Coalesce Research Group

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5th International Conference on

# BIOFUELS AND BIOENERGY

October 21-22, 2024 | Tokyo, Japan

**Coalesce Research Group**
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Greenville, SC 29607, USA

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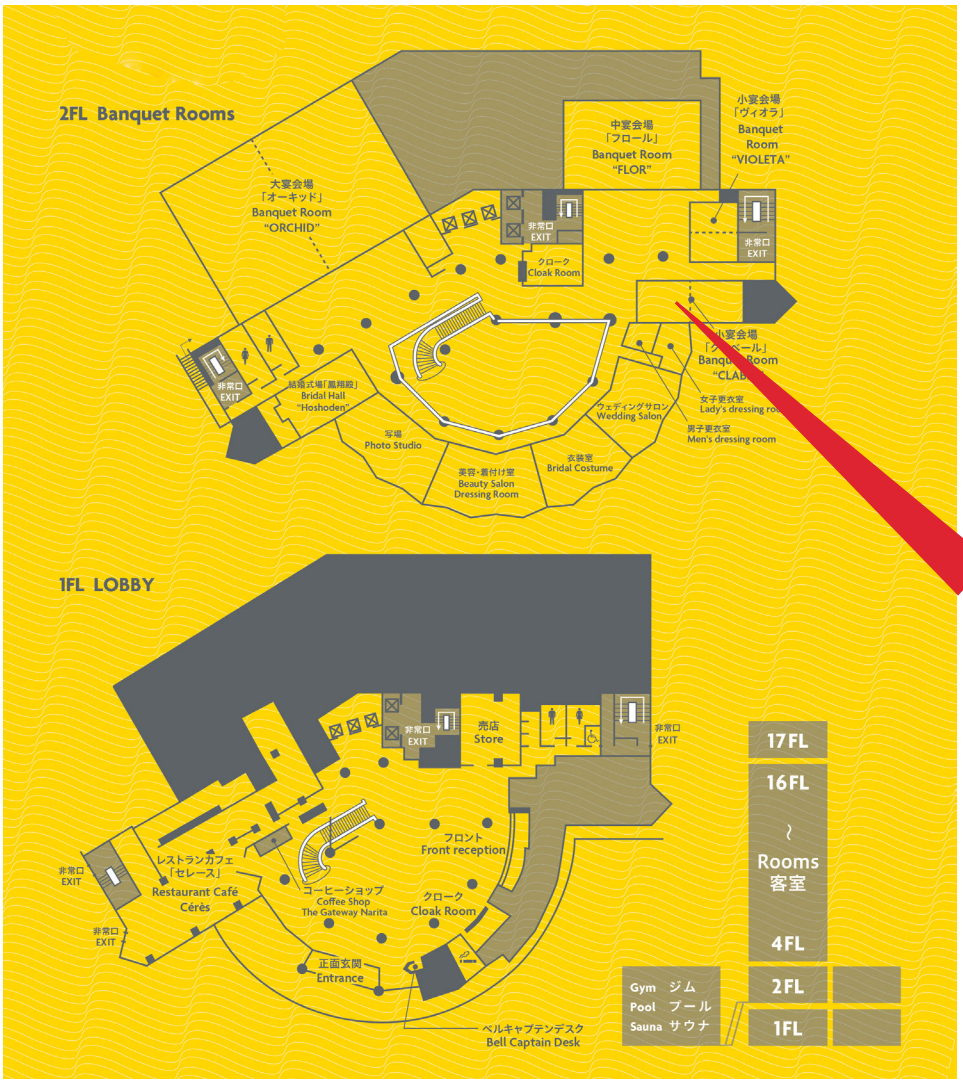
# Floor Map




## Conference Hall

## Wi-Fi Details:

**SSID : IHG One Rewards Free WIFI**
**Password:** not required but log in page will be coming up, and put **1311** into the access code and submit

# *Scientific Program*

# Scientific Program

**Monday**
**October 21, 2024**

5th International Conference on

# Biofuels and Bioenergy

| Day 1 - 21 October, 2024 | |
|---|---|
| Meeting Hall @ Clavel | |
| 08.00-8.45 | Registrations |
| 08.45-09.00 | Introduction |
| Keynote Presentations | |
| 09.00-09.40 | Search for Simple Surrogates to Represent Terpenes Biofuels in Combustion Models |
| | **Philippe Dagaut, Centre National de la Recherche Scientifique, France** |
| 09.40-10.20 | Risk Evaluation for Various Biofuels using Highly Sensitive Calorimeters (Review) |
| | **Hiroshi Koseki, Chiba Institute of Science, Japan** |
| Networking & Refreshments- 10.20-10.50 @ Orchid Foyer, and Iris | |
| 10.50-11.30 | Strain Dynamics of Contaminating Bacteria Modulate the Yield of Ethanol Biorefineries |
| | **Shilpa Garg, Technical University of Denmark, Denmark** |
| Oral Presentations | |
| Session Chair | **Philippe Dagaut, Centre National de la Recherche Scientifique, France** |
| Session Chair | **Jeffrey S. Cross, Institute of Science Tokyo, Japan** |
| **Sessions:** | Bioeconomy \| Biogas \| MSW Methane gas production upgrading \| Production of Biofuels \| Algae biofuels \| Bioenergy \| Bioenergy Conversion \| Wastewater Management |
| 11.30-12.00 | Development of EGAO (Ethanol-based Global Agricultural Optimization) Technology and its Application for the Sustainable Agriculture |
| | **Motoaki Seki, RIKEN Center for Sustainable Resource Science, Japan** |
| 12.00-12.30 | Hydrogen Gas Permeation of PdCu Membranes of Various Thicknesses |
| | **Jeffrey S. Cross, Institute of Science Tokyo, Japan** |
| 12.30 - 13.00 | Production of Biofuels Through HTL Process using Waste Compounds |
| | **Carlos Sainz, Rey Juan Carlos University, Spain** |
| Group Photo- 13.00-13.10 | |
| Lunch- 13.10-14.00 @ Restaurant Cafe Ceres | |
| 14.00-14.30 | Design of a High Added-Value Product Biorefinery based on Microalgae Biomass |
| | **Alejandro Piera, Rey Juan Carlos University, Spain** |
| 14.30-15.00 | Catalytic Pyrolysis of Walnut Shell Waste |
| | **Saimatun Nisa, Indian Institute of Technology Jammu, India** |
| 15.00-15.30 | Electrocatalytic Activity of Microbial Electrolysis Cells for Biohydrogen Production using High Conductivity Electrodes during High Strength Wastewater Treatment |
| | **Posadas-Hernández Manuel, The University of Sciences and Arts of Chiapas (UNICACH), Mexico** |
| 15.30-16.00 | Plant Microbial Fuel Cells for Green Remediation, Sustainable Development and Net Zero Emissions |
| | **Chung-Yu Guan, National Taiwan University, Taiwan** |

# Scientific Program

**Monday**
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|---|---|
| Networking & Refreshments- 16.00-16.30 @ Orchid Foyer, and Iris | |
| 16.30 - 17.00 | Preparation of $CaO@CeO_2$ Solid Base Catalysts used for Biodiesel Production |
| | **Wilasinee Kingkam, Thailand Institute of Nuclear Technology, Thailand** |
| 17.00 - 17.30 | Enhanced Anaerobic Co-Digestion of Cattle Manure with Food Waste and Pig Manure: Statistical Optimization of Pretreatment Condition and Substrate Mixture Ratio |
| | **Sangyeol Jo, Chosun University, South Korea** |
| Poster Presentation | |
| PP001 | Physicochemical Properties of Biochars Made from Different Feedstocks and their Biogas Production Performances |
| | **Choi Yong-Keun & Saerom Park, Choilab Inc, South Korea** |
| Panel Discussion @ 17.45- 18.15 | |
| 17.45 - 18.15 | PANEL SESSION: Biofuels as a sustainable solution: Reducing Waste, Feeding Energy |
| | **"Topics:**<br>**"Biorefinery as a Process to Get Chemical Platform Compounds from Agricultural Wastes"**<br>**"Biomass as a Sustainable Alternative Resource for Livestock Feed"**<br>**"Bioenergy with Carbon Capture and Storage"**<br>**"Biofuels and Carbon Footprint Reduction"**<br>**"Circular Economy in Biofuels"**<br>**"Technological Innovations in Biofuel Production"** |
| Panelists: | **Philippe Dagaut, Centre National de la Recherche Scientifique, France** |
| | **Shilpa Garg, Technical University of Denmark, Denmark** |
| | **Carlos Alberto Guerrero Fajardo, Universidad Nacional de Colombia, Colombia** |
| | **Surendra Singh Kachhwaha, Pandit Deendayal Energy University, India** |
| Day 1 Concludes followed by Certificate Felicitation | |

5th International Conference on

# Biofuels and Bioenergy

| Day 2 - 22 October, 2024 | |
|---|---|
| Meeting Hall @ Clavel | |
| Keynote Presentations | |
| 10.00 - 10.40 | Optimization of Hydrothermal Valorization of Coffee Cherry: Analysis of the Impact of Biomass/Water Ratio, Particle Size, Stirring, and Catalysts on Chemical Platforms and Biochar Production |
| | **Carlos Alberto Guerrero Fajardo, Universidad Nacional de Colombia, Colombia** |
| 10.40 - 11.20 | Industrial Scale Biodiesel Production from Waste Cooking Oil using Hydrodynamic Cavitation |
| | **Surendra Singh Kachhwaha, Pandit Deendayal Energy University, India** |
| Networking & Refreshments (11.20 - 11.40) @ Orchid Foyer, and Iris | |
| Oral Presentations | |
| Session Chair | **Carlos Alberto Guerrero Fajardo, Universidad Nacional de Colombia, Colombia** |
| Session Chair | **Surendra Singh Kachhwaha, Pandit Deendayal Energy University, India** |
| **Sessions:** | Biogas \| Biodiesel \| Bioenergy with carbon capture and storage \| Biomass Technology \| Production of Biofuels \| Sustainable Energy \| Wastewater Management \| Advanced Biofuels |
| 11.40 - 12.10 | Modeling of an Oxyfuel Combustion of Sewage Sludge with Subsequent $CO_2$ Utilization in a P2X Process |
| | **Szymon Herdzik, Technical University of Munich, Germany** |
| 12.10 - 12.40 | EcoDiesel |
| | **Praven Allopi, University KZN-Westville Campus, South Africa** |
| 12.40 - 13.10 | Magnetite Addition Reduces Nitrite Requirement for Efficient Anaerobic Ammonium Oxidation by Facilitating Mutualism of ANAMMOX and FEAMMOX Bacteria |
| | **Rahul Kadam, Chosun University, South Korea** |
| Lunch- 13.10 - 14.00 @ Restaurant Cafe Ceres | |
| 14.00 - 14.30 | Experimental and Numerical Study of Biomass Fuels Reforming with a Fast Start-Up Reactor using $Pt/Al_2O_3$ Monolithic Plate Catalyst |
| | **Xiaoyi Ding, Xi'an University of Technology, China** |
| 14.30 - 15.00 | Accelerating the Energy Transition: Policy and Regulatory Frameworks for Sustainable Energy Systems |
| | **Mohsen Alamooti, Middle East Mines Industries Development Holding Company (MIDHCO), Iran** |
| 15.00 - 15.30 | Experimental and Modeling Investigation of Bio-Oil and Waste Cooking Oil Co-processing for Aviation Fuels |
| | **Melba Domes Denson, Central Luzon State University, Philippines** |

