGEN PRODUCTION

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ABSTRACT

Microbial fuel cell is an electricity-generating device utilising electrochemically active microbes as biocatalyst. It is possible to used MFC as a biosensor to monitor the hydrogen fermentation in *Enterobacter sp.* because the device depends on the microbial activity for the electricity output. This study is aimed to prove the concept that the voltage signal generated by *Enterobacter sp.* via an MFC could be used for fast detection and monitoring of microbial health in terms of hydrogen production and microbial growth. An anodic chamber of two-chamber MFC was used for the purpose to cultivate the culture and performed hydrogen production. An anode located inside the chamber was used as a sensor terminal to monitor the fermentative batch operation within 24 hours. The open-circuit voltage (OCV) signal was found proportional to the dried weight biomass and accumulated biogas volume (sigmoid curve) between the lag and early stationary phases. However, the OCV value started to decrease dramatically when the pH was significantly dropped during the stationary phase until the end of experiments. The observation indicated that the pH had a great effect not only on biomass growth and biogas production but also the OCV output. The results proved that the MFC-based health sensor is applicable, could be the cost-effective and easier way to monitor the hydrogen fermentative process.

BE-IS-05 (INVITED SPEAKER)

ENHANCEMENT ON THE ELECTRICITY PERFORMANCE BY CURRENT-POWERED SOLENOID MAGNETIC FIELD IN MICROBIAL FUEL CELL

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ABSTRACT

Microbial fuel cell (MFC) technology enables renewable bioelectricity generation from biodegradable material using bacteria as catalysts. External magnetic field technology has been used in wastewater treatment technology. Many reports show that the application of magnetic field technology will affect biological metabolism, enzyme activity and cell membrane permeability (Brkovic et al., 2015). Many reports reveal that the static MF can be effective in numerous instances to improve the performance of MFCs (Yin et al., 2017). This study aims to apply a current-powered solenoid magnetic field on the outside surface of a double-chamber cubic MFC to explore the effects of various current strengths (0, 20, 40, 60, and 80 mA) on MFC performance. The maximum average voltage of 550 mV was obtained using extra solenoid magnetic fields with the 80 mA. This voltage value was about 2.5 times of the 200 mV without adding extra solenoid magnetic field. This high voltage performance was caused by the lower internal resistance (11 Ω) with extra solenoid magnetic field 11.4 mT, which was powered by the current 80 mA. According to the results by 16SrRNA gene, the domain species in microorganism community is *Geobacter* (12%), which is much higher than the 1% in the seed inoculum. It shows that the solenoid magnetic field could significantly improve the cumulation of *Geobacter*, who can make electrical contacts with extracellular electron acceptors and other organisms in a MFC.

BP-IS-02 (INVITED SPEAKER)

HYDROGEN ENERGY YIELD AND POLLUTANTS EMISSION IN CO-GASIFICATION OF PAPER MILL SLUDGE (PMS) AND AUTOMOBILE SHREDDER RESIDUES (ASRS)

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ABSTRACT

In Taiwan, Automobile shredder residues (ASRs) from end-of-life vehicles (ELVs) have typically been inclined to be in landfills. Due to the increasing quantity of scrapped cars and the decreasing disposal of landfill space, effective technology for dropping ASR is needed. Herein, ASRs and PMS are converted into hydrogen by co-gasification with controlled at equivalent ratio (ER=0.3), temperature (700 °C), and ASR modified ratio (0~15 wt%) in the full-scale fluidized-bed gasifier. The producer gas composition, product distribution, energy yield efficiency, pollutants (heavy metal and chlorine) separating characteristics investigation were all evaluated. The results exhibited that as much as 10% of an ASR mixed with PMS could be effectively gasified. The producer gas composition 4.91 vol.% H_2 and 2.06 vol.% CO with a higher heating value of 1.93 MJ/Nm^3 as well as the cold gas efficiency of 22.67 %, respectively. Increasing the ASR addition ratio could enhance the heating value in co-gasification, especially for the 10% ASR addition ratio. On the other hand, the heavy metal partitioning results showed that Cu, Zn, and Cr were mainly partitioned in the residue phase during the co-gasification. In the case of 10 wt.% ASR addition, the chlorine content in the solid and liquid phase decreased to 57.55% and 32.12%, which indirectly verified 10 wt.% ASR could inhibit the volatile chlorine speciation emission in the produced gas and enhance the produced gas quality. Therefore, this study could provide helpful information for ASR energy conversion systems and future control strategies for air pollutants emission.

BE-IS-03 (INVITED SPEAKER)

ENHANCED HYDROGEN PRODUCTION BY VISIBLE LIGHT PHOTOCATALYSIS WITH 2D MOS2 / 2D CDS COMPOSITE

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ABSTRACT

Among the main contributors to global warming are greenhouse gas (GHG) emissions from the transportation and power sectors[1]. The sustainable production of hydrogen for long-term chemical storage of intermittent renewable energy is one of the strategies toward realizing a zero-carbon economy[2]. One attractive route that has spurred the development of inexpensive yet highly effective photocatalytic materials is hydrogen production from water and sunlight. This study sought to enhance the morphological face contact between 2D MoS2 nanosheets containing 1T and 2H phases (inhomogeneous) and 2D Cadmium sulfide (CdS) sheets/flakes for enhanced charge transfer. Hydrothermal and solvothermal reactions were used to synthesize the two metal sulfides, respectively. Their composites (5, 10, 15, 20, 25 wt% MoS_2) were then prepared using a physical method. The 2D forms of both MoS_2 and CdS were confirmed by FE-SEM imaging. XRD patterns, XRF semi-quantitative analysis, and FTIR spectroscopy confirmed the presence of 1T and 2H phases in MoS_2 as well as the similar morphological and crystalline structures of the two sulfides. UV-Vis diffuse reflectance spectroscopy showed that the presence of MoS_2 did not significantly affect the estimated band gap of pristine CdS (2.32 eV). The foregoing results indicate the successful adsorption of MoS_2 onto the CdS surface with minimal intervention of the latter's lattice structure. A hydrogen production rate of 1036.1 $\mu mol/g_{cat}h$ was observed using the 15wt% MoS_2/CdS composite compared to 6.5 $\mu mol/g_{cat}h$ for CdS alone. After 10 hours of use at 27 °C, this same composite retained 80% of its photocatalytic activity. This work shows the significance of face contact (2D-2D) between inhomogeneous MoS_2 and CdS on their potential for water-splitting photocatalyst.

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BE-OS-02 (ORAL SPEAKER)

THE INFLUENCE OF ADDITIONS OF METAL OXIDE AND ALKALI SOLUTION IN DARK FERMENTATIVE BIOHYDROGEN PRODUCTION FROM MOLASSES

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ABSTRACT

Dark fermentation of organic industry waste i.e molasses it is a simply sugar and promising way to produce biohydrogen. Molasses is one of major by product from sugar industry. Thailand use as a source for producing ethanol [1]. Dark fermentation has acceptable and widely used technique in biohydrogen production but it also low yielding of hydrogen (H_2) as well as gave carbon dioxide (CO_2) equally [2]. In fact, by product from this technique would produce CO_2 which necessary to be separate before entering H_2 in application. This study aims to investigate the effect of metal oxide i.e. CaO, MgO and alkali solution (KOH) in growth media and substrate concentration, in serum bottle. To enhance of H_2 production and possible to reduce the ratio of CO_2 in gas product. This work conducts the experiment of biohydrogen production from molasse via dark fermentation by *Enterobacter aerogenes*. Enhancing the proportional of H_2: CO_2 to 2:1 has become a significant concern. The results show that the optimum condition in serum bottle and bioreactor are importance for yielding of biohydrogen. Moreover, this study encourages to biocircular economy cause by biohydrogen production not only reduce the greenhouse gas emission but also can produce a valuable biochemical product i.e. bio-methanol as a reactant for biodiesel and direct methanol fuel cell : DMFC.

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BR-OS-01 (ORAL SPEAKER)

PUSHING MICROBIAL DESALINATION CELLS TOWARDS FIELD APPLICATION: PREVAILING CHALLENGES, POTENTIAL MITIGATION STRATEGIES, AND FUTURE PROSPECTS

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ABSTRACT

Microbial desalination cells (MDCs) have been experimentally proven as a versatile bioelectrochemical system (BES). They have the potential to alleviate environmental pollution, reduce water scarcity and save energy and operational costs. However, MDCs alone are inadequate to realise a complete wastewater and desalination treatment at a high-efficiency performance. The assembly of identical MDC units that hydraulically and electrically connected can improve the performance better than standalone MDCs. In the same manner, the coupling of MDCs with other BES or conventional water reclamation technology has also exhibits a promising performance. However, the scaling-up effort has been slowly progressing, leading to a lack of knowledge for guiding MDC technology into practicality. Many challenges remain unsolved and should be mitigated before MDCs can be fully implemented in real applications. Here, we aim to provide a comprehensive chronological-based review that covers technological limitations and mitigation strategies, which have been developed for standalone MDCs. We extend our discussion on how assembled, coupled and scaled-up MDCs have improved in comparison with standalone and lab-scale MDC systems. This review also outlines the prevailing challenges and potential mitigation strategies for scaling-up based on large-scale specifications and evaluates the prospects of selected MDC systems to be integrated with conventional anaerobic digestion (AD) and reverse osmosis (RO). This review offers several recommendations to promote up-scaling studies guided by the pilot scale BES and existing water reclamation technologies.

BR-OS-02 (ORAL SPEAKER)

OPTIMIZATION OF BIOGAS PRODUCTION WITH UTILIZATION OF MAGNETITE GRANULAR ACTIVATED CARBON FROM COCONUT SHELL

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ABSTRACT

An optimization research was conducted on synthetic palm oil mill effluent to produce biogas with the utilization of magnetite embedded in granular activated carbon (GAC) originated from coconut shell. The approach of waste-to-wealth was acclaimed as a breakthrough in this research. The coconut shell was collected, cleaned and carbonized before synthesized into magnetite GAC. Five replicates at centre points in Central Composite Design (CCD) was used to investigate the simultaneous effect of the variables: Ni:Fe (0.25-0.80), magnetite:GAC (0.01-0.03) and type of GAC (GAC-1 or GAC-2) on biogas production. The experiment was designed and analyzed using Design expert V8.0 software by applying Response Surface Methodology (RSM). The total biogas production performance was evaluated on the basis of Total Volatile Fatty Acid (TVFA) produced, which was found ranged from 1.2-10.874 g/L. Quadratic model was well fitted (R-squared>0.80) with a confidence level higher than 95%. The optimum biogas production condition was using GAC-1 at Ni:Fe (0.53), and MNP:GAC (0.02) with total biogas production of 1.00±0.092 L. This count for 43.88% increment in total biogas production compared to non-magnetite granular activated carbon.

