Coalesce Research Group

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7th International Conference on

RECYCLING AND WASTE MANAGEMENT

August 19-20, 2024
South Point Hotel, Casino & Spa, Las Vegas, USA

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Conference Hall

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Username: Southpointmeetingrooms
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Scientific Program

Scientific Program

Monday
August 19, 2024

7th International Conference on

Recycling and Waste Management

Day-1 : August 19, 2024	
Meeting Hall : Napa B	
08:00 - 08:45	Registrations
08:45 - 09:00	Opening Ceremony and Introduction
Keynote Presentations	
09:00 - 09:40	Perceived Inexpensiveness, Quickness, and Effortlessness of Plastic Recycling: How Situational Variables Contribute to the Circular Plastic Economy
	Myriam Ertz, LaboNFC, University of Quebec at Chicoutimi, Canada
09:40 - 10:20	Producing Hydrogen as a By-product from Food Processing Wastes via Microbial Electrolysis
	Abhijeet P Borole, Electro-Active Technologies, Inc., USA
Networking & Refreshments (10.20 - 11.00) @ Napa Hallway	
Oral Presentations	
Session Chair	**Myriam Ertz, LaboNFC,** University of Quebec at Chicoutimi, Canada
Sessions:	Recycling – Reduce, Reuse and Recovery | Recycling and Waste Treatment Technologies | Bio Based and Resource Efficiency | Metal Recycling | Marine Plastic Pollution | Rubber and Plastic Recycling | Solid Waste Management | Agriculture and Food Waste Recycling
11.00 - 11.30	Sustainable Waste Management Model of Helsinki Metropolitan Area, Finland
	Petri Kouvo, Helsinki Region Environmental Services Authority HSY- Lappeenranta University of Technology, Finland
11.30 - 12.00	Prevention, Reduction and Recycling of Fishnet Pollution in Vietnamese Coastal Waters
	Max Ehleben, Ostfalia University of Applied Sciences, Germany
12.00 - 12.30	Development of a Detailed Methodology for a Cost-Effective and Long-Term Monitoring of Transboundary Riverine Plastic Pollution in the Lower Mekong River Basin
	Kongmeng Ly and Phetsamone Khanophet, Environmental Management Division, Mekong River Commission Secretariat, Lao PDR
12.30 - 13.00	Innovative Biogas Dehumidification and Desulfurization Systems for Green Hydrogen Production
	Wha Jung Kim and Jae Myung Lee, E&Chem Solution Corp., Republic of Korea
Group Photo: 13.00 - 13.15	
Lunch (13.15 - 14.00) @ Napa Hallway	
14:00 - 14:30	Recycling of Disposable Lighters
	Achim Schmiemann, Ostfalia University of Applied Sciences, Germany
14:30 - 15:00	Urban Mining of Roads and Sewers - Asset Information Management as part of Resource Protection
	Alexander Buttgereit, Jade University of Applied Sciences, Germany
15:00 - 15:30	Studies on the Removal of Residual Nitrogen in Landfill Leachate using the Sulfur-Containing Waste-Based Sulfur Denitrification Agent
	Shin Dong Kim, E&Chem Solution Corp., Republic of Korea