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| | |
|---|---|
| 15.30 - 16.00 | Experimental Investigation on the Performance and Exhaust Emission of a Direct Injection Diesel Engine Running on Fuel Additives with Variable Loads |
| | **Faisal Mahroogi, Islamic University of Madinah, Saudi Arabia** |
| Video Presentation | |
| VP-01 | Influence of FAME Raw Materials on its Aging Process |
| | **Paweł Grabowski, Warsaw University of Technology, Poland** |
| VP-02 | Influence of Factors on The Oxidative Stability of Fuels Obtained in Thermolysis of Waste Plastics |
| | **Oliwia Liberek, Warsaw University of Technology, Poland** |
| VP-03 | Biotransformation of Aromatic Biomass Waste into Biofuel using Oleaginous Yeast |
| | **Shivani Chaturvedi, CSIR-Central Institute of Medicinal and Aromatic Plants, India** |
| VP-04 | Wastewater Management and Public Health Risks, Prompting Algae-Based Treatment Systems |
| | **Sangeeta Chaturvedi, Dr. B.R. Ambedkar University Agra, India** |
| VP-05 | Optimization of Vacuum Pressure Swing Adsorption Technology for Biogas Upgrading |
| | **Mohammad Azadi Tabar, Vrije Universiteit Brussel, Belgium** |
| Awards & Closing Ceremony | |
| Networking & Refreshments (16.30 - 17.00) @ Orchid Foyer, and Iris | |
| Day 2 Concludes followed by Certificate Felicitation and Vote of Thanks | |

# *Day-1*
# *Keynote Presentations*

# SEARCH FOR SIMPLE SURROGATES TO REPRESENT TERPENES BIOFUELS IN COMBUSTION MODELS

**Philippe Dagaut**

*Centre National de la Recherche Scientifique, France*

## Abstract

Terpenes such as limonene, α-pinene, and β-pinene pertain to a class of hydrocarbons naturally released by plants. These high-energy density chemicals can be blended with liquid fuels. For the development of clean combustion of such biofuels, chemical kinetic reaction mechanisms need to be proposed. However, due to the relative complexity of such fuels, search for appropriate surrogates is highly desirable. Methylcyclohexenes isomers have been selected among possible available cyclic unsaturated hydrocarbons. The oxidation of terpenes has been performed under well control conditions. Limonene, α-pinene, and β-pinene, were oxidized in a jet-stirred reactor. Similarly, 1,1-methyl cyclohexene, 1,3- methyl cyclohexene, and 1,4- methyl cyclohexene was oxidized in the same reactor. FTIR and gas chromatography were used to characterize simple products of oxidation. In addition, samples of the reacting mixtures containing more complex products were collected, dissolved in acetonitrile, and analyzed by high-resolution mass spectrometry. Direct flow injection or chromatographic separation by ultra-high-performance liquid chromatography. Heated electrospray ionization and atmospheric pressure chemical ionization were used to characterize the products of oxidation. H/D exchange using $D_2O$ was performed for probing the presence of hydroxyl and hydroperoxyl groups in the products. Reaction with 2,4-dinitrophenylhydrazine was used to assess the presence of carbonyl functional groups in the products of oxidation. A large set of oxidation products, including highly oxygenated organic products with up to 9 oxygen atoms, was observed. Aromatic and/or polyunsaturated products were also detected. Van Krevelen plots, computed oxidation state of carbon, aromaticity index, maximum carbonyl ratio, and degree of unsaturation in products were used to analyze the results. A comparison of the products of oxidation of the three terpenes and the three-methyl cyclohexene indicated that none of the surrogates studied could fully represent the selected terpenes under cool-flame conditions.

## Biography

Dagaut, P. has completed his Ph.D. in 1986. He his Research Director at CNRS (Orleans, France). He is President of the Combustion Institute. He has been Editor of Combustion and Flame and of the Proceedings of the Combustion Institute. He is co-author of more than 350 peer reviewed papers with a h-index of 74 (Scopus).

# RISK EVALUATION FOR VARIOUS BIOFUELS USING HIGHLY SENSITIVE CALORIMETERS (REVIEW)

**Hiroshi Koseki**

*Chiba Institute of Science, Japan*

## Abstract

Currently various biofuels are developed and widely used in power plants and industries. And sometimes they caused fires and explosions during storage and transportation process. Therefore, we conducted cause investigation using highly sensitive calorimeters such as the TG/DTA, DSC, Setaram C80, and MS80, and TAM-3. Gas emission from biofuels were also measured using the gas-chromatography because sometimes they made explosions. In this study, solid samples such as wood pellet, RDF, RPF, wood mixtures were used. Recycling materials produced from gavages after the 2011 East-Japan earthquakes were also used. We found small het generation in biofuels which is one of the triggers of self-ignition and studied the effects of fermentation of aerobic micro-organism. Based on the results we evaluated fire and explosion risk of biofuels. That is, RDF and some wood pellet have high risk among our samples.

## Biography

Hiroshi Koseki received his doctor degree from the University of Tokyo, Japan where he had studied on characteristics of oil tank fires. He was the chief of hazardous material group and cause investigation group of the National Research Institute of Fire and Disaster (NRIFD), Tokyo, Japan. He has conducted investigation of cause of fires caused by various hazardous materials including bio-mass fuel and disaster waste. He has about 100 publications that have been cited over 500 times(H-index:23). He retired from NRIFD in 2011, and has been working for investigation of fires from disaster waste after the 2011 Tohoku earthquake. Currently he is a part-time lecturer at CIS (Chiba Institute of Science).

# STRAIN DYNAMICS OF CONTAMINATING BACTERIA MODULATE THE YIELD OF ETHANOL BIOREFINERIES

**Shilpa Garg**

*Technical University of Denmark, Denmark*

## Abstract

Bioethanol is a sustainable energy alternative that has the potential to reduce global greenhouse gas emissions by over 60%. However, its industrial production faces several challenges, including inefficiencies caused by bacterial contamination. Broad-spectrum elimination of these contaminants has shown minimal improvements, suggesting that the microbial community's ecological interactions play a key role in the production process. In this study, we examine the microbiome across all stages of bioethanol production at two biorefineries over three timepoints during a production season. Using shotgun metagenomics and cultivation-based methods, we identify beneficial bacteria and observe improved outcomes when yeast-to-bacteria ratios increase during fermentation. We present a microbial gene catalog that highlights bacteria-specific pathways linked to performance. Additionally, we demonstrate that overgrowth of *Limosilactobacillus fermentum* reduces production, with one strain lowering yields by approximately 5% in lab-scale fermentations, likely due to its metabolite profile. Temperature emerges as a key driver of strain-level dynamics. Enhanced microbial management strategies could unlock both environmental and economic benefits in this US$60 billion industry, facilitating its broader adoption.

## Biography

Shilpa Garg is a Senior Researcher/Associate Professor at the Technical University of Denmark (DTU), where she focuses on harnessing genomics and multi-omics tools to advance the understanding of complex diseases and sustainability. She has published in prestigious journals such as Bioinformatics, Nature Communications, and Nature Biotechnology, contributing valuable insights to her fields. Shilpa has earned multiple prestigious awards, including the NIH NHGRI Leadership Award and NNF/DDSA/NHGRI awards. As an editorial board member for Genome Biology and Communications Biology, she plays a pivotal role in shaping innovative research directions in genomics and computational biology.

# *Day-1*
# *Oral Presentations*

# DEVELOPMENT OF EGAO (ETHANOL-BASED GLOBAL AGRICULTURAL OPTIMIZATION) TECHNOLOGY AND ITS APPLICATION FOR THE SUSTAINABLE AGRICULTURE

**Motoaki Seki, Daisuke Todaka, Khurram Bashir, Yoshinori Utsumi, Do Thi Nhu Quynh, Vu Anh Thu, Satoshi Takahashi, Maho Tanaka and Kaori Sako**

*Riken Center for Sustainable Resource Science, Japan*

## Abstract

Water scarcity, high temperature, and salt accumulation on lands are serious agricultural problems causing significant losses to crop yield. Developing environmentally friendly strategies to mitigate these agricultural problems could boost agricultural production in unfavorable conditions and/or uncultivated lands. We have found that pretreatment with ethanol, a cheap and environmentally friendly chemical, enhances drought, heat, and high-salinity stresses in various plants, such as Arabidopsis, rice, wheat, maize, lettuce and cassava, and named the technology as EGAO (Ethanol-based Global Agricultural Optimization). Transcriptome and metabolome analysis showed that the expression of several stress tolerance-related genes and the accumulation of its related metabolites were increased. Ethanol pretreatment enhances high salinity- and high-light- stress tolerance by detoxifying ROS, and induces heat tolerance through stimulation of the endoplasmic reticulum stress response and increased accumulation of sugars. Furthermore, ethanol pretreatment induces stomatal closure and increases sugar accumulation, resulting in a reduced transpiration rate and higher water content in the leaves during drought stress treatment. In the conference, the current status for the analyses of the molecular mechanisms of EGAO and future perspectives of the application of bioethanol for the sustainable agriculture will be presented.

## Biography

Motoaki Seki received his Bachelor's and Master's degrees from Kyoto University, Japan, and a PhD degree from Hiroshima University, Japan. He has developed the technologies to produce useful plant resources, such as stress-tolerant plants by use of ethanol and acetic acid etc. He has also analyzed the regulatory networks of tuberous root development in cassava and aims to develop useful cassava plants, such as increased plant biomass and stress tolerance. He has been a Thomson Reuters/Clarivate Analytics Highly Cited Researchers (2014 2021) and an Editor-in-Chief of Plant Molecular Biology (2019-present). He has over 400 publications, and his publication H-index is 92.