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BP-OS-02 (ORAL SPEAKER)

ENHANCING METHANE PRODUCTION FROM PRETREATED WAS IN MEC-AD SYSTEM: PERFORMANCE, MICROBIAL ACTIVITY, AND IMPLICATIONS AT DIFFERENT APPLIED VOLTAGE

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ABSTRACT

Maximum solubilization of waste-activated sludge was obtained through previous pre-treatment studies (1,2), however, the optimal applied voltage in enhancing the methane production using pre-treated waste-activated sludge and the microbial growth and pathways at various applied voltages has never been addressed. In this study, firstly, waste-activated sludge was pre-treated by combined mixed alkali (NaOH: $Ca(OH)_2$ of pH 11.5) - thermal (95°C for 90min) pre-treatment method to enhance the solubilization efficiency. Then the pre-treated waste activated sludge along with anaerobic digestion sludge (1:1) were inoculated in bioelectrochemical anaerobic digester with series of applied voltages (0.3, 0.6, and 0.9 V). Based on the results, the methane enhancement and microbial pathways at different applied voltages were evaluated. The solubilization effect of 54.8 ± 2.4% was achieved by mixed alkali-thermal pre-treatment. In the pre-treatment process, at mixed alkali pre-treatment, the efficient lipids saponification was obtained by strong OH^- attack, and the thermal pre-treatment was effective in handling the defragmented cell components. Experimental results of 0.6 V achieved the highest methane yield of 83.7% (based on (volatile solids) VS input) followed by 0.9 V (64.7%) and 0.3 V (43.7%) compared with the AD system (control). The removal rate of COD and sludge VS were increased by the influence of specific applied voltage (0.3 – 0.9 V), and 0.6 V was noted as the optimal applied voltage. Redox compounds carrying the electrons were obtained from cyclic voltammogram (CV) in the bulk solution, and the microbial growth was enhanced under DIET, which increased the abundance of EAB, along with methanogens, and advanced the electron transfer rate. Our results suggest a clear approach by increasing the solubilization of WAS followed by bioelectrochemical anaerobic digestion with optimal applied voltage, enhances the abundance of EAB and methanogens, leading to higher methane production.

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BP-OS-03 (ORAL SPEAKER)

EFFECT OF PRETREATED PRIMARY SEWAGE SLUDGE FOR ENHANCING METHANE PRODUCTION IN MICROBIAL ELECTROLYSIS CELL

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ABSTRACT

Microbial electrolysis cell (MEC), one of the bioelectrochemical systems, can overcome the drawbacks in AD such as VFA accumulation and long hydraulic retention time (HRT) via the electrochemical redox reaction by microorganisms[1]. However, the organic matter in primary sewage sludge contains extracellular polymeric substances (EPS), which cannot be degraded by microorganisms thus hindering the hydrolysis process.[2]. One of the effective ways to accelerate the sludge hydrolysis rate is through pretreatment. Many MEC studies using pretreatment were conducted on the waste-activated sludge (WAS), but only limited studies noted in using primary sewage sludge due to its high biodegradable and unstable organic matter[3,4]. In this study, we operated MECs with ultrasonic (US) and combined alkali-ultrasonic (ALK-US) pretreated primary sludge at an applied voltage of 0.6 V, to investigate the methane yield performance and the effect of the lag phase of MECs. MEC ALK-US showed the highest degree of solubilization (25 %), followed by MEC US with 5.4 %. Methane yield was the highest in MEC ALK-US of 167 mL/g COD_{in}, followed by MEC US, MEC, and AD of 137 mL/g COD_{in}, 130 mL/g COD_{in}, and 83 mL/g COD_{in}, respectively. In the modified Gompertz model, AD was the longest at 5.63 days and followed by MEC ALK-US, MEC, and MEC US at a value of 1.12, 0.38, and 0.43 days, respectively. It implies that MECs can have a shorter digestion time and higher biogas production than AD through the bioelectrochemical reaction. It might be due to the VFAs obtained through solubilization by pretreated sewage sludge that lessen the lag phase and enhanced methane production.

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SE-OS-01 (ORAL SPEAKER)

REVERSE LOGISTICS IN CIRCULAR ECONOMY: A LITERATURE OF REVIEW

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ABSTRACT

Reverse logistics – the process of moving goods to recapture value or to dispose them properly – catalyses circular economy. Due to both economic and environmental concerns, reverse logistics activities are growing in scale and quantity. A paradigm shift in economic development, the move to a circular economy, can have a favourable impact on economic and environmental efficiency. There appears to be a trend in society that the current industrial economic model is characterised by take, manufacture and dispose – in which raw resources are taken, changed into goods, sold, and consumed by end users, and the products are disposed of at the end of their useful lives. This review is intended to gain knowledge on the important management factors involved in the role of reverse logistics in circular economy. The goal of this research is to provide a review of the circular economy in conjunction with reverse logistics practices. The findings of this literature review is summarised in both tables and figures. The outcome is a better understanding on the importance and the contributions of reverse logistics in the circular economy framework.

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BE-OS-03 (ORAL SPEAKER)

PRODUCTION OF BIOHYDROGEN AND METHANE FROM TWO-STAGE AND ONE-STAGE CO-DIGESTION OF VINASSE AND SPENT BREWER'S YEAST

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ABSTRACT

The co-digestion of vinasses and spent brewer's yeast cell for two-stage biohydrogen and methane production, as well as one-stage methane production, was investigated. In batch mode, the effect of vinasses, spent brewer's yeast, and fly ash concentrations on two-stage biohydrogen and methane production, as well as one-stage methane production, was examined. In the fermentation system, fly ash was used as a buffer. In the first stage of a two-stage process, the optimum conditions were 11 g-VS/L of vinasses, 9 g-VS/L of spent brewer's yeast cell, and 6,000 mg-CaO/L of fly ash concentration. A maximum hydrogen yield of 42.02 ml-H_2/g-VS_{added} was obtained under these conditions. Acidic effluents obtained under all conditions were used to produce methane in the second stage, yielding a methane yield of 182.40 ml-CH_4/g-VS_{added}. The dominant hydrogen producing bacteria and methanogenic archaea found in the two-stage fermentation process were *Clostridium* sp., Unidentified *Clostridiaceae*, *Methanosaeta* sp., *Methanosarcina* sp., and *Candidatus Methanoplasma*, according to microbial community analysis using high-throughput amplicon sequencing. At 11 g-VS/L of vinasse, 9 g-VS/L of spent brewer's yeast cell, and 4,000 mg-CaO/L of fly ash, the maximum methane yield of 242.5 ml-CH_4/g-VS_{added} was achieved for a one-stage methane production process. *Methanosaeta* sp., *Methanosarcina* sp., and *Methanoculleus* sp. were the most common methanogenic archaea in the one-stage methane process. The energy yield from the two-stage hydrogen and methane production was 7.02 kJ/g-VS_{added}. One-stage methane production, on the other hand, yielded an energy yield of 8.73 kJ/g-VS_{added}.

BE-OS-22 (ORAL SPEAKER)

OPTIMIZATION OF BIOGAS EFFLUENT AND FILTER CAKE PROPORTIONS FOR TWO-STAGE HYDROGEN AND METHANE PRODUCTION

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ABSTRACT

This study aimed to optimize the proportions of biogas effluent (BE) and filter cake (FC) to produce hydrogen and methane via batch and continuous fermentation. Mixture design with D-optimal was used to design the batch experiments. The results indicated that the optimal proportions of BE and FC for a hydrogen production were 28.95 and 31.05 g-volatile solids (VS)/L, respectively, which yielded the hydrogen yield (HY) of 17.2 mL-H_2/g-VS. The hydrogenic effluent was further used to produce methane in the second stage in which the methane yield (MY) of 207.0 mL-CH_4/g-VS was achieved. A semi-continuous fermentation was further conducted in a CSTR. The hydraulic retention time (HRT) in hydrogen and methane reactors were optimized. The findings indicated that the optimum HRT in hydrogen reactor and methane reactor were 3 and 20 days, respectively. Under the optimum HRT the HY and MY were 9.8 mL-H_2/g-VS and 140.2 mL-CH_4/g-VS, respectively.

BE-OS-04 (ORAL SPEAKER)

THE PERFORMANCE OF SINGLE-STAGE AND TWO-STAGE FERMENTATIVE HYDROGEN AND METHANE PRODUCTIONS FROM NAPIER GRASS

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ABSTRACT

In Thailand, Napier grass (*Pennisetum purpureum x Pennisetum americanum*) is fast-growing, high-yield, easy-to-harvest, and high abundance. Cellulose is the main component of Napier grass that can be converted into methane via anaerobic digestion process. In this study, the anaerobic digestion of Napier grass was evaluated in a two-stage anaerobic system compared to the traditional single-stage process using continuous stirred tank reactor (CSTR). Napier grass was fed into the reactors with organic loading rate of 1 kgVS/m^3-day. The digestion was carried out in semi-continuous system under mesophilic conditions (38 °C). The relationship between digestion performance and key parameters, including pH, VFA yield, biogas yield, and methane yield, were evaluated. The experimental results revealed that an anaerobic digestion was successfully performed in both single-stage and two-stage system.

SE-OS-02 (ORAL SPEAKER)

TECHNO-ECONOMIC ANALYSIS OF A PALM OIL MILL EFFLUENT TO BIOMETHANOL PLANT

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ABSTRACT

Palm oil is a tropical plant that has native roots in Africa, which has grown to be one of the most cultivated crops in the world, representing 60% of trade in vegetable oils worldwide[1]. Palm oil mill effluent (POME) is one of the major waste products in the production of palm oil and is particularly damaging to the environment due to inherently high levels of biological oxygen demand (BOD) and chemical oxygen demand (COD). However, it also possesses high levels of organic compound compositions which makes it particularly viable in converting into value-added materials such as biogas. This biogas is one of the potential raw materials in biomethanol production. However, the conversion process of POME into biomethanol has yet to be synthesised and investigated in term of its feasibility and viability. Therefore, this research was aimed towards synthesising a thorough overall process of converting POME into biomethanol. The synthesised process was then investigated using techno-economic analysis to determine its feasibility and viability. This had been done with extensive review to synthesise an overall process flow which was then simulated using MATLAB and UniSim software to determine its technical viability. Economic analysis has also been conducted by evaluating its associated costs (variable and fixed) through plant equipment cost estimation as well as operating expenditure estimation. Its results were then applied to breakeven analysis and cash flow after tax analysis to deduce its breakeven point and to study its economic performance. The results showed the process was technically feasible with a biomethanol production rate of 296.76 kg/hr obtained from a POME feed rate of 42,674.05 kg/hr, indicating a yield of 0.695 %. The overall process also indicated total utility consumption of 1,980,000 kWh. Economic viability was also reached with an attractive rate of return of 14.77 % and a payback period of 3.75 years. These results indicated that the synthesised conversion process of POME into biomethanol is a feasible and viable process.

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BP-OS-04 (ORAL SPEAKER)

HIGH-SOLID DARK FERMENTATION OF CASSAVA PULP AND CASSAVA PROCESSING WASTEWATER FOR BIO-HYDROGEN PRODUCTION

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ABSTRACT

Cassava pulp (CP) and cassava processing wastewater (CPW) were used as substrates for the production of hydrogen through a high-solid dark fermentation (DF) process. CP was suspended in CPW and hydrolyzed enzymatically under optimum conditions of 150 g-CP/L, 29 U/g of α-amylase, 47 U/g of glucoamylase, and 60 FPU/g of cellulase. The hydrolysis performed at 50 °C for 24 h yielded a final reducing sugar concentration of 96.6±2.6 g/L, equivalent to 0.64 g-reducing-sugar/g-CP and over 80% hydrolysis efficiency based on carbohydrate content in CP. Subsequent DF of CP-CPW hydrolysate, containing 132.9±5.3 g-total-solids/L, at room temperature (35±2 °C) and 100 rpm, with 10% (w/v) heat-treated anaerobic granules as inoculum, resulted in a production of 2,739±62 mL-H_2/L-medium, equivalent to a hydrogen yield (HY) of 18.3±0.4 mL-H_2/g-CP. The hydrogen production potential, maximum hydrogen production rate, and lag time, estimated by the modified Gompertz model, were 2,736 mL/L, 64.6 mL/(L·h), and 5.8 h, respectively.