# HYDROGEN GAS PERMEATION OF PDCU MEMBRANES OF VARIOUS THICKNESSES

**Jeffrey S Cross and Kimleng Keang**

*Institute of Science Tokyo, Japan*

## Abstract

Japan's hydrogen strategy aims to create a sustainable and low-carbon society by 2050. The main goal of this strategy is to utilize hydrogen as a key energy carrier. This strategy encompasses the production, storage, and utilization of hydrogen, promoting its use across various sectors including transportation, industry, and power generation. A critical component of this strategy is the development of efficient hydrogen separation technologies to ensure the purity and availability of hydrogen for diverse applications economically. The first part of this presentation will introduce of Japan's hydrogen strategy, highlighting the policy framework and technological advancements driving the country's commitment to a hydrogen-based economy.

In the second half of this talk, Prof. Cross will discuss research conducted in his laboratory on hydrogen gas permeation of PdCu membranes of different thicknesses. These membranes offer a promising solution for high-purity hydrogen production by effectively separating hydrogen gas from other gases. The presentation will delve into the properties and performance of PdCu membranes, showcasing experimental results at various temperatures and pressures. This research focuses on the evaluation of the PdCu membranes used over a range of hydrogen gas experimental conditions and membrane characterization.

## Biography

Jeffrey S. Cross, Ph.D. received the B.S. degree in Chemical Engineering from Kansas State University, Manhattan, Kansas, in 1986, and then M.S. degree in chemical engineering from University of Arkansas, Fayettevile, Arkansas, in 1989 and received a Ph.D. from Iowa State University, Ames, Iowa in 1992. He received a US. National Science Post-doctoral research fellowship in 1993 to conduct research at the the National Institute for Inorganic Materials now known as NIMS, in Tsukuba, Japan. He worked at Fujitsu Labs Ltd. in Atsugi, Japan where he developed thin film electrodes and studied ferroelectric capacitor reliability. From 2008 he joined the Tokyo Institute of Technology (from Oct. 1st, 2024 known as the Institute of Science Tokyo) and he is currently a Professor in the Department of Transdisciplinary Science and Engineering. He has published more than 120 SCI/SCIE journal articles in the areas of education technology, energy policy, waste to energy conversion, renewable energy, machine learning, and microplastics. He supervises a research lab of approximately 20 people consisting of 15 graduate students from 10 different countries.

# PRODUCTION OF BIOFUELS THROUGH HTL PROCESS USING WASTE COMPOUNDS

**Carlos Sainz Urruela**

*Rey Juan Carlos University, Spain*

## Abstract

Nowadays, the production of biofuels is acquiring a great interest in the refinery industry as a way to end with the fossil fuels. In this work, the synthesis of biofuel from different waste materials were studied, using organic compounds, synthetic plastics or mixtures by the hydrothermal liquefaction (HTL) technique. Through this method, 4 phases are obtained, gas, bio-oil, aqueous and char phases. Bio-oil phase can be used to generate different biofuels by a hydrogenation process, aqueous phase can be used as a medium to grow algae, fungi or bacteria, and the char can be used to do an enzymatic detoxification to facilitate the mentioned growing process. HTL process consists in the exposure to high temperature and pressure conditions to a specific biomass to promote its depolymerization and get crude-like oil from where the 4 phases are derived. It is developed in 4 mL and 100 mL reactors. In both cases, temperature and time were controlled to observe differences, although in 100 mL reactor a pressure sensor was placed. Analytical measures were made to know the composition of the phases, for the following growing and the study of biooil as possible biofuel, whose calorific value will be compared with the ones of the standard biofuels.

## Biography

Carlos completed his PhD in chemistry in 2023 from Alcalá de Henares University, Spain. In the last two years, he has been working in the university Rey Juan Carlos (Madrid) collaborating in Green Transition and Digital Transition Projects, whose main work is based on the development of a thermo-bio-chemical refinery to generate cost-effective biofuels together with several added-value products from different wastes by integrating two complementary chemical and biological technologies. Along his career, he has published 7 scientific papers in diverse Q1 journals, besides a patent related to the purification of high added-value phycobiliproteins from algae as a step in the maximum usage of microalgae. Currently, the priority of his work is focused on the production of biofuels based on waste as feedstock by using the HTL technology linked to the valorization by fermentative processes of the wastewater fraction while reducing to a minimum the discharge of toxic residues to the environment.

# DESIGN OF A HIGH ADDED-VALUE PRODUCT BIOREFINERY BASED ON MICROALGAE BIOMASS

## Alejandro Piera

*Rey Juan Carlos University, Spain*

## Abstract

A novel biorefinery from Porphyridium purpureum was proposed to obtain bio-jet fuel and phycoerythrin (PE). Firstly, PE was extracted using reusable ionic liquids followed by a single stage purification process through hydrophobic interaction chromatography (HIC). PE purity grade up to 8.16 (analytical grade) was achieved. Secondly, the waste biomass obtained in the PE extraction was valorized by hydrothermal liquefaction (HTL) to produce bio-crude. Next, this biocrude was upgraded by continuous hydrotreatment (HDT). At this point, several temperatures and pressures were studied by using a commercial $CoMo/Al_2O_3$ catalyst. Coprocessing procedure with vacuum gas oil (VGO) was also evaluated. Finally, a simulated distillation was applied to obtain bio jet fuel and other fractions.

## Biography

Alejandro Piera is a PhD Student from Rey Juan Carlos University, Spain. His research is based on the study of microalgae and cyanobacteria biorefinery processes, developing an integral use of the biomass of these microorganisms. In this sense, he had worked in the development of biofuel production processes (biodiesel) and extraction and purification of high added value bioproducts (pigments, proteins, lipids, etc.). Throughout his career he has published several related scientific communications, papers, and a patent. Currently, his focus is on the production of biocrude through hydrothermal liquefaction and its upgrading to obtain bio jet-fuels.

# CATALYTIC PYROLYSIS OF WALNUT SHELL WASTE

**Saimatun Nisa and Gaurav A Bhaduri**

*Indian Institute of Technology Jammu, India*

## Abstract

Walnut is an important export product form the Union Territory of Jammy and Kashmir. After extraction of the kernel, the walnut shell forms a solid waste that needs to be managed. Pyrolysis is one interesting option for utilisation of this walnut waste. In this study microwave pyrolysis reactor is used to convert the walnut shell biomass into its value-added products. Catalytic and non-catalytic conversion of walnut shell waste to oil, gas and char was evaluated using Co based catalyst. The catalyst was characterised using XPS and SEM analysis. Pyrolysis temperature, reaction time, particle size and sweeping gas ($N_2$) flow rate were set in the ranges of 400–600°C, 40 min, <0.6 mm to < 4.75 mm and 300 ml $min^{-1}$, respectively. The heating rate was fixed at 40°C $min^{-1}$. Maximum gas yield was obtained at 600°C, 40 min, particle size range 1.18-2.36, 0.5 molar catalytic as 45.2%. The liquid product catalytic and non-catalytic was characterized by GCMS analyses. In addition, the solid product was analysed by means of FTIR & SEM.

## Biography

Saimatun Nisa is pursuing her PhD in chemical engineering department from Indian Institute of Technology Jammu. I have 1 publication that have been cited over 60 times, and publication H index is 1. I have attended three international conferences at different parts of India and have got best paper award in CHEMCON 2023. My area of interest in research is waste to energy, biochar applications, water and waste water management.

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# ELECTROCATALYTIC ACTIVITY OF MICROBIAL ELECTROLYSIS CELLS FOR BIOHYDROGEN PRODUCTION USING HIGH CONDUCTIVITY ELECTRODES DURING HIGH STRENGTH WASTEWATER TREATMENT

**Posadas-Hernandez Manuela[1], Pathiyamattom-Joseph Sebastianb[2], Conde-Diaz Jorge Evaristoc[1], Estrada-Arriaga Edson Baltazard[3] and Barragan-Trinidad Martin[2]**

*[1]University of Sciences and Arts of Chiapas, Mexico*
*[2]National Autonomous University of Mexico, Mexico*
*[3]Mexican Institute of Water Technology, Mexico*

## Abstract

In recent years, production of biohydrogen from biological processes has been a relevant scientific topic, due to the need to produce it through renewable and environmentally friendly methods. Dark fermentation and Microbial electrolysis cells (MECs) have been used to produce gaseous biofuels such as hydrogen and methane, among other gases. Biohydrogen gas can be produced from organic matter through electro-hydro-genesis process in a MEC using high strength wastewater. However, in many MECs, the yields obtained have been low due mainly to the high resistance generated by the pair of electrodes. Therefore, a cathode made of a low-cost and very active material is of great importance for generating high biohydrogen production in MECs. In this study, to reduce the internal resistances and obtain high biohydrogen production in a MEC, we have used 304 stainless steel #60 pleated mesh as anode and nickel doped iron (Fe/Ni) as cathode, with a distance between electrodes of 2 cm, using synthetic water, vinasse, cane sugar molasse and human urine as high strength wastewater with 17 mg/L, 21mg/L, 22 mg/L and 20 mg/L as initial Chemical Oxygen Demand (COD) respectively. A voltage applied of 0.8 and electric conductivity of 15.80 mS/cm was tested in the MEC. The maximum electrocatalytic biohydrogen production obtained was 217 $m^3$ of $H_2/m^3_R d$ when vinasse was used, followed by sugar cane molasse with199 of $H_2/m^3_R d$, 166 of $H_2/m^3_R d$ from synthetic water and 14 of $H_2/m^3_R d$ from Human urine. The linear sweep voltammetry, Open circuit potential and Impedance values have showed that the hydrogen evolution reaction in Vinasse was significantly better than sugarcane molasse and human urine.
Keywords: Biofuels, Microbial electrolysis cells, electrodeposited Fe/Ni.

## Biography

Manuel Posadas Hernández is graduated from Regiomontana University in 1986 at Monterrey, Mex. with a bachelor's degree in chemical engineering. He has a masteral degree in water technology and management in 2016 at Autonomous University of San Luis Potosí, Mex. and a doctorate in water sciences and technology in 2023 at Mexican Institute of Water Technology. He was a college and university teacher for several years. Currently he is pursuing a second Doctorate at University of Science and Arts of Chiapas, Mexico.

# PLANT MICROBIAL FUEL CELLS FOR GREEN REMEDIATION, SUSTAINABLE DEVELOPMENT AND NET ZERO EMISSIONS

**Chung-Yu Guan, Jhih-Cian Lin, Yu-Jou Lai, and Jou-Huai Chang**

*National Taiwan University, Taiwan*

## Abstract

People should use green technologies to treat global warming, climate change, environmental pollution, and city climate. Plant microbial fuel cells (PMFCs) is one of the green technologies that contains plants, water, soils, and electrochemical systems for multiple functions, such as energy production, pollution remediation, temperature reduction, and environmental greening. In addition, can process carbon capture, carbon storage, and carbon substitute. PMFCs have several mechanisms in liquid and solid phases to treat pollution. People can apply plant microbial fuel cells in wetlands, soil remediation, groundwater remediation, urban greening, alkali soil treatment, and net zero emissions. In the first scope, people used PMFCs to remediate spiking heavy metal-polluted soils. In the second scope, researchers use wetland plant species in water and sediments with electrochemical systems. They used a datalog to record the output voltage from daytime to nighttime. In the third scope, they applied PMFCs in actual polluted soils and groundwater. In the fourth scope, researchers combined PMFCs with green roofs. They use datalog and microclimate equipment to record data all day. In the fifth scope, researchers apply PMFCs in alkali soil treatment. They used a conductivity meter and gas receiver to sample greenhouse gases. For bioelectrochemical processes, plant uptake, microbial activities, and electrode absorption, PMFCs reduced pollution concentration quickly. The output voltage was increased within 90 days of the operation period because of the rich nutrition in sediments. In PMFCs based on green roofs, plant species affect the output voltage. In addition, these systems can reduce over 20°C of floor slab in hot periods. PMFCs can treat salt problems in soils for plant uptake and electrode absorption. These systems also reduce methane flux in salt soils because they change microbial communities. PMFCs have multiple mechanisms for soil and groundwater remediation. They can be developed in wetlands green roofs, and alkali soils. PMFCs can achieve net zero emissions and green energy production for plant photosynthesis, physiological reactions, environmental remediation, wetland applications, and alkali soil treatment.

## Biography

Chung-Yu Guan is currently Associate Professor in the School of Forestry and Resource Conservation, National Taiwan University. He was an Associate Professor and Assistant Professor in Department of Environmental Engineering at National Ilan University. He was a Visiting Scholar at the Hong Kong Polytechnic University in Hong Kong, Visiting Scholar at Kyushu Institute of Technology in Japan, and postdoctoral fellow at National Taiwan University. Chung-Yu Guan holds PhD from National Taiwan University, Taiwan. He has published over 30 SCI journal papers these five years and serves as Gust Editor of some SCI Journal. His team aspires to develop green technologies for carbon sinks, sustainable remediation, biorefinery, and wetland research.

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# PREPARATION OF $CaO@CeO_2$ SOLID BASE CATALYSTS USED FOR BIODIESEL PRODUCTION

**Wilasinee Kingkam, Jirapa Maisomboon, Khemmanich Khamenkit, Sasikarn Nuchdang, Kewalee Nilgumhang, Sudarat Issarapanacheewin, and Dussadee Rattanaphra**

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## Abstract

As energy sources such as petroleum become more limited and, environmental pollution including ecological damage. There is a greater focus on using low-carbon, eco-friendly, clean, and safe renewable resources. Biodiesel has gained considerable attention due to its renewable, biodegradable, non-toxic properties and its benefits for humans and the environment. The study investigated the use of $CeO_2$ extracted from monazite with calcium oxide (CaO) as a solid catalyst for biodiesel production. The wet impregnation method was used to produce$CaO@CeO_2$ mixed-oxide catalysts with 0–50 wt.% CaO. X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) surface area analysis, thermogravimetric analysis (TGA), and a Fourier transform in-frared spectrometer (FTIR) was used to characterize the catalysts. In order to determine the optimal preparation conditions, the effect of different CaO compositions on the performance of $CaO@CeO_2$ mixed-oxide catalysts was examined. The catalytic activity of the $CaO@CeO_2$ catalyst for the transesterification reaction of palm oil to produce biodiesel was studied. The results show that the optimum yield of biodiesel can reach 97% fatty acid methyl ester over the $30CaO@CeO_2$ catalyst at the reaction conditions of 5 wt.% catalysts, methanol-to-oil molar ratio of 9:1, with a reaction temperature of 65°C within 30 min. The results show that the high catalytic activity and stability of the $CaO@CeO_2$ catalyst make it a promising candidate for industrial-scale biodiesel production. Further study is needed to improve the stability and efficiency of catalysts in transesterification reactions to achieve a high FAME yield using long-life-span catalysts. Moreover, it is necessary to investigate the economic feasibility of this process for application in large-scale biodiesel production.

## Biography

Wilasinee Kingkam is a nuclear scientist who studies materials science and engineering from the Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology (Public Organization). Her responsibilities are to focus on research and development methodology in both materials science and materials via utilization in nuclear processing. Moreover, writes or assists in writing grant proposals and collaborates with senior nuclear scientists including publishing an international research paper. During the past two years, she had several great chances to participate in various research projects that provided knowledge and laboratory skill set that will be useful as a science researcher. The first year, she had to do research on biofuel production projects and studied the effect of rare earth elements, for example, Mixed rare earth oxide, $La_2O_3$, $Ce_2O_3$, $Nd_2O_3$ compound on to various support materials as a catalyst in biodiesel production with a published research paper in Scopus index and the other research paper not related to biodiesel production. Now, she has been responsible as a project leader for 4 projects underfunded by Thailand's Science Research and Innovation budget as following.

1. Study on natural radioelements concentration in chemical fertilizer and cultivated soil for health and environmental impact assessment.
2. Enhancing of the output performance for flexible triboelectric nanogenerators with rare-earth complex-oxide dielectric materials and using radiation process.
3. Development of absorbent for heavy metal and radioactive materials liquid waste treatment from diatomite using radiation process.
4. Design and prototype development of atmospheric pressure plasma for dust and fume collector.

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# ENHANCED ANAEROBIC CO-DIGESTION OF CATTLE MANURE WITH FOOD WASTE AND PIG MANURE: STATISTICAL OPTIMIZATION OF PRETREATMENT CONDITION AND SUBSTRATE MIXTURE RATIO

**Sangyeol Jo, Rahul Kadam, Jonghwa Lee, Hangbae Jun, and Jungyu Park**

*Chosun University, Republic of Korea*

## Abstract

This study investigated the optimal pretreatment condition and mixture ratio of cattle manure (CM) for its efficient anaerobic co-digestion (AcoD) with food waste (FW) and pig manure (PM). The pretreatment performances of thermal (TM), microwave (MW), and ultrasound (US) technologies and the AcoD performance were statistically and experimentally evaluated at various mixture ratios of CM, FW, and PM. The results revealed that the most effective pretreatment condition with the TM, MW, and US pretreatments was 129.3°C for 49.6 min, 824.2 W for 7.3 min, and 418.0 W for 36.3 min, respectively. The best AcoD performance of optimally pretreated CM (PCM) was achieved when 30.5% PCM was mixed with 42.5% FW and 27.0% PM. A long-term evaluation showed that the start-up rate for the anaerobic mono-digestion of PCM was 2.3 times faster than that of CM and the amount of methane produced was 4.7 times higher; process stability was thus preferentially maintained under a higher organic loading rate (OLR) (2.0 kg-VS/$m^3$·d). The start-up rate for the AcoD of PCM with FW and PM was 1.2 times higher than that of the AcoD of CM with FW and PM. Although the performance gap between the AcoD reactors after steady state was not significantly different, the PCM AcoD reactor provided a more stable operation under a higher OLR (5.0 kg-VS/$m^3$·d). This study demonstrates that the pretreatment and co-digestion of CM could significantly enhance the production of biogas and improve process stability.

## Biography

Sangyeol Jo has completed his M.S at the age of 27 years from Chungbuk national University, Republic of Korea. He is the Ph.D of Chosun University, Republic of Korea. He has over 10 publications that have been cited over 49 times, and his publication H-index is 3.

# *Day-1*
# *Poster Presentation*

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# PHYSICOCHEMICAL PROPERTIES OF BIOCHARS MADE FROM DIFFERENT FEEDSTOCKS AND THEIR BIOGAS PRODUCTION PERFORMANCES

**Saerom Park[1], Young-Hoo Kim[1], Ji Eun Kim[2], Gwangnam Kang[2] and Yong-Keun Choi[1]**

*[1]Choilab Inc., South Korea*
*[2]ATE Corporation, South Korea*

## Abstract

**Background:** The fossil fuels such as oil, coal are still dominated as the energy source around the world. To solve the various problems by utilization of it, the anaerobic digestion (AD) system is one of the promising technologies because the organic waste can be treated and biogas can be produced. In particular, the methane in the produced biogas can be an excellent source due to the high caloric value (over 21 $MJ/m^3$) for the replacement of fossil fuels and electric generation.

**Objective:** To evaluate the association between the different feedstocks-derived biochar and biogas production in AD system.

**Methods:** The used biochars in this experiment were produced from different feedstocks (i.e., sewage sludge, coffee residues, rice husk, microalgae, grasses, fallen leaves) at 550℃ for 2 hours using pyrolysis. The produced biochars were analyzed for their physicochemical properties including carbon contents, elemental compositions, pHpzc, and BET surface area. In addition, the biogas performances (i.e., methane production) were evaluated in AD system with the additives (biochar).

**Results:** The rice husk, grasses, and fallen leaves-derived biochar possessed larger BET surface area (>100 $m^2/g$), although the carbon contents of most biochar showed over 50%. In contrast, the microalgae and sewage sludge-derived biochar had the higher minerals (e.g., N, P, K, Ca, Fe, and Si) contents, while the lower BET surface area. Compared to the methane production yield in AD system without biochar, it in AD system with the microalgae and sewage sludge-derived biochars increased (c.a., 10%).

**Conclusion:** There are various mechanisms such as the electron transfer, buffering, microorganisms, and pollutants adsorption in AD system with biochar, according to the previous literatures. The physicochemical properties of biochar made from the different feedstocks affect the methane production yield. In particular, the mineral contents can be one of the major parameters for the increase of biogas production. The waste biomasses-derived biochar can be promising and potential agent.