BP-OS-05 (ORAL SPEAKER)

COMPARISON BETWEEN HYDROTHERMAL AND CO-PRECIPITATION METHOD IN GREEN SYNTHESIS OF MAGNETIC SILVER NANOPARTICLES

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ABSTRACT

Nanoparticles researches have been attracted for the past decade due to their unique electronic, mechanical, optical, chemical, and magnetic properties, which can be used in various applications including sensor, medical, food and others. There are various methods to synthesis nanoparticles which can be classified based on two approaches: top down and bottom-up approach. However top-down approach requires labor extensive, high energy requirement and imperfection of surface structure. Thus, many scientists favour to use bottom-up approach in producing nanoparticles as this approach considered more economical and the ability to produce smoother and consistent size distribution compared to top-down approach. Example of bottom-up approach including chemical precipitation, sol-gel, hydrothermal, electrodeposition and etc. The common method applied in producing magnetic silver nanoparticles are co-precipitation and hydrothermal method as both method capable to produce well distributed particles size with consistent shape. Comparison between co-precipitation and hydrothermal method can be observed based on crystallinity and magnetic properties of the nanoparticles produced. Therefore, this study is conducted to determine the comparison between both method in producing magnetic silver nanoparticles using green synthesis method that used plant extract as the reducing agent and stabilizer during the synthesis reaction. The synthesized nanoparticles will then be characterized to look on its size, shape and morphologies using fourier-transform infrared spectroscopy (FTIR), x-ray diffraction (XRD), and scanning electron microscopy (SEM) and comparison analysis will be done to understand its functional properties. Later, the nanoparticles will be tested for anti-bacterial properties by doing viable plate count method to determine the anti-bacterial properties of the nanoparticles. The results of this study will be beneficial for scaling-up the nanoparticles production in future.

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BR-OS-03 (ORAL SPEAKER)

OIL PALM BIOMASS PRETREATMENT AND HYDROLYSIS: A RECENT BIOTECHNOLOGICAL VENTURE TOWARDS BIO-BASED LACTIC ACID PRODUCTION

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ABSTRACT

The immense reliance of many processes on non-renewable petrochemical carbon sources results in several environmental nuisances and a failure to address the growing global chemical demands. Hence, many works are underway to shift from petrochemical industries to a sustainable lignocellulosic biomass biorefinery in lactic acid production. Malaysia is the leading country as a palm oil producer, with an enormous supply of inexpensive, renewable and non-food, yet untapped oil palm biomass resources. In this regard, oil palm fronds (OPF) rich in glucan content account for 70% of total agricultural biomass in Malaysia, which can accommodate 2 million metric tons per annum of fermentable sugar. The richness of carbohydrates in OPF serves as the key to unlocking bio-based lactic acid commercialization for future sustainable breakthroughs. This paper aims to provide insights into the exploitation of OPF as the novel feedstocks in bio-refinery processes. Special emphasis in this review is put on the technology, global demand, commercial status and future prospects of the production of second-generation lactic acid, as this process has received most research and development efforts so far. It reviews the current research attributed to the compositional analysis of OPF by primarily focusing on the National Renewable Energy Laboratories (NREL) protocol. It then focuses on the recent technological advancements of different pretreatment methods, hydrolysis and fermentation for carbohydrate recovery in lactic acid production. Given the tremendous potential as a sugar platform, OPF can be used as excellent carbon feedstock in the fermentation of value-added fine chemicals, lactic acid, using suitable pretreatment and hydrolysis technologies in biotechnological processes.

BE-OS-21 (ORAL SPEAKER)

THE UTILIZATION OF RICE STRAW (ORYZA SATIVA L.) AS A GREEN CATALYST IN THE PRODUCTION OF HYDROGEN VIA CATALYTIC PYROLYSIS OF SHRIMP FARM SLUDGE

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ABSTRACT

The catalytic mechanism of rice straw (RS), *Oryza Sativa L.*, on the carbonation of shrimp farm sludges by pyrolysis process was investigated in this work. Generally, 75% of rice straw is Silicon dioxide (SiO_2) which can be utilized as an effective catalyst in the decomposition of tar during the pyrolysis process to support the cracking of Carbon to Carbon bond, and Carbon to Hydro bond and leads to the promotion of total gas yield value. The results we obtained show that the pyrolysis of organic matters at high temperatures was enhanced by the addition of a suitable volume of SiO_2 in the rice straw. Accordingly, the additional Silicon content increased the hydrogen yield from the shrimp farm pyrolysis up to 45% at 700°C, 48% at 800°C, and 13% at 900°C, respectively. Not only that, but the ratio (g/g) on the amount of rice straw used in the combination along with sludges also plays a very significant role in this work. The biochar obtained after the pyrolysis process provides excellent quality, high carbon content, large surface area, and very porosity which also indicates a wide range of applications. The work also confirms the role of an effective catalyst of rice straw in the production of green energy via the pyrolysis process.

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BE-OS-05 (ORAL SPEAKER)

INSIGHTS OF IMMOBILIZATION TECHNIQUES FOR ENZYMATIC HYDROLYSIS AND SUBSEQUENT HYDROGEN PRODUCTION

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ABSTRACT

Hydrogen gas, a carbon-free energy source, can be produced via fossil fuel reforming, coal gasification, water electrolysis, photocatalysis, or biological process. Biohydrogen production from lignocellulosic biomass (LCB) in this regard, appears as an environmental benign, sustainable, non-food competing second generation fuel. LCB serves as the largest potential carbon source for sustainable biohydrogen production with an enormous global annual capacity of more than 1 trillion tons. Enzymes in this case, are widely used to hydrolyse the LCB into fermentable sugars and subsequent hydrogen production is carried out by dark fermentation. However, the untapped non-food competing LCB is currently impeded by several critical bottlenecks including sensitivity of enzymes and cells to numerous denaturing conditions, recyclability, high cost of enzyme, slow productivity of hydrolysis and fermentation resulting in larger bioreactor and CAPEX requirement which makes it less competitive in commercial application. These critical bottlenecks can be overcome by immobilization technique, which enables the recyclability, stability and productivity of the enzyme and cells. Despite immeasurable review conducted on the hydrolysis and fermentation aspects, unproportionate low attention is given to the equally critical immobilization technique. Current review accommodates for the important outlook and critical insights into the immobilization techniques, providing important guidelines for the selection and operation of immobilization techniques to elevate commercial competitiveness of biohydrogen production from LCB in the future. The types of immobilization method for both enzymes and cells are comprehensively compared and analysed. Enzyme covalent binding is a superior immobilization technique in terms of lower enzyme leaching issue and improved system stability across changing pH and temperature. The critical aspects of the process parameters, such as temperature, pH, enzymes/substrates concentration, which could significantly affect the enzymatic hydrolysis efficiency are thoroughly examined in this review. The microorganisms and the type of carbon sources applied in the fermentation process are outlined and investigated.

BR-OS-08 (ORAL SPEAKER)

EFFECT OF COAGULANTS ON THE STRUCTURE OF BIOCELLULOSE AEROGEL

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ABSTRACT

Cellulose aerogel has the characteristics of low density, high porosity, high specific surface area, etc., making it widely used in heat insulation, biological scaffolding, and oil adsorption. Cellulose has high biocompatibility and biodegradability and is very friendly to the environment. In this experiment, celluloses are included microcrystalline cellulose (MCC) and biocellulose (BC) produced by *Gluconacetobacter xylinus* strains. The preparation of cellulose aerogel was prepared cellulose solution that dissolved cellulose by 1,5-diazabicyclo [4.3.0] non-5-ene (DBU) and dimethyl sulfoxide (DMSO) solvents, and introduced into the autoclave, and carried out at 5 bar CO_2 at 30℃ for 15 minutes. After the reaction, transfer the solution into the glass mode, and added the coagulant (water, methanol, ethanol, isopropanol, 1-butanol) to make the gel for 24 hours, then treated with liquid nitrogen, and put the gel into the freezing-drying cooler for 48 hours at -80℃. Finally, measure its density, porosity, SEM, FTIR, and XRD to compare the differences. The results show that after the cellulose is dissolved and regenerated with methanol as a coagulant, the density of the aerogels is low, about 0.05 g/cm^3, and the structure is circular open cells. The experiments followed different coagulants such as water, ethanol, and without coagulant, and obtained the density is about 0.05-0.06 g/cm^3. The larger the molecular weight of alcohols as coagulants, the slower the diffusion rate between solvents, which isn't conducive to the substitution between solvents. Isopropanol and butanol are alcohols with higher carbon numbers, with a density of about 0.06-0.07 g/cm^3. Aerogels prepared by adding them as coagulants may cause uneven structure, enlarged pores, and produce regenerated cellulose with high crystallinity. The aerogel prepared from BC has a lower density of 0.03 g/cm^3 with water as a coagulant. While adding other alcohols has a larger density of 0.04-0.05 g/cm^3 and the pore structure is looser.

BP-OS-06 (ORAL SPEAKER)

OPTIMIZATION OF BIOHYDROGEN PRODUCTION WITH UTILIZATION OF MAGNETITE GRANULAR ACTIVATED CARBON FROM COCONUT SHELL

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ABSTRACT

An optimization research was conducted on synthetic medium by mimicking sugar composition in palm oil mill effluent to produce biohydrogen at 60ºC thermophilic dark fermentation with 200 ml working volume. The aim is to utilize the use of magnetite embedded in granular activated carbon (GAC) originated from coconut shell as microbial support carrier in an attached system. The coconut shell was collected and carbonized, namely GAC-O, before synthesized into magnetite GAC. The efficiency for the GAC-O was evaluated by comparing it with commercialized GAC, namely, GAC-C. Five replicates at centre points in Central Composite Design was used to investigate the simultaneous effect of the variables; Ni:Fe (0.25-0.80), magnetite:GAC (0.01-0.03) and type of GAC (GAC O or GAC C) on the biogas production and Total Volatile Fatty Acid (TVFA). The experiment was designed and analyzed using Design expert V8.0 software by applying Response Surface Methodology (RSM). The total biohydrogen production performance was evaluated on the response towards TVFA produced, which was found ranged from 1.2-10.874 g/L. Quadratic model was well fitted (R-squared>0.80) with a confidence level higher than 95%. The optimum biogas production condition was GAC O as preferred GAC at Ni:Fe (0.53) and magnetite:GAC (0.02), with total biogas production of 1.67±0.09 L biogas/L.d This count for 43.88% increment in total biogas production compared to non-magnetite granular activated carbon, which only produced 1.16±0.10 L biogas/L.d. The approach of waste-to-wealth was acclaimed as a breakthrough in this research.