## Biography

**Yong-Keun Choi** is currently CEO of Choilab InC. and Adjunct professor at Konkuk University in Republic of Korea. He received PhD in the field of biotechnology and worked at Texas A&M AgriLife Research Center in US. His primary research areas of interest include the applications (e.g., pollutants adsorption in aqueous solution) of biochar, biogas (i.e., methane) production in AD system, microalgae cultivation (e.g., wastewater treatment and biodiesel production), air purification (e.g., particulate matters) by plants, and microorganism fermentation (e.g., cosmetic ingredients and wine production).

**Saerom Park** is currently a senior research engineer at Choilab InC. in Republic of Korea. She received PhD in the field of biotechnology from Konkuk University in Republic of Korea. Her primary research areas of interest include the applications of biomass and biopolymers. She works in biogas production using biomass-derived biochars.

# *Day-2*
# *Keynote Presentations*

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# OPTIMIZATION OF HYDROTHERMAL VALORIZATION OF COFFEE CHERRY: ANALYSIS OF THE IMPACT OF BIOMASS/WATER RATIO, PARTICLE SIZE, STIRRING, AND CATALYSTS ON CHEMICAL PLATFORMS AND BIOCHAR PRODUCTION

**Carlos Alberto Guerrero Fajardo, and Alejandra Sophia Lozano Perez**

*Universidad Nacional de Colombia, Colombia*

## Abstract

The valorization of coffee waste was explored through the production of biochar, with a focus on analyzing the impact of stirring, B/W ratio, particle size, and catalysts. Notably, the smaller B/W ratios of 1:20 and 1:40, as well as smaller particle sizes of 0.5 and 1 mm, yielded the highest results, while stirring showed minimal influence on yield. Catalysts, particularly $CH_3COOH$, significantly enhanced the yield, surpassing 100%, with $NaHCO_3$ also showing slight improvements. The resulting biochar was characterized as anthracite, with little variation in physicochemical properties due to stirring, B/W ratio, and particle size, while catalysts induced functionalization and altered the product's hardness. This study sheds light on the pressing issue of coffee cherry waste management by demonstrating the potential for valorization through biochar production. By optimizing factors like B/W ratio, particle size, and catalyst application, valuable insights have been gained into enhancing the yield and quality of biochar from coffee waste. The findings not only contribute to sustainable waste management practices but also highlight the importance of exploring innovative solutions for utilizing agricultural by-products effectively.

## Biography

Carlos A. Guerrero-Fajardo has a PhD in Chemical Engineering, Heterogeneous Catalysis Area, from Universidad Nacional de Colombia (2007) and a PhD in Chemistry, heterogeneous Catalysis Area, from Université Louis Pasteur (Strasbourg France). He focuses his research on special materials for improving methane selective oxidation. Additionally, he has 45 years of experience as a Chemistry Professor in Organic, Industrial, and Environmental Chemistry areas at Universidad Nacional de Colombia. Good performance in heterogeneous catalysis research, design of catalysts in methane selective oxidation to formaldehyde, research in the sol-gel method to get high metallic dispersion, and research in catalysts for syngas conversion to fuel products from biomass gasification. Process and product design for improving technologies related to natural resource conversion toward energetic products. Finally, he directed approximately 100 projects for different companies related to the management of renewable and non-renewable natural resources, and has a total of 55 publications and 390 citations.

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# INDUSTRIAL SCALE BIODIESEL PRODUCTION FROM WASTE COOKING OIL USING HYDRODYNAMIC CAVITATION

**Surendra Singh Kachhwaha, Nirav Prajapati, Pravin Kodgire, and Rakesh Kumar Vij**

*Pandit Deendayal Energy University, India*

## Abstract

**Background:** Biodiesel is an excellent alternative to petro-based diesel fuel which is renewable, biodegradable, reduce hazardous emissions and environmentally friendly fuel derived from the transesterification reaction between oil feedstock and alcohol in presence of a catalyst.

**Objective:** The present study reports the experimental investigation to produce biodiesel from non-edible oils at industrial scale (100 L/batch capacity) using hydrodynamic cavitation (HC) based intensification technique.

**Methods:** The HC based innovative biodiesel production pilot plant of 100 L/batch capacity has been designed and developed for production of biodiesel using waste cooking oil (WCO). Multi-hole orifice is used to generate cavitation conditions to intensify the transesterification reaction. The operating parameters are methanol to oil molar ratio 6:1, catalyst loading 1 wt%, reaction time 60 min, orifice inlet pressure 3 bar (cavitation number equal to 0.738) and reaction temperature of 60°C. The experiment was repeated using ethanol.

**Results:** The biodiesel yield achieved were 96.93 % and 96.54 % using methanol and ethanol, respectively. The yield efficiency (biodiesel produced per unit electricity consumed) were found to be 0.00103 g/J and 0.000852 g/J using methanol and ethanol, respectively. The cavitational yield (moles of biodiesel produced upon the energy required in the reaction) were found to be 0.000481 moles·L/J and 0.000288 moles·L/J using methanol and ethanol, respectively.

**Conclusion:** The results show that existing HC pilot plant gives 6-8 times higher yield efficiency compare to the conventional technique. The hydrodynamic cavitation technique is energy-efficient, environment-friendly, time-efficient, and cost-efficient for biodiesel production from varieties of feedstock at an industrial/pilot scale. The physicochemical properties of produced biodiesel matches with the ASTM and EN standards.

## Biography

Surendra Singh Kachhwaha is Professor in Department of Mechanical Engineering at School of Technology, Pandit Deendayal Energy University in Gandhinagar since 2011 and founder member of Center for biofuels and Bioenergy Studies (Centre of Excellence). He received his B.E. in mechanical engineering from University of Jodhpur and his M.Tech. and Ph.D. in mechanical engineering from Indian Institute of Technology, Varanasi and Delhi respectively. Professor Kachhwaha is known for his contributions to teaching and research in the fields of thermal engineering, wind and bioenergy and has been the recipient of "Chair Professor Suzlon" fellow from 2018-2023. He has conducted various skill development programmes for UG and PG students.

# *Day-2*
# *Oral Presentations*

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# MODELING OF AN OXYFUEL COMBUSTION OF SEWAGE SLUDGE WITH SUBSEQUENT $CO_2$ UTILIZATION IN A P2X PROCESS

## Szymon Herdzik

*Technical University of Munich, Germany*

## Abstract

**Background:** Carbon-containing eFuels can be produced sustainably via P2X processes, with water electrolysis being a crucial future technology. Unlike hydrogen, which already has a wide range of applications, the use of $O_2$ has been scarcely considered. Utilizing oxygen for the efficient production of $CO_2$ from biomass presents a potential application pathway. This pathway will be investigated by producing $CO_2$ through the oxyfuel combustion of sewage sludge.

**Objective:** To simulate the oxyfuel combustion of sewage sludge in order to produce a suitable $CO_2$ stream for further processing into eFuels.

**Methods:** A simulation software (Aspen Plus) is used to model a combination of a combustion plant and a P2X process. The methanol production using carbon dioxide and hydrogen is analyzed as an exemplary P2X process. The oxygen for the $O_2$-enriched combustion and the hydrogen for the chemical synthesis come from water electrolysis. A sensitivity analysis is carried out to investigate the effects of the oxygen/air ratio and the recirculation rate of flue gas into the combustion on the composition of the combustion gas and subsequent methanol production.

**Results:** The dependence of the $CO_2$ concentration on the oxygen/air ratio and the oxygen mass flow could be determined by simulation. With complete oxyfuel combustion, a concentration of 83% $CO_2$ is achieved in the combustion gas. The gas still contains 11% water and less than 1% oxygen. With a recirculation rate of 65% of the exhaust gas back into the combustion process, a minimum oxygen content of less than 1% is achieved.

**Conclusion:** The simulation shows that a concentrated $CO_2$ stream can be achieved through oxyfuel combustion, which could be used for subsequent conversion into methanol. A further examination of $CO_2$ purification and a comparison with experimental results should lead to a better assessment of the simulation results.

## Biography

Szymon Herdzik studied mechanical and process engineering at RWTH Aachen University. After graduating, he began working as a research assistant at the Professorship of Regenerative Energy Systems at the Technical University of Munich. His research focuses on the material and energetic utilization of sewage sludge. In his last project, he investigated the effects of hydrothermal carbonization on the composition of sewage sludge and the change in its properties as a fuel. In his current project, he is investigating the oxyfuel combustion of sewage sludge and the subsequent conversion of the resulting $CO_2$ into methanol using hydrogen from water electrolysis.

# ECODIESEL

**Praven Allopi**

*University KZN-Westville campus, South Africa*

## Abstract

**Background:** The world recognizes that fossil fuel is a finite resource and not sustainable, with its continuous use impacting heavily on the environment as well. The drive for sustainable alternative fuels that can meet growing energy needs and decrease global warming has seen ongoing research and development in the biofuels sector. While biofuels are seen as effective, it has not been without its drawbacks.

**Objective:** To produce a cost-effective superior diesel from plant oils and fats or any oil/fat from biological origin (including used cooking oil) so as to combat the effects of global warming and meet growing energy needs in a cost effective, sustainable manner.

**Method:** Plant based oil in different ratios is reacted with some catalysts and/or fossil diesel to produce a superior diesel (EcoDiesel.)

**Results:** Production of a superior biofuel, Eco-diesel with the following advantages as opposed to biodiesel:

- Lightning-fast process to manufacture as opposed to biodiesel
- No irritating titration of oils which differs from batch to batch in biodiesel
- No loss of a batch and doesn't need a batch wise process
- No soap formation and glycerine issues, hence no clogging of diesel filters
- No water rinsing and expensive resin columns or even centrifuging required
- Readily can be blended with fossil diesel in any ratio
- Extremely safe process as no dangerous catalysts like methanol and caustic soda are required
- Superior density ranging from 0.825 to 0.840 as opposed to 0.87 for biodiesel
- Extremely clean burning (no white smoke or black smoke, so almost maximum burn)
- If we run out of fossil diesel this can be used 100 % as environmentally friendly diesel
- Close to carbon neutral and can be modified to be 100 % carbon neutral
- Close to zero sulphur
- The density around 20°C ranges between 825 to 845, but the average is around 827
- Viscosity at 40°C is around 2.9 cst
- Flashpoint is between 40° and 50°C

**Conclusion:** The Eco-diesel has been working quite well in tests since last year December, having been tested at grassroots on a number of vehicles. It has proven to be more economical and gives improved mileage. It can have close to zero sulphur and when used without fossil diesel as it approaches zero sulphur, so improved engine lifespan. No black or white smoke emissions i.e. extremely clean burning. It's also cheaper to produce and much faster and easier to manufacture as opposed to other types of diesel. It has numerous advantages over biodiesel. The process is extremely safe. All Fuel can be grown, increasing oxygen levels and prolonging the planets life. From a safety aspect, it's also very safe as no

harsh and explosive chemicals. Colour of ecodiesel will vary from amber/orange to yellow. Feedstock of veg oil determines colour.