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BE-OS-08 (ORAL SPEAKER)

CONTINUOUS PHOTOENZYMATIC DECARBOXYLATION OF FATTY ACIDS FOR ALKANE FUELS PRODUCTION IN A MICROFLUIDIC PHOTOBIOREACTOR

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ABSTRACT

Alkanes are high-quality and indispensable jet fuel components for aviation or other long-distance transport. Fatty acid photodecarboxylase, a recently discovered blue light-driven enzyme sourced from *Chlorella variabilis* NC64A (*Cv*FAP), can convert fatty acids to corresponding (C1-shortened) alkanes, which provides an alternative approach for the production of alkane fuels at a mild condition. Microfluidic reactors have attracted significant attention owing to their high mass-transfer efficiency and low light attenuation for the application of efficient continuous photobiocatalysis. In this study, a capillary microreactor with 500 μm inner diameter and 350 μL total volume was adopted for the continuous photodecarboxylation of palmitic acid. The effects of operation conditions including light intensity, temperature, residence time, catalyst concentration, substrate concentration and co-solvent volume ratio on alkane fuels production were assessed in detail. An optimal alkane yield of 96.9% was achieved at a blue light intensity of 200 μmol/ (m^2 s), a reaction temperature of 30 °C, a residence time of 35 min, a catalyst concentration of 0.25 mL/mL, a substrate concentration of 12 mM, and a co-solvent volume ratio of 30%. Compared with photodecarboxylation of palmitic acid in shaking bath flask reactor, the average production rate of pentadecane in microfluidic photobioreactor was increased by 37.8% at a residence time of 8.75 min. These results suggested that the continuous photodecarboxylation of fatty acids in microfluidic photobioreactor is a promising way for alkane fuels production.

BE-OS-09 (ORAL SPEAKER)

REVIEW ON CRISPR TECHNOLOGIES AS STRATEGY TO IMPROVE DARK FERMENTATIVE BIOHYDROGEN PRODUCTION USING CLOSTRIDIUM SPP

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ABSTRACT

Nowadays the global energy markets are making the transition towards a more sustainable and cleaner renewable energy due to increasing energy demand and excessive greenhouse gas effect from fossil fuel combustion. Hydrogen has been regarded as a clean fuel and one of the future energy carriers practiced in fuel cells for electricity generations. The hydrogen generation using the dark fermentation method also has much attention due to its lower energy requirement and environmentally friendly process[1]. Moreover, the locally available nutrient-rich agricultural wastes would offer cheap and sustainable carbon resources[2] besides additional benefits on waste management[3]. Yet, this system still having problems producing a high biohydrogen yields for its commercialization[4]. Researchers have been worked on various improvement strategies including bioreactor designs[5], pre-treatment and operating methods[6], medium and microbial community optimization[7]. However, hydrogen production tends to be limited by the bacterial metabolic pathway[8]. Hence, the advanced gene sequencing and Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)-Cas technology can potentially improve biohydrogen productivity and yield by eliminating the non-hydrogen producing pathway[9]. At present, CRISPR-Cas technology had been applied in several Clostridial species to enhance other biofuel production[10]. However, a limited study was done using the advanced technology for improving biohydrogen production. This review would enable readers to understand the trend in CRISPR-Cas systems for bacterial genome editing. Besides, the useful pre-existing findings and strategies on metabolic engineering to improve biofuel production from microbial dark fermentation were also summarized. The potential of the CRISPR-based applications towards improved dark fermentative hydrogen in Clostridium strain was being pointed out in this paper. A deep understanding of the *Clostridium spp.* metabolic pathway is seen to be the strategy towards the accurate utilization of CRISPR-Cas technology to overcome existing bottlenecks, thus creating opportunities for economical hydrogen production soon.

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BE-OS-10 (ORAL SPEAKER)

BIOGAS PRODUCTION FROM RECYCLED ABSORBENT HYGIENE PRODUCT

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ABSTRACT

Absorbent hygiene products are 2-7% of total municipal solid waste in Europe and USA, and include diapers, adult incontinence products, sanitary protection pads, tampons and personal care wipes: they are all constituted of plastic (PE and PP), super-absorbing polymers (sodium polyacrilate) and cellulose. Cellulose can be separated by an autoclavation and extrusion step, and in this study we have investigated the potential application of this recycled cellulose in anaerobic digestion. Samples were pretreated with sodium hydroxide NaOH at different concentration, temperature and time, and subsequently characterised in terms of total (TS) and volatile solids (VS), chemical oxygen demand (COD), total nitrogen, ammonium nitrogen and biomethane potential (BMP). Results show that cellulose from absorbent hygiene products can be efficiently used for biogas production. Data also confirmed a positive effect of alkaline treatments on biomethanation of recalcitrant biomass, increasing from 400 up to more than 1000 mLCH4/gVS.

BE-OS-11 (ORAL SPEAKER)

RENEWABLE ENERGY SCENARIOS FOR SUSTAINABLE ELECTRICITY IN MALAYSIA

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ABSTRACT

Renewable energy (RE) is an important addition to existing energy systems, indispensable to the sustainable development of human society now and in the future. Renewable energy is advantageous as it is clean, renewable and sustainable. Although the global power supply mainly relies on fossil fuels, as fuels are consumed and the formation cycle is extremely long, resources will gradually decrease and costs will increase accordingly. There are many types of renewable energy, and the selection of which RE should be chosen in a specific situation depends on many factors. The objective of this study is to develop a decision-making framework based on the Analytical Hierarchy Process (AHP) which covers four available renewable energy technologies in Malaysia. Through this process, the most critical issues in implementing the renewable energy systems can and have been identified. Four criteria were chosen for this study which include technical, economic, environment and policy, which were then analyzed through the AHP hierarchy to identify the potential problems. It was found that hydropower carried a weight of 0.384, followed by biomass (0.279), wind power (0.207) and solar (0.166). This indicates that hydropower is the most suitable energy source for the development of power supply in Malaysia although there are certain issues including potential technology, ecological environment and market must be overcome. The order of significance between wind and solar are quite unexpected, because wind power is not comprehensively implemented in Malaysia compared to solar, yet its potential was found to be greater than solar energy. Nevertheless, this research had only considered four criteria with limitations in terms of the sub-criteria chosen. The accuracy of this framework may be improved if additional criteria are included and analyzed which can closely simulate the actual scenario of renewable energy development in Malaysia.

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BE-OS-12 (ORAL SPEAKER)

BIOGAS PURIFICATION AND UPGRADING USING METAL-ORGANIC FRAMEWORK

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ABSTRACT

Due to limited source of fossil fuel, biogas produced via anaerobic digestion play important role in promoting renewable alternatives. In order to supply biogas in end-application like heating and fuels, purified biogas is compulsory to minimise the negative effect to environment. Among all the technologies available, adsorption are commonly applied to remove undesired components in biogas such as hydrogen sulphide and carbon dioxide. Metal-organic framework known as MOF gain considerable attention as most promising adsorbent due to their high surface area, pore volume, selectivity, and thermal stability. The other factors effecting adsorption capacity such as optimum condition and morphology of the crystallite structure are crucial to obtain best adsorption performance. Modification or functionalization of MOF can be incorporated to produce a suitable adsorbent in terms of efficiency and economy to remove several contaminants in biogas. MOF also acts as the filler to polymer in membrane separation to increase the adsorption selectivity and permeability. This review discusses on the important properties affecting the adsorption performance on the established and stable MOF specifically used in hydrogen sulfide and carbon dioxide adsorption and separation study.

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BE-OS-13 (ORAL SPEAKER)

APPLICATION OF BIOHYDROGEN BY REVERSE WATER GAS SHIFT (RWGS) REACTION FOR BIOMETHANOL SYNTHESIS

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ABSTRACT

Mixed gas of hydrogen (H_2) and Carbon dioxide (CO_2) in Biohydrogen fermentation is a raw material for biomethanol (methanol from bio-source) synthesis. In Thailand, molasses is a promising source for producing Biohydrogen through dark fermentation process. Molasses solution is digested under an anaerobic condition of 30 °C by *Enterobacter Aerogenes*, then giving mainly H_2 and CO_2 of equal amounts. This mixed gas is reformed in fixed bed reactor under $Cu/ZnO/Al_2O_3$ catalyst and operating at 500 °C and of 1 atm. via Reverse Water Gas Shift (RWGS). The reformed product is composed of water and synthesis gas (H_2, CO, and CO_2). This experiment is hydrogenation on CO/CO_2 for producing methanol (CH_3OH) under 170 °C and 40 atm. using $Cu/ZnO/Al_2O_3$. In this study, the CO_2 content effect to ratio of $H_2/CO/CO_2$ is studied for knowing of the optimum H_2 and the appropriate ratio for methanol synthesis. The 5, 25, and 45 % of CO_2 balancing with ratio of H_2/CO 1.5, 2.0, and 2.5 are respectively studied. It is found that increasing CO_2 percentage effected to reduce methanol yield in all ratio of balancing H_2/CO. When 5, 25, and 40 % of CO_2 in mixed gas ratio of H_2/CO 2.5 yielded methanol 59, 28, 15 g/hr, using H_2/CO 2.0 resulted methanol 62, 28, 16 g/hr. and using H_2/CO 1.5 yielded methanol 41, 26, 14 g/hr. respectively. These experiments can be summarized that high content of CO_2 in mixed synthesis gas affected to decrease methanol yield. The H_2 content influent to methanol yield when less CO_2 in mixed gas. The H_2 and CO_2 will help to adjust the ratio of H_2/CO_2 by separating CO_2 before or after doing RWGS reaction for receiving the optimum ratio of $H_2/CO/CO_2$ to yield maximum methanol and to obtain good economic also environmental result when using biohydrogen resource.

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BE-OS-14 (ORAL SPEAKER)

WIRA MFC – DESIGNING A STEM GAME APPS FOR SCHOOL-AGED CHILDREN IN MICROBIAL FUEL CELL AND COMPOSTING

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ABSTRACT

Game-based learning is a proven method of learning that can embrace and nurture students' interest in STEM knowledge. However, the development of game involving STEM education in application of sustainable energy is not specifically been discussed. Microbial fuel cell (MFC) technology is theoretically an affordable sustainable energy, which works well with the science of composting. The aim of the study is to design a digital game apps that can improve the primary learning of students in clean energy of MFC and integrated with composting learning, while keeping the fun element. In this paper, the conceptual model for the game design is been discussed followed by the development of the game design. The game element infused for the game has been specifically embedded to connect the engagement of user while they gain the educational content from the game. A preliminary test done shows an increasing in knowledge based from a pre post-test given to a group of students and the result is significantly high in treatment group student than the control group.

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BE-OS-15 (ORAL SPEAKER)

DARK FERMENTATION AND MICROBIAL ELECTROLYSIS CELL FOR GASEOUS BIO-FUEL PRODUCTION FROM CO-FERMENTATION OF DISTILLERY WASTEWATER WITH GLYCEROL WASTE

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ABSTRACT

Hydrogen (H$_2$) and methane (CH$_4$), as attracting renewable energies carrier to reducing greenhouse gas emissions could be produced potentially by coupling dark fermentation and microbial electrolysis cell (MEC). Distillery wastewater (DW) is defined as high concentration of nitrogen meanwhile glycerol waste (GW) is contained high carbon content. Mixture of these two substrates is the most suitable for dark co-fermentation to enhance H$_2$ production. This research aimed to investigate H$_2$ production by dark co-fermentation of DW and GW and subsequently H$_2$ and CH$_4$ production using MEC fed with effluent discharged by dark co-fermentation. The result shown that dark co-fermentation between DW and GW at ratio 99:1 (%V/V) produced the highest H$_2$ yield of 149.5 mL-H$_2$/g-VS$_{added}$. Continuously stirred tank reactor (CSTR) was used to produce H$_2$ in continuous mode. Maximum H$_2$ yield of 99.7 mL-H$_2$/g-VS$_{added}$ was achieved from co-fermentation of DW and GW ratio of 99:1 (%V/V) at hydraulic retention time (HRT) of 3 days which corresponding to organic loading rate (OLR) 19.1 g-VS$_{added}$/L·d. Effluent from CSTR reactor was later used to produce H$_2$ and CH$_4$ by batch MEC with apply voltage at 1.0 volts and 10 Ω. Maximum H$_2$ yield 33.5 mL-H$_2$/g-VS$_{added}$ was obtained within 8 days of fermentation with continuously stirred at 120-140 rpm. Then, CH$_4$ was detected in day 6 and reached the steady production with maximum yield 115.1 mL-CH$_4$/g-VS$_{added}$. It can be concluded that it feasible to enhance H$_2$ and CH$_4$ production of DW and GW by coupling dark fermentation and MEC.

BE-OS-16 (ORAL SPEAKER)

NEW APPROACH FOR RAISING BIOHYDROGEN PRODUCTION FROM ORGANIC WASTES VIA THE REFORMATION OF AMMONIA STRIPPED FROM ANAEROBIC DIGESTION EFFLUENT

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ABSTRACT

Hydrogen (H_2) is a promising eco-friendly fuel, because of producing only water upon combustion and having high energy yield (122 MJ/kg). Among its efforts for achieving sustainable development goals, Korean government is planning to secure around 540 million tons of H_2, until 2040. The two strategies commonly followed for green H_2 generation are dark fermentation (DF) and steam biogas reforming (SBR). SBR is a process that is implemented after anaerobic digestion (AD) targeting H_2 production from AD-derived biogas. Later studies suggested boosting the generated H_2 by implementing DF, followed by (AD+SBR). Herein, we propose an additional route for H_2 generation, i.e., subjecting AD effluent to ammonia stripping (AS), then applying ammonia reforming process (ARP). Such route (AS+ARP) is more recommended to be added to "DF → (AD+SBR)" strategy, in case of treating high nitrogen-containing wastes, e.g., food waste, livestock manure, and sewage sludge (total nitrogen range of 5-30 kg/ton). In this study, we tried to evaluate the benefits of combining DF, AD+SBR, and AS+ARP. Further, we evaluated the contribution of each step in the whole process, in terms of H_2 production and carbon footprint. Results showed that the annual H_2 potential of DF, AD+SBR, and AS+ARP, was found to be 26, 368, and 47 Kton H_2/y, representing 6, 83, and 11% of total H_2 potential (442 Kton H_2/y). The expected greenhouse gas (GHG) reducing potential by generating power using recovered H_2 was estimated to be 3 million tons CO_2-eq/year, but it was lowered down to 1.3 million tons CO_2-eq/year due to the energy consumption for operating each process. The total GHG reduction by AS+ARP accounted for 13% of the sum of GHG reduction for DF and SBR processes (Ammonia reforming: 171,245 ton CO_2-eq/y, DF: 160,189 ton CO_2-eq/y, SBR: 1,007,059 ton CO_2-eq/y).

BE-OS-17 (ORAL SPEAKER)

AUTO-GENERATIVE HIGH-PRESSURE (AHPD) TECHNOLOGY FOR HIGH CALORIFIC HYDROGEN PRODUCTION

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ABSTRACT

Converting biomass to H_2 through dark fermentation (DF) is advantageous because of process simplicity and capability for achieving high production rates. However, two major obstacles are still yet to overcome, i) inadequate H_2 yield and ii) the need for further effluent treatment. Highly purified H2 (> 90%) must be generated for commercial purposes, such content is impossible to be achieved via DF. For overcoming this challenge, a novel approach has been developed targeting the generation of high H_2-containing biogas, which can be done via CO_2 dissolving under the self-generated high-pressure. Five reactors (R1-R5) were operated in batch mode. The reactors (R1-R4) had alkalinity to chemical oxygen demand (COD) ratio of 0.2 g $CaCO_3$/g COD while R5 had 0.3 g $CaCO_3$/g COD. R1, R2, and R3 contained 2, 3 and 4 g Ca^{2+}/L, respectively. For avoiding pH drop that is caused by CO_2 dissolution, calcium chloride ($CaCl_2$) was added to R1, R2, and R3, giving concentrations of 2,3 and 4 g Ca^{2+}/L respectively. 2 g carbon nanotubes (CNT) carbon nanotubes (CNT)/L was added to R4 as microbial carriers. Results revealed that R4 acquired the highest H_2 content (93%) at a pressure of 14.2 bar. On the other hand, maximal H_2 yield and pressure of 0.6 mol H_2/mol, and 17.3 bar could be harvested from R2, and R5, respectively. Final pH values were higher than 4.0 in R1 and R2, while it dropped to 2.0 in R3. Our results suggest that CNT could retain the microbial consortia, serving as a scaffold for biofilm. Unexpectedly, $CaCl_2$ could not be always adopted a CO_2 scavenger, since pH maintaining at a favorable range requires certain concentration of $CaCl_2$.

BE-OS-18 (ORAL SPEAKER)

UTILIZATION OF TiO_2 ASSISTED PLASMA FOR VOC REMOVAL WITH H_2 PRODUCTION

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ABSTRACT

The statistical data indicated that humans spend 87-90% of their time inside the buildings or apartments. However, the large increases in the use of furnishings, paints, glues, etc., leads to an increase in indoor volatile organic compounds (VOCs) emissions. Besides, fine particulate matter (PM 2.5, particulate matter with an aerodynamic diameter less than 2.5 μm) can penetrate indoor environments from the ambient outside. Previous research has shown that VOCs and PM 2.5 cause chronic effects on humans as hematological problems and cancer. To mitigate VOCs and PM 2.5 for more purify indoor environment, air filters have been utilized in the air conditioning system and indoor air purifier. However, that technique is not impressive, but also consumes a huge of energy to maintain. Photocatalysis is one of the methods applied to the treatment of VOCs and PM 2.5. In this research, copper mesh and stainless steel have been used as substrates. Titanium dioxide (TiO_2) was coated on the metal surface of substrates by the sol-gel coating method. Then, the atmospheric-pressure plasma was applied on metal substrates for assisted energy for catalyst. The product obtained from this process under the catalysis assisted plasma is capable of handling VOCs and produced the hydrogen. To analyze the capability of handling gaseous VOCs and PM 2.5, this study used instruments such as a portable detector and UV-vis spectrometer. Besides, optical microscope (OM), SEM, and EDX analysis to observe the surface morphology of titanium dioxide and the thickness of the coating.

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BP-OS-09 (ORAL SPEAKER)

IMPROVED METHYL LEVULINATE SYNTHESIS FROM CORE OIL PALM TRUNK SAP THROUGH MICROWAVE-ASSISTED REACTION

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ABSTRACT

Conversion of renewable resources into high value-added chemicals have attracted much attention due to its low carbon dioxide emission during the process. Utilisation of renewable resources such as lignocellulose biomass are expected to achieve this vision and able to provide better solution in energy and environmental conservation[1]. The biomass can be obtained from agriculture by-products such as palm oil plantation. In Malaysia, palm oil plantation estimated to produce 60.8 million dry tonnes of solid biomass annually and approximately 75 % are from trunk and frond. The core oil palm trunk (COPT) consists of sap, which is rich in free sugars such as glucose, fructose, and sucrose[2] that can be an excellent carbon source in the syntheses of methyl levulinate[3]. Microwave-assisted synthesis of methyl levulinate (ML) was extensively studied by using commercial glucose (C-Glu) as reference at different temperatures (130-170 °C), times (10-50 mins) and $Al_2(SO_4)_3$ (0.6 and 1.2 wt%). Later the optimum parameter was applied to core oil palm trunk (COPT) sap. The high-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS) indicated that the optimum parameter of C-Glu into ML synthesis was at 170°C, 50 min with 1.2 wt % $Al_2(SO_4)_3$. At this optimum parameter, the highest glucose conversion was 99.14% and ML yield was 57.29 %. However, with COPT sap methanolysis, the ML yield increased to 68.35%. This study has proved the ML synthesis with possess high yield and short reaction time could be obtained from microwave-assisted synthesis of COPT. The synthesis is qualifying as a green technology, efficient and economic.

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BE-OS-19 (ORAL SPEAKER)

DUAL CHEMICAL METAL (DCM) IMPREGNATION SYNTHESIS ON ACTIVATED CARBON FOR H_2S CAPTURE IN ADSORPTION-DESORPTION CYCLE

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ABSTRACT

This study reports on the impregnation of bi-metallic adsorbents based on commercial coconut activated carbon (CAC), surface-modified with metal acetate ($ZnAc_2$), metal oxide (ZnO and TiO_2) and the basic compounds potassium hydroxide (KOH). The adsorbents were then characterized by scanning electron microscopy and elemental analysis (SEM-EDX), microporosity analysis through Brunauer-Emmett-Teller (BET) analysis, thermal stability via thermogravity analysis(TGA) and functional group analysis via Fourier Transform Infrared Spectroscopy (FTIR). These modified adsorbents went through a real adsorption test for H_2S capture via 1 L adsorber with 5000 ppm H_2S balanced for N_2 together with temperature and pressure maintained at ambient condition. Adsorption-desorption was carried out for three cycles with varying the blower temperature at 50°C, 100°C and 150°C as the desorption condition. Characterization results revealed that the impregnated solution homogeneously covered the adsorbent surface, morphology, and properties. Based on this study, $ZnAc_2/TiO_2$/CAC had shown a significant increase in adsorption capacity in the second cycle at different temperature applied in desorption: (1.67 mg H_2S/g) at 50°C, (1.84 mg H_2S/g) at 100°C and (1.96 mg H2S/g) at 150°C. However, it does not have the potential to be a good adsorbent because it had a sharp increase in the percentage of degradation : (20.25%) at 50°C, (27.17%) at 100°C and (29%) at 150°C. $ZnAc_2$/ZnO/CAC seemed to produce the lowest percentage of degradation at the end of the 3rd cycle for all the varied temperatures in the adsorption-desorption cycle. Therefore, $ZnAc_2$/ZnO/CAC has the potential to be used and commercialized for biogas purification for H_2S removal.