## Biography

Praven Allopi pursued a Bachelor of Science degree in Chemistry, Biochemistry, and Microbiology at UKZN- Westville campus. His academic journey laid a strong foundation for his future endeavors in the field of chemistry and beyond. In October 1997, Praven joined Eskom's Tutuka Power Station as a Section Chemist. He managed the laboratory, overseeing the analysis of coal, water, and oil. His role was crucial in ensuring the quality and efficiency of the power station's operations. While working at Eskom, Praven demonstrated his commitment to continuous learning by completing a Human Resources Management program through UNISA. He furthered his education by obtaining a National Diploma in IT from the University of KwaZulu-Natal (UKZN), where he was honored with the Vice Chancellor's Award for two consecutive years. In 2004, Praven began researching biodiesel, which led to the establishment of his biofuel company in 2007. The company focused on collecting and trading used cooking oil and converting it into biodiesel. This initiative not only promoted sustainable energy but also addressed environmental concerns related to waste oil disposal. Praven's innovative spirit extended to the health sector, where he became involved in cannabis oil extraction for pain relief and the treatment of burns and cancer. One of his notable achievements was the removal of sulfur from a high-sulfur oil/solvent, showcasing his problem-solving skills and dedication to improving product quality. Today, Praven Allopi is the Director of Saiber Energy. Under his leadership, the company produces a superior turbo diesel that is 100% environmentally friendly, reflecting his ongoing commitment to sustainable and innovative energy solutions. Praven Allopi's journey is a testament to his dedication to education, innovation, and sustainability. His contributions to the fields of chemistry, biofuels, and health have made a significant impact, and his work continues to inspire those around him.

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# MAGNETITE ADDITION REDUCES NITRITE REQUIREMENT FOR EFFICIENT ANAEROBIC AMMONIUM OXIDATION BY FACILITATING MUTUALISM OF ANAMMOX AND FEAMMOX BACTERIA

**Rahul Kadam, Sangyeol Jo, Heewon Jang, Dongyun Seo and Jungyu Park**

*Chosun University, South Korea*

## Abstract

Partial nitrification (PN) is crucial for anaerobic ammonium oxidation (ANAMMOX) but is impeded by high-energy consumption issues tied to the precise control of reactions. Additives such as magnetite offer an alternative to traditional electron acceptors ($O_2$ and $NO_2^-$) and circumvent the bottlenecks of PN/ANAMMOX by integrating ANAMMOX and ANAMMOX coupled to Fe (III) reduction (FEAMMOX) reactions, thus improving nitrogen (N) removal efficiency. We found that the addition of 50 mg/L of magnetite enhanced N removal efficiency. Specifically, the magnetite-supplemented ANAMMOX (M-ANA) reactor achieved 71%, 66% and 57% N removal for $NH_4^+$:$NO_2^-$ molar ratios of 1:1.3, 1:0.8, and 1:0.5, respectively. Even under lower $NO_2$ concentrations, the M-ANA reactor matched performance of the control ANAMMOX (C-ANA) reactor. Notably, the M-ANA reactor showed potential for ammonium removal (56%) without any $NO_2^-$ supplementation. Magnetite addition boosted the abundance of microorganisms involved in FEAMMOX reaction and facilitated positive mutualism between ANAMMOX and FEAMMOX reactions. Heme C concentration and specific microbial activity in the M-ANA reactor were 1.3 and 2.2 times higher than in the C-ANA reactor. These findings could shape how carbon- and energy-neutral N removal processes could be attained in the future.

## Biography

Rahul Kadam has completed his M.S from Maharana Pratap University, India. He is the Ph.D. of Chosun University, Republic of Korea. He has over 10 publications that have been cited over 47 times, and his publication H-index is 4.

# EXPERIMENTAL AND NUMERICAL STUDY OF BIOMASS FUELS REFORMING WITH A FAST START-UP REACTOR USING PT/AL2O3 MONOLITHIC PLATE CATALYST

**Xiaoyi Ding, Chenyan Mao and Xiongli Wang**

*Xi'an University of Technology, China*

## Abstract

The conversion of biomass fuel into hydrogen-rich gas is essential for operation of fuel cells. This paper presents an experimental and numerical study on reforming characteristics of biomass fuels (biogas, methanol) and pure methane. A Pt/Al2O3 monolithic plate catalyst based on aluminum alloy was developed, with macro morphology two samples using coating (CAT1) and hot pressing (CAT-2) methods applied. The reaction activity and thermal stability of the catalysts under the two adhesion processes were compared. After reacting at 873-923 K for 10 hours, there was obvious shedding on the surface of CAT-1, while there was no crack or shedding on the surface of CAT 2. The CAT-2 catalyst maintained excellent thermal stability at 1073 K. Meanwhile, the hydrogen production from biogas reforming has stricter limit of reforming parameters, and the area with higher H2 composition is narrower. Compared with the first two fuels, methanol can achieve higher H2 composition at lower temperature. When temperature exceeds 800 K and the S/C is lower than 1.5, it is favorable for the generation of high concentration H2. and the error between experimental and simulating H2 composition at equilibrium state is within 3%. Equipped in a transparent cylindered reactor, the surface temperature of CAT-2 catalyst could increase by 100K within 60s, providing a fast-start up performance for operation of fuel cells.

## Biography

Xiaoyi Ding has completed his Ph.D. in 2021 at Shanghai Jiao Tong University and Received a Visiting PHD in 2020 from the University of Edinburgh. He has an experience as an engineer from BYD otto company, Dr. Ding now works in Xi'an University of Technology as a Lecturer and focuses on advanced renewable energy system. His studies include: fuel cell system utilizing green-powered fuel, evaluation of multi-energy system, power to gas, degradation prediction of lithium battery, etc.

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# ACCELERATING THE ENERGY TRANSITION: POLICY AND REGULATORY FRAMEWORKS FOR SUSTAINABLE ENERGY SYSTEMS

**Mohsen Alamooti[1], Moones Alamooti[2] and Olusegun Stanley Tomomewo[2]**

*[1]Middle East Mines Industries Development Holding Company, Iran*
*[2]University of North Dakota, USA*

## Abstract

**Background:** The global energy sector is transitioning from fossil fuels to sustainable alternatives, driven by climate change concerns and energy security needs. Progress varies widely between regions due to differing policy frameworks. Many countries face challenges balancing environmental goals with economic and social considerations in implementing effective sustainable energy policies.

**Objective:** To examine the association between policy and regulatory frameworks and the rate of adoption of sustainable energy systems across different countries, and to identify best practices in policy design that effectively accelerate the energy transition.

**Methods:** Data were drawn from the International Energy Agency's World Energy Outlook 2023, the Regulatory Indicators for Sustainable Energy (RISE) database, and national energy policy documents. A sample of 50 countries, representing diverse economic and geographical contexts, was selected. The study analyzed data on renewable energy adoption rates, energy efficiency improvements, and policy indicators over the period 2010-2023. Data were analyzed using a mixed-methods approach, combining quantitative regression analysis with qualitative case studies and expert interviews.

**Results:** The study found strong links between effective policy frameworks and faster adoption of sustainable energy. Key elements included clear renewable targets, supportive regulations for efficiency, and policies for storage and grid upgrades. Countries with comprehensive policies showed 15% higher renewable adoption and 12% better efficiency improvements. Specific effective mechanisms included feed-in tariffs, renewable portfolio standards, and carbon pricing, especially when part of a coherent long-term strategy.

**Conclusion:** The energy transition rate varies widely between countries, largely due to policy differences. Accelerating this shift requires adopting policy best practices, and focusing on stable, adaptable long-term frameworks. Key areas include clear renewable targets, efficiency regulations, and grid modernization support. Future research should develop context-specific policy recommendations for a fair and effective global transition, considering unique regional challenges and opportunities.

## Biography

Mohsen Alamooti has expertise in project management and a passion for improving industrial processes and performance. His analytical and goal-oriented approach creates new pathways for enhancing efficiency in mining, steel making, and oil and gas sectors. He has built his skillset after years of experience in resource management, program and portfolio management, and creative problem-solving across various industries. His foundation is based on a bachelor's degree in Chemical Engineering Sciences with an emphasis on Chemical Processes, which provides a strong technical background for his work. This approach is responsive to complex industrial challenges and offers innovative solutions. Alamooti's focus on human creativity and performance allows him to effectively manage teams and drive projects to successful completion.

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# EXPERIMENTAL AND MODELING INVESTIGATION OF BIO-OIL AND WASTE COOKING OIL CO-PROCESSING FOR AVIATION FUELS

**Melba Domes Denson, Mariefel Olarte, Manuel Garcia-Perez, and Jean-Sabin McEwen**

*Central Luzon State University, Philippines*

## Abstract

**Background:** The worldwide issues of decreasing fossil fuels, expensive gas prices, and environmental concerns significantly motivate the search for an alternative fuel reserve. Bio-oil derived from biomass is a promising source but cannot be directly used as a 'drop-in' transportation fuel and therefore the need to upgrade. Catalytic hydrotreatment is one method to refine bio-oil and the pre-sulfided Ni-$Mo_xS_y$/$\gamma$-$Al_2O_3$ catalyst has been widely used for hydrodeoxygenation (HDO). Various experimental works have been done on the HDO of bio-oil considering light compounds and other catalysts, but still, the reaction pathways could hardly be understood especially for the highly active bio-oil compounds which are reported to cause catalyst deactivation during upgrading.

**Objective:** To investigate the reaction mechanisms happening during the hydrodeoxygenation of bio-oil to produce sustainable aviation fuel – range hydrocarbons.

**Methods:** In this work, the Density Functional Theory method (DFT) was employed to investigate the adsorption behavior and hydrodeoxygenation reaction pathway of the highly reactive bio-oil compounds over an unsupported $MoS_2$ catalyst. The experimental work utilized a batch type Parr reactor to hydrogenate the heavy bio-oil fraction co-processed with waste cooking oil. The resulting hydrocarbons were analyzed accordingly, and results showed that most of the feedstocks were converted to hydrocarbons conforming to ASTM standards specifically for aviation fuel.