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BE-OS-20 (ORAL SPEAKER)

PARAMETRIC STUDY ON ANION EXCHANGE MEMBRANE (AEM) ELECTROLYSIS PERFORMANCE AND HYDROGEN PRODUCTION

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ABSTRACT

This study has focused on the effect of operating parameters on the performance of anion electrolyte membrane (AEM) electrolysis unit for the long term. The parameters involved are KOH electrolyte concentration (0.5 – 2.0M), electrolyte flow rate (1.0 - 9.0 mL / min), and operating temperature (30 – 60 °C) were used to study the performance of the single AEM electrolyzer with 5 cm^2 active area. The performance of the electrolyzer was studied by determining the current density over a two-hour operating period. In addition, the performance of the electrolyte unit was studied to evaluate the efficiency and economic aspects of hydrogen production through the AEM electrolyzer unit. Based on the study, the operating parameters greatly influence the performance of electrolysis either in terms of hydrogen production or energy efficiency. During the operating parameters of temperature at 60 °C minimum voltage supplied is 2.2V at 1.0 A/cm^2, hydrogen production at 53.94 ml/min with energy consumption 43.25 kwh/kg and energy efficiency of 77.69%. Meanwhile for electrolyte concentration rate at 2.0M minimum voltage supplied is 2.2V at 0.8 A/cm^2, hydrogen production at 29.18 ml/min with energy consumption of 61.41 kwh/kg and energy efficiency 54.71%. As for electrolyte flow, at 9 ml/min the voltage supplied was 2.2V at 0.8 A/cm^2 with hydrogen production at 29.30 ml/min with energy consumption of 60.96 kwh/kg and energy efficiency of 55.12%. Based on the study, it has been proven that the hydrogen production at optimum energy efficiency increased with the increase of KOH electrolyte concentration and operating temperature. For the operating temperature, it is found that the demand for energy required decreases when the temperature increases at a certain temperature. The feed flow rate shows insignificant in performance as it is almost constant for each increase in electrolyte flow rate. This could be due to the electrolyte flow rate does not affect the mass transfer of the reactants either in the form of convection mechanism or diffusion in the electrolyte cell. Hence, the flow rate is no longer a limiting factor of reactant supply, and this has made the electrolyzer performance insignificant with almost the same value. Therefore, this study has proved that the higher the current density, the higher the hydrogen production, however the voltage efficiency will decrease. In conclusion, the electrolyte concentration and operating temperature have an impact on the performance and electrolysis process of AEM stack.

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BP-OS-10 (ORAL SPEAKER)

KINETIC STUDY ON BIOGAS PRODUCTION THROUGH ANAEROBIC MESOPHILIC CO-DIGESTION OF PINEAPPLE WASTE AND COW DUNG AT DIFFERENT SUBSTRATE RATIO

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ABSTRACT

The abundance of pineapple wastes and its disposal techniques are the main problem with the expanding pineapple demand around the world. The utilization of pineapple waste into bioenergy could be the most efficient and sustainable strategy to generate green energy while reducing pollution. The current study compares the effect of biogas generation by anaerobic co-digestion of pineapple waste and cow dung to mono digestion alone under mesophilic condition, with the goal of modifying the substrates ratio and increasing the system stability. Five different cow dung to pineapple waste ratios (1:1, 1:2, 1:3, 2:1 and 3:1) were assessed based on volatile solid (VS) contents. The highest biogas and methane yield was obtained at ratio 1:3 with 179.08 mL gas /g VS and 142.89 mL CH4 / g VS, respectively. When compared to mono digestion of pineapple waste alone, the co-digestion process improved the process stability in terms of C/N ratio, ammonia nitrogen, VS removal, and pH. Biogas refinement using carbon dioxide remover was able to reach a high methane percentage while lowering carbon dioxide percentage to below 3%. The kinetic study using the modified Gompertz model showed that the co-digestion process had shortened the lag phase, and the highest gas production rate was observed at 12.80 mL/g VS.d. This suggests that the co-digestion process could increase the gas production rate, enhance process efficiency and significantly reduce the fermentation time. Co-digestion of pineapple waste co-digestion with cow dung appears to be a promising approach for bioenergy recovery.

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BR-OS-04 (ORAL SPEAKER)

BIO-METHANE POTENTIAL FROM WILTED SUGARCANE LEAVES ENSILED WITH METHANOGENIC AND HYDROGENIC EFFLUENT

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ABSTRACT

This research evaluates the bio-methane potential of wilted sugarcane leaves (SCL) silage ensiled with difference additives including hydrogenic effluent (HE) from a hydrogen production process using sugarcane molasses as a substrate, methanogenic effluent (ME) from a biogas production process using vinasse as a substrate, *Lactobacillus plantarum* (LAB), and distilled H_2O (dH_2O) (Control). Results indicated that a silage has a higher lactic acid concentration than the control in the order of LAB (45%) and HE (26%), while a ME silage has a higher acetic acid concentration than the control, 73%. The presence of lactic acid and acetic acid in silage caused a drop of pH in the silage process and a degradation of lignocellulose. Lignocellulose was degraded by 56% in the silage ensiled with ME while the silage ensiled with HE has the %lignocellulosic degradation similar to the silage ensiled with LAB in the ranges of 26-28%. Maximum methane yield (MY) in the silage ensiled with ME, HE, and LAB were 370, 343, and 335 mL-CH_4/g-VS, respectively, which were 23-30% higher than the control (259 mL-CH_4/g-VS). Ensiling showed a positive effect on increasing methane yield by 6-35% in comparison to the raw SCL (243 mL-CH_4/g-VS) implying that ensiling is the viable strategy for the improvement of biogas production.

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BR-OS-05 (ORAL SPEAKER)

BIOGAS PRODUCTION UNDER DIFFERENT INOCULUM TO PALM OIL MILL EFFLUENT RATIO

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ABSTRACT

Palm oil mill effluent (POME) is a wastewater generated from palm oil industries that rich with organic and nutrients which can becomes an excellent substrate for biogas production. A comprehensive study was carried out to study the effect of different ratio of inoculum to POME substrate for biogas production. In addition, the removal efficiencies of biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammoniacal nitrogen (AN), total nitrogen (TN) total suspended solid (TSS), volatile suspended solid (VSS) were also evaluated. Bio-methane potential (BMP) was used by manipulating temperature and HRT which were set to 28-32 ℃ and 30 days. The BMPs were operated under different ratio of inoculum to substrate at ratio of 20:80, 30:70 and 40:60. Highest cumulative biogas yield obtained was 1990 mL in the BMP containing 30:70 (inoculum:substrate) followed by the ratio of 40:60 with 1055 mL and 20:80 with 345 mL. Maximum TSS and VSS removal efficiency were 27% and 55%, recorded in 30:70 respectively, while in 40:60 and 20:80 were 23% and 12% and 8% and 51% respectively. The removal of TN was also high at 30:70 with 79% removal. Removal efficiency of COD was in BMP of 20:80 with 54% removal while BOD removal was seen the highest in 40:60 ratio BMP. Lastly, the AN were managed to be removed about 95% in 20:80 BMP. The results obtained in this study indicated that with different ratio od inoculum to POME substrate can enhance biogas production and quality of POME prior discharge to environment.

BP-OS-11 (ORAL SPEAKER)

FUNCTIONAL GROUPS EVALUATION AND TEMPERATURE EFFECTS ON ANION EXCHANGE MEMBRANE (AEM) ELECTROLYZER PERFORMANCE FOR H_2 PRODUCTION

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ABSTRACT

Hydrogen has been identified as an alternative energy carrier, and its synergy with renewable energy is particularly advantageous, as excess electrical energy can be chemically stored in hydrogen to balance the discrepancy between energy demand and production. Water electrolysis is a reliable process involving the electrolytic decomposition of water to produce hydrogen of high purity. Among the several technologies that have been developed for electrolysis, anion exchange membrane water electrolysis (AEMWE) is investigated with an attempt of addressing the anion exchange membrane's (AEM's) low chemical stability by choosing a suitable functional group based on its stabilities and performance. From related literature, the selected AEM functional groups for evaluation were imidazolium, piperidinium, and quaternary ammonium. The effect of these membranes on AEMWE performance was predicted through simulations at two (2) operating temperatures: 20°C and 80°C. The properties evaluated were the Young's modulus, tensile strength, ion exchange capacity, swelling ratio, water uptake, and ionic conductivity. Evaluation results classified the functional groups based on chemical stability, mechanical stability, alkaline stability, among others, and ranked them using radar charts in determining which had the best combination of properties. These AEM's ionic conductivities were then incorporated in a numerical simulation of AEMWE using MATLAB at 20°C and 80°C. The simulation results verify the evaluation results and show the increase in efficiency at higher temperatures, thus recommending the piperidinium functional group as the most suitable functional group to address AEM's low chemical stability.

BP-OS-13 (ORAL SPEAKER)

MINI REVIEW ON REACTIVE SOLVENT EXTRACTION OF FERMENTATIVE 1,3-PROPANEDIOL

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ABSTRACT

Biosynthesis of 1,3-PDO is an attractive alternative to petrochemical approach due to the 50% reduction in energy consumption, GHG emission and its ability to utilise renewable resources. The potential use of glycerol glut from biodiesel industry thrives over the use of food-based corn sugar, especially in SEA region. In order to move forward for the commercialization of bio-based 1,3-PDO, one of the major bottlenecks that impedes the economic feasibility includes an economically-viable downstream process, which occupies around 50 -70% of the total cost. This is due to the complexity of separating 1,3-PDO from other compatible compounds found inside the fermented broth and its nature of being a polar compound. In general, the purification of 1,3-PDO is undergone in the order of biomass removal, followed by a primary step to extract 1,3-PDO and a final step to isolate 1,3-PDO from other chemically compatible compounds. Most attention has been given to the primary step as it involves complex kinetics to extract 1,3-PDO. Several methods have been investigated for the primary step including methods that involve phase separation. Liquid-liquid extraction method was found to be unsuitable for the extraction as 1,3-PDO hardly dispersed into the organic extracting phase. Aqueous two-phase system extraction was found to recover high portion of 1,3-PDO into the extracting phase. However, due to its aqueous property, high amount of energy is required to isolate 1,3-PDO from that phase in the final step. Despite high recovery of 1,3-PDO was recorded for the salting-out technique, the recovery of salt requires further investigation to ensure its sustainability. Therefore, in this review paper, reactive extraction methods were thoroughly reviewed to fulfil the shortcomings of the previous methods. Reactive extraction showed high recovery of 1,3-PDO with good recycle of the organic aldehyde and diluent used. However, the recyclability of reactive extraction requires further investigation.

BP-OS-14 (ORAL SPEAKER)

STUDY OF SWINE MANURE DEODORIZATION THROUGH ANALYSIS MICROORGANISM COMMUNITY

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ABSTRACT

The number of heads of breeding and the amount of swine manure is increasing caused by becoming large and dense while the number of farms is decreasing during the one decade. Accordingly, civil complaints that are concentrated by regional groups are consistently filed by people who live near stockbreeding barns. Even though odor reduction methods are still developed recently, the problem is these are not resolved practically due to difficulty to access. Swine manure in barn decomposing organic matter generates odor-causing materials such as NH_4, H_2S or organic acid. Ammonia is the hazardous component that occurred the most in the odor and generating fine dust in the atmosphere. Ammonia gas is reported that barn among pig to barn accounts for the largest rate. The reason is the pig slurry causes ammonia gas by decomposition by microorganisms in swine manure for several months. The research of reduction of odor is divided to pre-reduction and post-reduction and focuses on post-reduction. The post-reduction process is used the microbial agents include the microorganism like Bacillus. The microbial agents which are reducing odor inducing dominant effective microorganism in the existing environment has insufficient research result about exact mechanism and effects. Therefore, this research was conducted with an experiment on swine manure by using microbial agents containing *Bacillus*, *Lactobacillus*, *Rhodobacter* to investigate the effect on reducing the odor and ammonia. The ammonia concentration of the swine manure is monitored over time and after the experiment, microbial community structure analysis was performed on swine manure. According to this research, it is considered the research on odor post-reduction is possible to be advanced through confirmation through odor reduction mechanism by microbial agents and establishment of persistence of effect.