**Results:** The identified carbon species of the resulting hydrocarbons consist of n-paraffin, iso-paraffin, cycloparaffin, and aromatics. Characteristics of the hydrocarbon range products in terms of density, viscosity, and surface tension conform to the ASTM standards for jet fuels. On one hand, modeling results showed that hydrogenation and hydrolysis were the main reactions occurring during the HDO of the highly reactive bio-oil compounds.

**Conclusion:** Bio-oil can be upgraded by co-hydrotreating it with waste cooking oil to produce aviation fuels. The result of this study will contribute towards the understanding of bio-oil refining. The modeling work can also pave ways to further investigate other bio-oil compounds such as the heavy oligomers which are reported to cause coke formation during hydrotreatment, and other reaction mechanisms such as polymerization.

## Biography

Melba Domes Denson has her expertise in bioenergy and bioproducts engineering. Specifically, she had work experiences in the hydrotreatment of bio-oil co-processed with waste cooking oil to produce aviation fuels, bio-oil fractionation, computational modeling to investigate the reaction mechanisms of biomass pyrolysis and hydrotreatment reactions, bio-oil characterization, among others. She is currently affiliated to Central Luzon State University, a prestigious institution of higher learning in the Philippines, with primary roles in teaching (both graduate and undergraduate students), and research and development. She is actively engaged in a project that aims to assess potential feedstocks for SAF in the Philippines under the UN-ICAO's CORSIA sustainability criteria.

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# EXPERIMENTAL INVESTIGATION ON THE PERFORMANCE AND EXHAUST EMISSION OF A DIRECT INJECTION DIESEL ENGINE RUNNING ON FUEL ADDITIVES WITH VARIABLE LOADS

**Faisal Mahroogi[1], Mahmoud Bady[1] and Muhammad Usman Kaisan[2]**

*[1]Islamic University of Madinah, Saudi Arabia*
*[2]Ahmadu Bello University, Nigeria*

## Abstract

The Kingdom of Saudi Arabia is dedicated to sustainable development and clean energy. It uses cutting-edge approaches to address energy-related issues, including the circular carbon economy and a more varied energy mix. For Saudi Arabia to achieve its Vision 2030 goal of having a net zero future by 2060, sustainability is essential. By addressing the energy and climate issues of the modern world with responsibility and innovation, Vision 2030 is turning into a global role model for the transition to a sustainable future. As per the Ambitions of the National Environment Strategy of the Saudi Ministry of Environment, Agriculture, and Water (MEWA), raising environmental compliance across all sectors and reducing pollution and adverse environmental impacts are critical focus areas. As a result, the current study presents an experimental analysis of a diesel engine's performance and exhaust emissions mainly running on waste cooking oil (WCO). The engine type utilized is a one-cylinder direct injection diesel engine with constant speed and natural aspiration. The research was done on the engine's performance and emission parameters when fueled with a mixture of 5% butanol, 85% diesel, 5% WCO, and 5% diethyl ether (D85B5W5DD5). The study's findings demonstrated that engine emissions of nitrogen oxides (NOx) and carbon monoxide (CO) varied significantly depending on the applied load. The brake thermal efficiency, cylinder pressure, and engine brake power were all impacted by load change.

## Biography

Faisal O. Mahroogi is an associate professor at the Mechanical Engineering Department of the Islamic University of Madinah Faculty. He has a Ph.D. from the University of Michigan Ann Arbor, USA. His research interests include alternative fuels, ICE emissions, and automotive technology. He has published more than 17 papers on the topics mentioned above. Now, he is a consultant for senior design projects in the Mechanical Engineering department at the Faculty of Engineering at the Islamic University of Medina. Besides the research, his main concern is improving students' automotive skills by teaching them how to build FSAE cars with high-quality prototypes to compete with universities worldwide. In addition, Dr. Faisal is managing creative projects made by the students in the second year of engineering college to build their minds in all directions and improve the innovation of their personalities as engineers.

# *Day-2*
# *Video Presentations*

# INFLUENCE OF FAME RAW MATERIALS ON ITS AGING PROCESS

**Paweł Grabowski, Angelika Szwarczyńska and Aneta Nowakowska**
*Warsaw University of Technology, Poland*

## Abstract

**Background:** Fatty acid methyl esters (FAMEs) are used as a stand-alone biofuel or as a biocomponent for diesel fuel. Unfortunately, FAMEs are characterized by relatively poor resistance to oxidation processes, the consequence of which is very often an increase in acid number and viscosity, which is due to the formation of free fatty acids and secondary oxidation products such as dimers or polymers. The purpose of this study was to investigate the effect of the type of oil used for transesterification on the aging process. Increased temperature was used to accelerate aging.

**Objective:** FAME from refined and unrefined rapeseed oil and after-frying oil (UCO) were used for the study.

**Methods:** Transesterification of these oils was carried out under laboratory conditions. Samples of the obtained FAMEs were aged at temperatures of: 80, 100, 120, 140 and 160°C for periods of: 4, 8, 12, 16 and 20 hours. Acid, peroxide and anisidine numbers were determined for each sample, and IR spectra were collected.

**Results:** Based on the results from IR spectra and acid, peroxide and anisidine number, it was found that more and more FAME degradation products were formed as the temperature and residence time of the samples increased. The greatest degradation was observed for FAME from unrefined oil and frying oil. FAME from refined oil showed some degree of oxidation resistance up to about 120°C. The result of the analyses was influenced by the presence of carotenoid pigments, which are natural antioxidants.

**Conclusion:** The least resistant to aging was FAME obtained from frying oil and refined oil. Fuel blends with these biocomponents should be further enriched with additives to improve this parameter. The work was financed from the funds of the budget of the City of Plock, in connection with the Competition of the Mayor of the City of Plock for the financing of research grants implemented under the task “Co-operation with universities”.

## Biography

Paweł Grabowski has completed his PhD in the year 2012 at the age of 29 years from Faculty of Chemistry at the Lodz University of Technology. Since 2014, he has been working at the Institute of Chemistry of the Warsaw University of Technology in the Department of Organic Chemistry and Technology, currently as an assistant professor. He has published more than 10 papers in reputed journals. Specialization - production of biodiesel, modification of biodiesel with the use of ionizing radiation, the use of ultrasounds in the production of biodiesel, catalysts in transesterification.

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# INFLUENCE OF FACTORS ON THE OXIDATIVE STABILITY OF FUELS OBTAINED IN THERMOLYSIS OF WASTE PLASTICS

**Oliwia Liberek, Jakub Dąbrowski and Paweł Grabowski**

*Warsaw University of Technology, Poland*

## Abstract

**Background:** The increased importance of plastics in every field of industry has led to an increase in their production. The improper management of used plastics and the production of disposable packaging has resulted in an increase in the mass of waste, which effectively degrades the environment and is a threat to living organisms. By using effective recycling of waste plastics, a certain mass of them can be allocated to the production of compression ignition engine fuels through the use of the pyrolysis process.

**Objective:** To examine the influence of factors (access to sunlight, temperature, the presence of metal ions and time) on the oxidative stability of fuels obtained from pyrolysis of waste plastics.

**Methods:** The obtained results of bromine, peroxide, anisidine and acid numbers as well as kinematic viscosity at 40°C were compared to determine the direction of changes, occurring as a result of oxidation, in the samples.

**Results:** Access to light is a factor initiating oxidation reactions, the presence of metal ions catalyzes oligomerization reactions, and the action of elevated temperature significantly accelerates the formation of oxygen compounds, contributing to the loss of oxidation stability of the oil.

**Conclusion:** The use of non-standard methods for testing oxidation stability allows to understand the mechanism of oxidation processes. The obtained results confirm the possibility of using fractions from the thermolysis of waste plastics as fuel components. However, these fractions might require hydrogenation to reduce the influence of external factors on their oxidation and therefore improve their stability.

## Biography

Oliwia Liberek, M. Sc., eng., graduated in Chemical Technology from the Faculty of Civil Engineering, Mechanics and Petrochemistry of the Warsaw University of Technology, Branch Płock, in 2019. Since 2020, she has been working at the Department of Organic Chemistry and Technology of the Institute of Chemistry, Warsaw University of Technology in Płock. Her research interests include biofuels and fuels from waste materials, mainly fractions obtained in pyrolysis of waste plastics. In particular her researches are focused on the oxidative stability of fuels.

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# BIOTRANSFORMATION OF AROMATIC BIOMASS WASTE INTO BIOFUEL USING OLEAGINOUS YEAST

**Shivani Chaturvedi[1,2], Prasanta Kumar Rout[1] and Sunil Kumar Khare[2]**

*[1]CSIR-Central Institute of Medicinal and Aromatic Plants, India*
*[2]Indian Institute of Technology, India*

## Abstract

The growing energy demand has emphasized the need for environmentally friendly renewable and sustainable alternatives. India has submitted its 'Intended Nationally Determined Contribution' (INDC) to the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). To meet these commitments, it is essential to explore potential solutions for reducing reliance on traditional fossil fuels, such as producing biofuels derived from non-food oil crops, agricultural wastes, and by-products from aromatic or medicinal plant processing in industries. These raw materials can be recycled through microbiological processes, aligning with the principles of the circular economy. In a recent study, four fungi and four oleaginous yeasts were utilized to demonstrate the effectiveness of this approach. Distilled biomasses from various aromatic crops (lemongrass, mentha, citronella, geranium, ocimum, palmarosa) were used for microbial growth and lipid production, and their properties were characterized. The results showed that lemongrass, citronella, ocimum, and Palmarosa exhibited significant lipid accumulation compared to other distilled biomasses. Furthermore, the major fatty acids produced by certain microorganisms in the presence of mentha, citronella, and ocimum were oleic, linoleic, linolenic, and lignoceric acid. The bio-oil obtained from one of the microorganisms (R. mucilaginosa) was further transformed into biodiesel and met the EN 14214 and ASTM D6751 standards. This process not only valorizes waste but also provides additional income for farmers, contributes to waste reduction, and supports the movement for a cleaner environment.

## Biography

Shivani Chaturvedi is currently a post-doctoral fellow affiliated with the Department of Science and Technology at the Indian Institute of Technology Delhi, India. With over twenty-three years of dedicated research experience, she has contributions in the fields of nutrition, biomass biology, and enzyme & microbial biochemistry. She obtained her Doctoral degree in Chemistry from Kumaon University in collaboration with the Defense Research and Development Organisation in Pithoragarh, India in 2000 marking a start to her academic journey. Her career also includes over eight years of teaching at both Graduate and Post Graduate levels, coupled with impactful roles at renowned institutions such as the National Botanical Research Institute, Lucknow, and the Indian Institute of Technology Delhi from 2001 to 2017. Since 2015, she has been a pivotal contributor to the UGC-funded ePG Pathshala project, focusing on Biochemistry being implemented by IIT Delhi. She has published many research papers and book chapters in International & National Journals of repute. She was awarded "Bioved Mahila Gaurav Samman" in 2013; "Vigyan Parishad Pryag Shatabdi Samaan" in 2013 and "Young Scientist Associate Award" at the 10th Indian Agricultural Scientists and Farmers Congress held in 2008. Beyond her research pursuits, Dr. Chaturvedi serves as a reviewer for several international journals and has made significant contributions to various international books. She is also an accomplished author, having penned four books that highlight her passion for scientific and literary expression alike.

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# WASTEWATER MANAGEMENT AND PUBLIC HEALTH RISKS, PROMPTING ALGAE-BASED TREATMENT SYSTEMS

**Chaturvedi Sangeeta**

*Dr. B.R. Ambedkar University Agra, India*

## Abstract

This study investigates the current state of wastewater management, a pressing concern arising from the rapid growth of urbanization and industrialization, which has led to a significant increase in wastewater production. The research underscores the advantages of effective wastewater management, including enhanced soil quality, improved plant nutrient levels, and reduced diversion of freshwater resources for irrigation. Nevertheless, it also acknowledges the concurrent environmental, social, and human impacts associated with wastewater management. This study provides a comprehensive examination of these issues and proposes future research directions to address the complexities and challenges inherent in wastewater management.

**Objective:** Microalgae play a crucial role in wastewater management by treating pollutants and contaminants from wastewater. This research aims to utilize microalgae to remove nitrogen, phosphorus, and heavy metals from wastewater, making it safer to reuse and keeping them restricted to discharge into the environment. This research motivates the recycling and reusing of water, highlighting that it can reduce treatment costs and conserve energy, making it a cost-effective option for municipalities. Additionally, efforts have to be made to recycle and reuse water for food production as agriculture requires significant amounts of clean water to irrigate. Another approach is to recycle and reuse over 40% of treated wastewater, and public education campaigns to promote water conservation. Some communication methods have been developed to spread the importance of investing in infrastructure.

**Methods:** The use of algal systems for wastewater treatment offers a promising solution for sustainable and cost-effective water management. By combining algae-based treatment with renewable energy sources, such as solar or wind power, we can create a truly circular and regenerative system that benefits both the environment and the economy.

**Result:** The scalability of this approach is also significant. This technology can be applied to other hot arid regions around the world that face similar water scarcity challenges. By replicating this process in various locations, we can create a global impact on sustainable water management. Furthermore, the integration of algae-based wastewater treatment with other sustainable technologies, such as solar power or green buildings, could create a comprehensive solution for sustainable infrastructure development.

**Conclusion:** The importance of water repurposing and reuse, especially in regions like the Southwest where water scarcity is a pressing issue. By removing nutrients from wastewater and adjusting the pH to neutral, can create a stable and safe environment for the treated water to be reused. Using this water for non-potable purposes like irrigation, landscaping, or golf courses is a great way to conserve potable water and reduce the demand on traditional water sources. The potential to recycle wastewater into drinking water is a game-changer. Water recycling and reuse technologies have made significant advancements in recent years, and it's exciting to see these innovations being applied in real-world scenarios.

## Biography

Born in 1969, Sangeeta Chaturvedi is a post-doctoral fellow under the Department of Botany, Dr. B.R. Ambedkar University Agra, India. She has research experience of over twenty years in the fields of 10 years plus water analysis and phycology background and in-depth understanding of business, technologies, trends, business models and processes. She obtained her Doctoral degree in Botany (Phycology) from Agra University. She also possesses more than 4 years' experience of teaching at the Graduate and Post Graduate Levels. Between 1993 and 1998 and 2011-2013. She completed a project at Govt. Dungar College Bikaner on PHYCOPERIPHYTON ON ARTIFICIAL STRUCTURE AT BIKANER FROM 2003-2005 funded by department of Science and Technology New Delhi. Highly accomplished water analysis and phycology expert with over 10 years of experience in research, project management, and strategic development. Proven track record of leading teams, building strong relationships, and driving achievement through exceptional leadership and communication skills. Possesses in-depth knowledge of water analysis, project strategies, technologies, trends, business models, and processes.

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# OPTIMIZATION OF VACUUM PRESSURE SWING ADSORPTION TECHNOLOGY FOR BIOGAS UPGRADING

**Mohammad Azadi Tabar**

*Vrije Universiteit Brussel, Belgium*

## Abstract

Biomethane, derived from biogas through upgrading processes, is crucial for renewable energy production, offering environmental benefits and energy security. Vacuum pressure swing adsorption (VPSA) is one of the leading methods for biogas upgrading due to its flexibility, low capital cost, and scalability. Optimizing VPSA systems is essential for improved performance and economic viability. Local optimization focuses on refining specific parameters within a constrained space to improve system efficiency. Conversely, global optimization seeks to identify the best solutions across a broader spectrum, considering a wider range of variables and constraints. Both approaches offer distinct advantages but also pose challenges. Local optimization may converge prematurely to suboptimal solutions, while global optimization often requires extensive computational resources. To address these challenges, this work proposes a novel hybrid approach, integrating local and global optimization strategies to overcome limitations associated with each. This hybrid methodology combines stochastic and deterministic techniques, leveraging the strengths of both to achieve superior results. Stochastic methods introduce randomness to explore diverse solution spaces, preventing convergence to local optima. Meanwhile, deterministic approaches provide systematic refinement, ensuring robustness and efficiency in the final solution. The integration of these approaches provides a balanced optimization framework, navigating the trade-offs between exploration and exploitation. By synergizing stochastic and deterministic strategies, the proposed method overcomes limitations of traditional techniques, enhancing performance of VPSA systems to deliver biomethane at high purity, high recovery, and low energy consumption. This research presents a significant advancement in renewable energy technology, by offering a robust solution for optimization the VPSA technology.

## Biography

Mohammad Azadi Tabar is a Ph.D. student at Chemical engineering department, Vrije Universiteit Brussel specializing in biogas upgrading to biomethane. His research focuses on process design and modification through economic, exergy, and energy analysis of biogas upgrading unit, aiming to optimize upgrading technology for enhanced biomethane purity and recovery. For this purpose, he works on pilot scale VPSA unit to achieve experimental data, consequently modeling the upgrading unit in aspen adsorption, and combining the model with MATLAB, aspen process economic analyzer, aspen adsorption, and visual basic application (VBA) to develop an automated method for optimization of VPSA under different technical constraints and economic scenarios.

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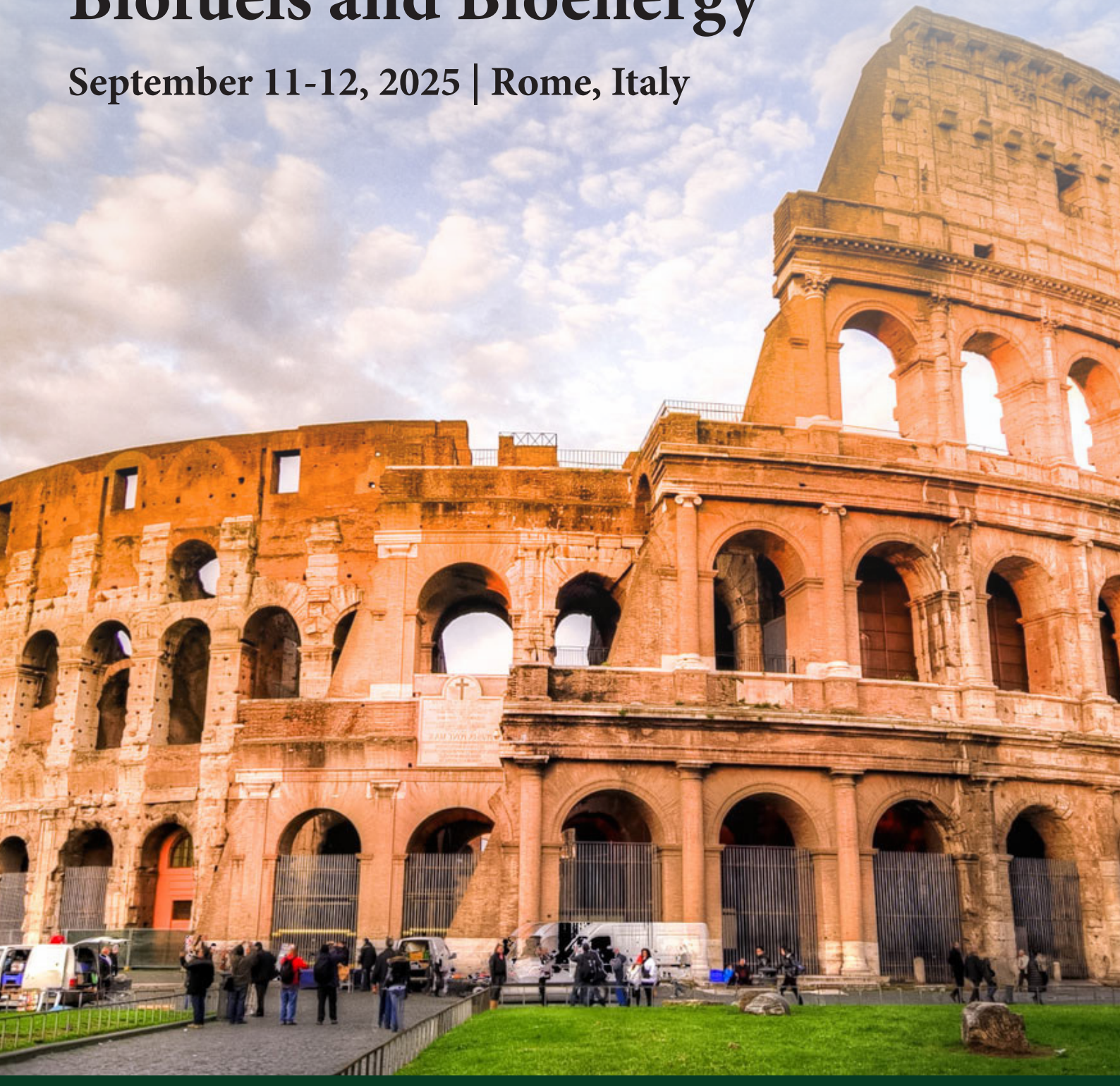


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