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BE-OS-23 (ORAL SPEAKER)

PHOTOSYNTHETIC MICROBIAL DESALINATION CELL (PHMDC) FOR ELECTRICITY PRODUCTION AND WATER TREATMENT

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ABSTRACT

The dependency on fossil fuels for energy generation and water shortage is a global concern addressed as a sustainable development goal. Microbial desalination cell (MDC) is a bio-based solution to this problem. It offers a sustainable approach to desalinate saltwater by directly utilizing the electrical power generated by organic matter oxidation. Triple chamber MDC employs anaerobic bacteria to produce protons and electrons in the anode chamber. The middle chamber consists of saltwater, which acts as a bridge to transfer an electron from anode to cathode. Meanwhile, the cathode chamber often uses a chemical such as ferricyanide as an electron acceptor, which is not practical and toxic. Therefore, this study used locally isolated microalgae, *Characium* sp. UKM1, *Chlorella* sp. UKM2, *Coelastrella* sp. UKM4, *Chlamydomonas* sp. UKM6 and *Scenedesmus* sp. UKM9 to take the role of the terminal electron acceptor. The photosynthetic potential of all microalgae was assessed through biomass assessment, dissolved oxygen concentration and pigment production through the photosynthesis process. The maximum specific growth rate (μmax) of UKM1, UKM2, UKM4, UKM6 and UKM9 were 0.0704 day^{-1}, 0.0732 day^{-1}, 0.0643 day^{-1}, 0.0815 day^{-1} and 0.0647 day^{-1}, respectively. During the microalgae cultivation, *Scenedesmus* sp. UKM9 produced the highest dissolved oxygen while *Chlamydomonas* sp. UKM6 produced the greatest amount of chlorophyll which is 12.14 mg m^{-3}, due to photosynthesis. Both

BP-OS-15 (ORAL SPEAKER)

EFFECTS OF CO_2 FLOW RATE IN SUPERCRITICAL FLUIDS EXTRACTION OF *POLYGONUM MINUS* ROOTS

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ABSTRACT

Polygonum minus (locally known as Kesum) roots has been reported to contain bioactive sesquirtepenes compound, which is *β-caryophyllene*. In this study, supercritical fluid extraction using carbon dioxide was employed to investigate the effects of CO_2 flow rate (2 ml/min, 3ml/min and 4 ml/min) towards essential oil yield (EO) and *β-caryophyllene* yields from *P.minus* roots. The extraction pressure, temperature and time were fixed at 80 bar, 40°C and 240 min, respectively. The results showed the highest amount EO obtained at flow rate 4 ml/min with 33.3% followed by flow rate 3 ml/min and 2 ml/min were 24% and 12.4% respectively. On the other hand, the highest amount β-caryophyllene was obtained at the lowest flow rate of 2 ml/min with 7.69% yield, followed by 3ml/min (1.62%) and 4 ml/min (1.54%). It can be explained that by increasing the CO_2 flow rate, it will increase the initial extraction rate and the overall extraction of EO. However, mass transfer resistance limits the amount of β-caryophyllene transported to the bulk solvents with increasing CO_2 flow rate. Thus, further study is needed to overcome the mass transfer limitation and improve the overall extraction of β-caryophyllene from *P.minus* roots.

BE-OS-24 (ORAL SPEAKER)

PERFORMANCE VERIFICATION OF BIO-ELECTROCHEMICAL REACTOR ADAPTATION TYPES IN BENCH SCALE

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ABSTRACT

Bio-electrochemical anaerobic digestion(BEAD) is a technology that can maximize bio-energy production by promoting biochemical reactions of microorganisms with slow growth rate through electrode and voltage supply to anaerobic digestion(AD). Although BEAD has been proven to improve performance in many studies, it has been progressed in the lab-scale due to problems (increased internal resistance due to increased electrode distance, inhibition of material transfer due to electrode structure, etc.). Various improvement methods(ex: rotating impeller electrode, auxiliary bio-electrochemical reactor(ABER), etc.) have been suggested for field application of BEAD technology, but these studies are also limited to lab-scale studies, and verification in large-scale studies is required. In this study, BEAD performance was verified on the bench scale that increased the size on the lap scale, and the suitability of the improvement methode was confirmed through the improvement of the performance by improving the problem of BEAD. The reactor consisted of AD, BEAD and AD+ABER. AD and BEAD reactor working volume is 100L, and ABER reactor working volume is 8 L. The electrode was used SUS304, and The electrodes surface area/working volume(A/V ratio) 9.12 m^2/m^3, respectively. The voltage was supplied to 0.4 V. Food waste was used for substrate, and the organic loading rate (OLR) of 2~4 kg-COD/m^3/d was operated at 35 °C. ABER circulated the bluk using a pump. In AD and BEAD, the performance difference was insignificant, unlike previous studies. However, AD+ABER showed higher COD removal efficiency and biogas production than AD. In addition, lower VFAs were observed compared to AD, confirming process stability through rapid treatment of VFAs. This is because the mass transfer rate was improved through the separation of the electrode part and the stirring part. In conclusion, the problem of the expansion of BEAD and the possibility of field application through the improvement of BEAD structure were confirmed.

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BR-OS-06 (ORAL SPEAKER)

A COMPARATIVE STUDY OF THE MORPHOLOGICAL, BIOMASS AND LIPID PRODUCTION OF NATIVE MICROALGAE CULTURED IN ANAEROBIC POME

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ABSTRACT

Microalgae cultivation on anaerobic POME has been examined in some studies as a possible phycoremediation agent to reduce contamination load and discharge effluents safely. However, the relationship between microalgae growth in POME with respect to their morphological changes and lipid accumulation in biomass were not well investigated. Therefore, the purpose of this study was to evaluate the responses of microalgae *Chlamydomonas* sp. UKM6 and *Scenedesmus* sp. UKM9 cultured in anaerobic POME. These microalgae were cultivated in various POME concentrations in bold basal Medium (0% v/v, 25% v/v, 50% v/v, 75% v/v, 100% v/v). The resulting biomass was evaluated in terms of growth performance, lipid production and morphology. The results highlighted that *Chlamydomonas* sp. UKM6 showed the highest specific growth rate (0.37 d^{-1}) and maximum biomass (1.31 gL^{-1}) in 25% (v/v) anaerobic POME. Similar with *Scenedesmus* sp. UKM9, maximum specific growth rate (0.23 day^{-1}) and maximum biomass (1.54 gL^{-1}) was observed at a concentration of 25% (v/v) anaerobic POME. However, the maximum lipid content for *Chlamydomonas* sp. UKM6 and *Scenedesmus* sp. UKM9 were recorded as 50.58 mgL^{-1} and 37.54 mgL^{-1} in 50% (v/v) of anaerobic POME, respectively. The proportions of saturated, monounsaturated, and polyunsaturated fatty acids almost the same for both microalgae. *Chlamydomonas* sp. UKM6 and *Scenedesmus* sp. UKM9 produced a large portion of monounsaturated fatty acids of 42.78% and 41.79% of the total fatty acids in the isolate, respectively. Moreover, the morphological structure of microalgae had clearly demonstrated the presence of abundant lipid structures in the cytoplasm, as well as the loss of thylakoid structure when microalgae were cultured in POME anaerobic media. Thus, these findings clearly show that anaerobic POME has a major influence on the performance of microalgae, lipid production and the morphological structure of both microalgae and that they are correlated.

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BP-OS-16 (ORAL SPEAKER)

BIOGAS IMPURITIES AND THE EFFECTS ON BIOGAS FED SOFC PERFORMANCE: A REVIEW

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ABSTRACT

Biogas is one of the greatest potentials to be used as fuel for SOFCs due to high energy efficiency while reducing the emission of greenhouse gases (GHGs) and gaseous pollutants. However, the key challenge for adopting biogas as SOFC fuel is the presence of contaminants that could diminish the lifetime of the SOFC. This review addresses the impurities of biogas as a fuel for high temperature SOFC and its effect of each type of contaminants on the performance of SOFC. The composition of biogases from several type of sources such as waste-water treatment plant, agricultural waste and landfill are discussed in detail. The effects of each contaminant's compound found on addressed biogases towards SOFC degradation have been analysed.

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BE-OS-25 (ORAL SPEAKER)

PHOTO BIOHYDROGEN PRODUCTION BY CELLULOSIC AEROGEL IMMOBILIZED MIXED CULTURE

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ABSTRACT

Immobilized cell technology has been widely used in bio-hydrogen production. Most of the research on immobilized hydrogen production is used in dark fermentation hydrogen production. Few studies discuss the application of hydrogen production immobilized cell technology by photo fermentation. If immobilization is applied to photosynthetic bacteria, it must be in a sufficient light environment that can grow, so complicated conditions such as transparency and porosity still need to be considered.
In this study, the microcrystalline cellulose aerogel used for photo mixed culture immobilization, which has the advantages of biodegradability, light permeability, and high porosity. The experiment worked out the effect of different pH on batch photo immobilized fermentation, and two-stage dark/photo immobilized fermentation. Discuss through gas chromatographic analysis, Metagenomic analysis, and Metabolite analysis, and use hydrogen yield (HY) as the evaluation index of hydrogen fermentation.
The experiments have found that HY reaches 0.858 mol H_2/mol substrate at pH 7.0. As the pH increases from 7.0 to 9.0, the total hydrogen production is decreased. The experiments have found that photo immobilized cell hydrogen production at pH 9.0, increasing the number of activations of the immobilized cell but decreasing hydrogen production. However, through bacterial community analysis, it was found that the dominant bacteria changed from *Rhodopseudomonas* to *Citrobacter* after the activation of immobilization tests. The substrate concentration is 20 g-glucose/L of dark/photo immobilized two-stage fermentation, and the HY reaches 1.75 mol H_2/mol substrate.

BE-OS-27 (ORAL SPEAKER)

IMPROVING BIO-HYDROGEN PRODUCTION OF MULTI-WALLED CARBON NANOTUBES CARBOXYLIC ACID FUNCTIONALIZED (MWCNT-COOH) BY CO-IMMOBILIZATION TECHNIQUE WITH *Clostridium pasteurianum*

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ABSTRACT

Bio-hydrogen gas, is a good alternative to fossil fuels, as a clean energy carrier and has a number of advantages, including no carbon emissions, maximum energy per unit, known fuel weight, and storage possibilities. Various studies have been proved to successfully increase hydrogen production by augmentation of nanomaterials with anaerobic hydrogen producing microorganisms. A novel approach is proposed in this study to co-immobilized a pure strain of *Clostridium pasteurianum* (CH5) with functionalized adhesion multi-walled carbon nanotube carboxylic acid functionalized (MWCNT-COOH) and to explore the possible stimulation of biohydrogen production. Results showed that this co-immobilization approach significantly improved the hydrogen production under selected concentrations of MWCNT-COOH addition. A direct co-immobilization of *Clostridium pasteurianum* (CH5) with 800mg/L of MWCNT-COOH obtained an improved hydrogen yield up to 2.43 mol H_2/mol glucose. Furthermore, if *Clostridium pasteurianum* (CH5) and the same concentration of 800mg/L of MWCNT-COOH were pre-incubated for 24 hr then being immobilized together, the hydrogen yield went up to be 3.07 mol H_2/mol glucose. Overall, pre-incubation with 800mg/L of MWCNT-COOH then immobilization approach proposed in this study demonstrated a 50.4% increase of accumulative hydrogen production comparing to the control (without co-immobilization of MWCNT-COOH). This is also a 146.36% increasing of hydrogen production comparing to the traditional suspended growth of *Clostridium pasteurianum* (CH5) mixed with the same concentration of MWCNT-COOH. Results in this study suggested that by bring nano-material to a closer contact of microorganism, better stimulation of hydrogen production could be obtained. This could be a feasible and simple approach for future bio-hydrogen production applications.

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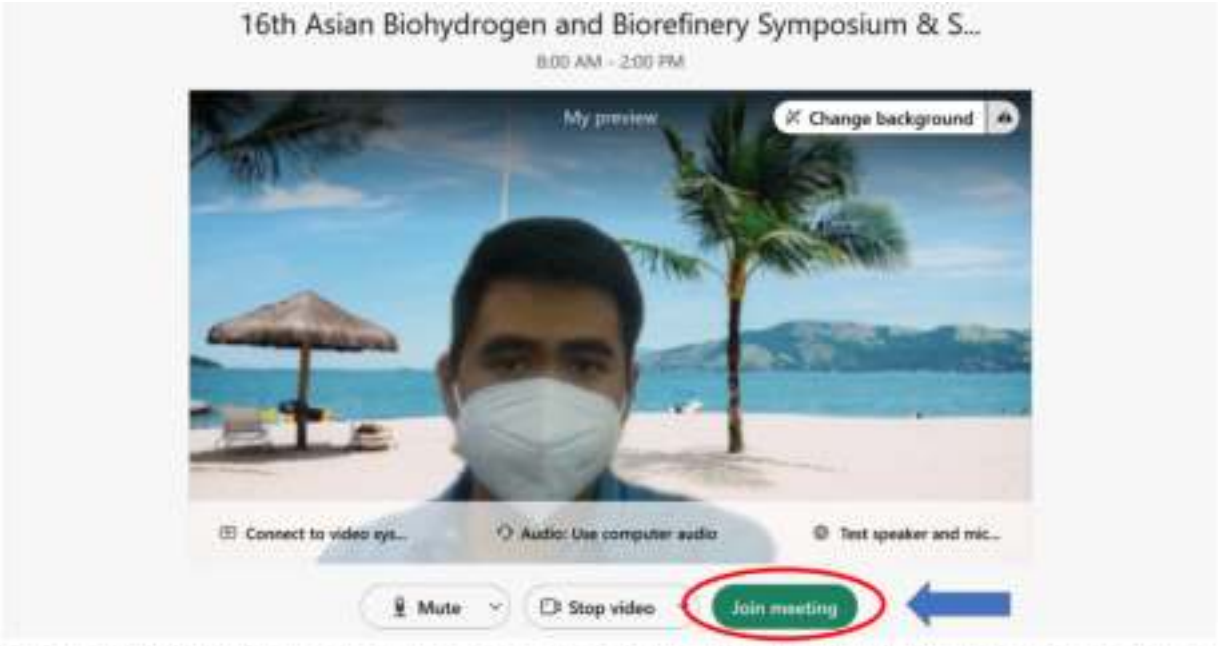

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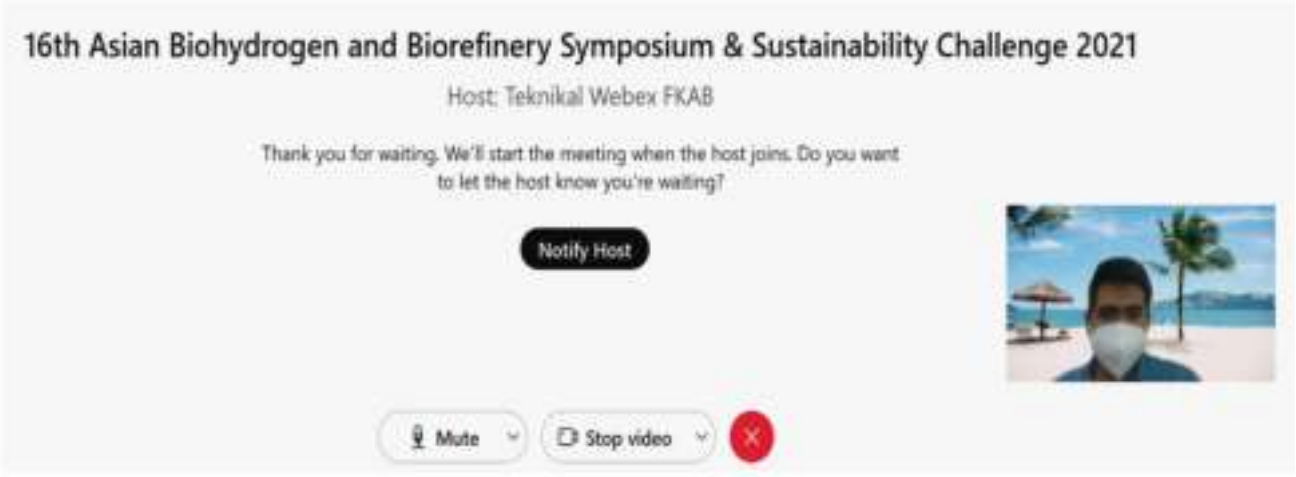

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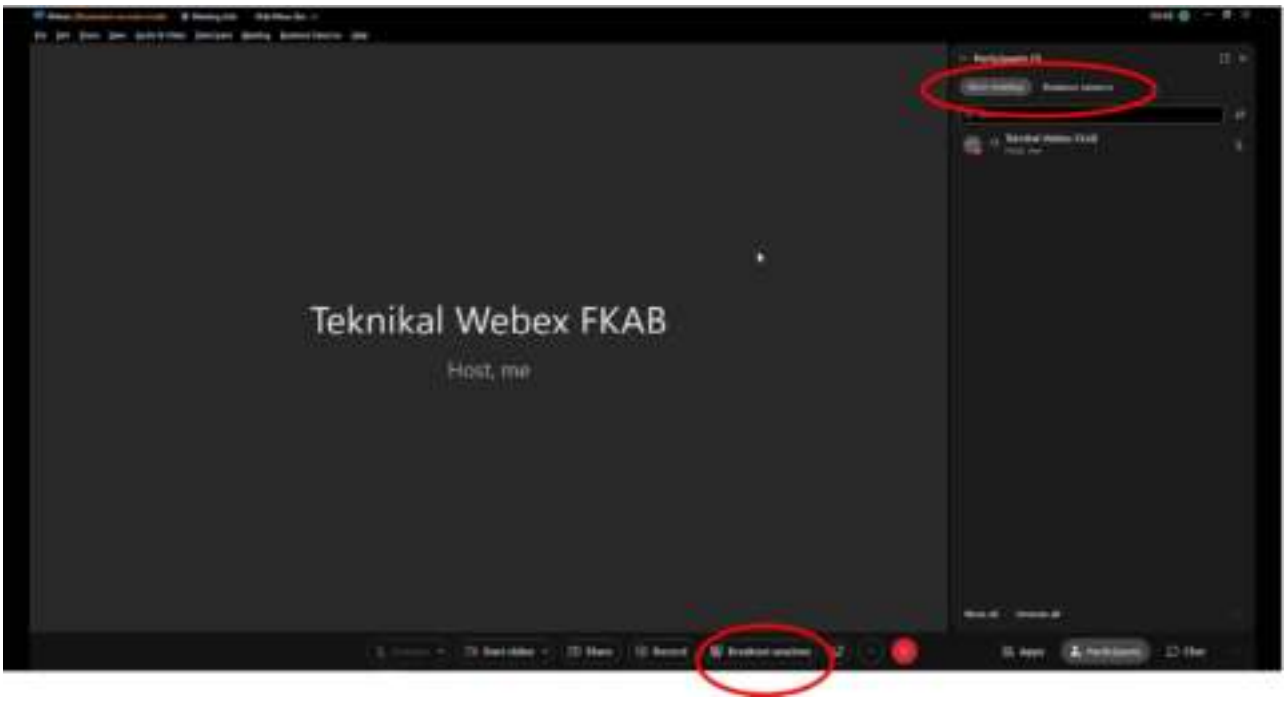

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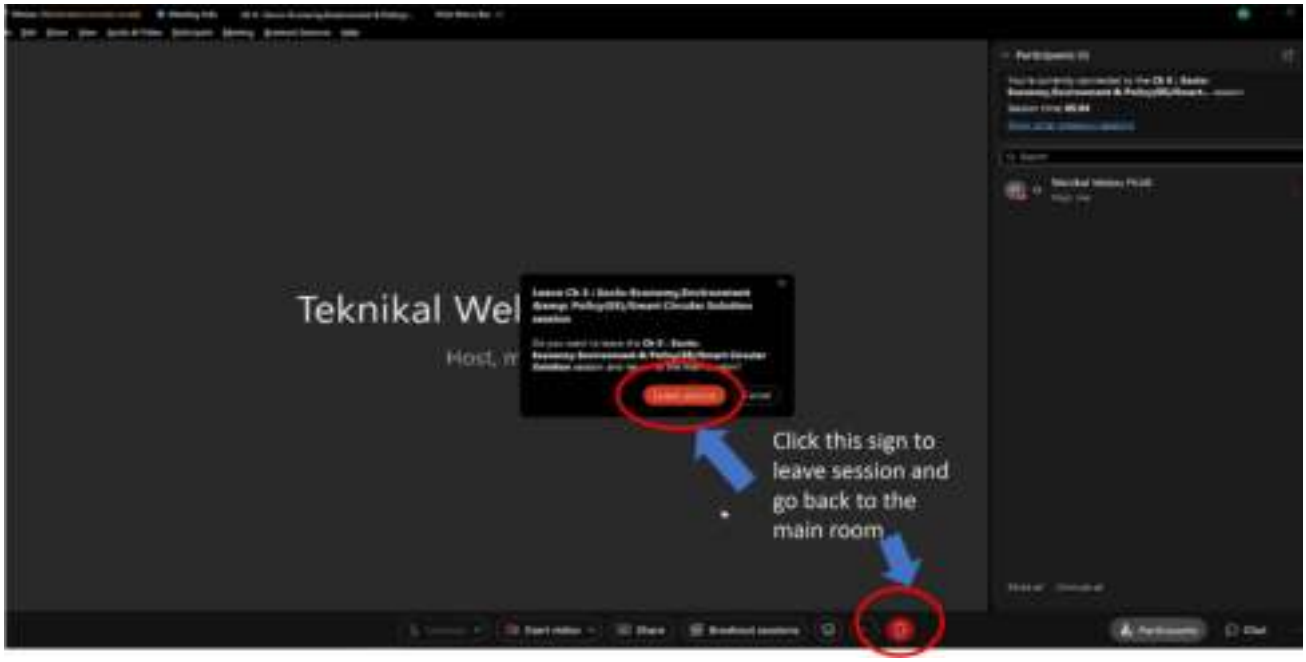

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