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15:30 - 16:00	Water Recovery by Assisted Evaporation in Lithium Extraction from Solar Ponds
	Claudio Acuña-Pérez, Técnica Federico Santa María University, Chile
Networking & Refreshments (16:00 - 16:30) @ Napa Hallway	
16:30 - 17:00	Direct Sorting to Metal Species from Miscellaneous Scrap Metal by the Combination of Laser-Induced Breakdown Spectroscopy and Machine Learning Classification
	Shunsuke Kashiwakura, Ritsumeikan University, Japan
17:00 - 17:30	Hydrogen Production through Direct Plastic Decomposition by Fe-Al Based Catalysts using Microwaves
	Ami Okamoto, Ristumeikan University, Japan
Poster Presentations (17:30 - 18:00)	
Poster Judges	**Myriam Ertz,** LaboNFC, University of Quebec at Chicoutimi, Canada **Abhijeet P Borole,** Electro-Active Technologies, Inc., USA
POSTER 01	Enhancing the Accuracy of Biosolids Composite Sampling for Environmental Analysis
	Lotfi Khiari and Mohamed Zakaria Gouda, Laval University, Canada
POSTER 02	Analysis of Decomposition of Bioplastic Bags in Compost
	Crystal Cheng, Torrey Pines High School, USA
	Bryan Huang, Alan Zhang and **Max Yang,** Canyon Crest Academy, USA
POSTER 03	Degradation of PFOS Contaminated Soil Using Mechanochemical Technique
	Rahim Shahrokhi, Seoul National University, South Korea
Day 1 Concludes followed by Certificate Felicitation	

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Day 2 - August 20, 2024	
Meeting Hall : Napa B	
Keynote Presentations	
09:00 - 09:40	Improving Methane Yield during Anaerobic Digestion of Wet Organic Waste
	Birgitte K Ahring, Bio-Products, Sciences and Engineering Laboratory (BSEL), Washington State University, USA
09:40 - 10:20	Response Surface Methodology for Membrane Bioreactor in Wastewater Treatment
	Sarra Kitanou, Ibn Tofail University, Morocco
Networking & Refreshments (10.20 - 11.00) @ Napa Hallway	
11:00 - 11:40	Unlocking the Potential of Phosphate Industry and Tannery Waste: Synthesis of Functional Metal-Organic Frameworks, Mesoporous Silicas, and Zeolite *via* a Sustainable Industry Residue Valorization Route
	Youssef Belmabkhout, University Mohammed VI Polytechnic (UM6P), Morocco
Oral Presentations	
Session Chair	**Junboum Park,** Seoul National University, South Korea
Sessions:	Recycling and Waste Treatment Technologies | Recycling – Reduce, Reuse and Recovery | Waste to Energy | Waste Water Treatments | Hazardous Waste Management | Paper Recycling | Solid Waste Management
11:40 - 12:10	Mechanism of White Phosphorus Production by Silicon Reduction from Iron Phosphate and Aluminum Phosphate
	Kazuki Nakayoku, Ristumeikan University, Japan
12:10 - 12:40	Elemental Phosphorus Production from Steel Dephosphorization Slag using Silicon Sludge
	Haruki Okamura, Ritsumeikan University, Japan
12:40 - 13:10	Recovery of a Hydraulic Binder (Belite Cement) and Pure Aggregates from Waste Concrete for a Zero CO_2-"Green Concrete"
	Winfried Malorny, Wismar University of Applied Sciences, Germany
Lunch (13:10 - 14:00) @ Napa Hallway	
14:00 - 14:30	Suppression of Hexavalent Chromium (Cr(VI)) release from Cement by *In-situ* CO_2 Mixing
	Junboum Park, Seoul National University, South Korea
14:30 - 15:00	The Driving Factors of Corporate Carbon Emissions: An Application of the LASSO Model with Survey Data
	Helen Huifen Cai and Yongle Chen, Middlesex University Business School, UK and Zhejiang Xinheyi Biotechnology Co.Ldt. China
15:00 - 15:30	Enhancing Fine Particle Recovery in the Froth Flotation Process with Hydrophobized Glass Bubble
	Claudio Acuña-Pérez, Técnica Federico Santa María University, Chile

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15:30 - 16:00	Sustainable Solid Waste Management
	Hira Khalid and Hassan Javed, Lahore Leads University, Pakistan
Networking & Refreshments (16:00 - 16:30) @ Napa Hallway	
16:30 - 17:00	Membrane Bioreactor *Versus* Activated Sludge Process for Aerobic Wastewater Treatment and Recycling
	Sarra Kitanou, Ibn Tofail University, Morocco
17:00 - 17:30	Photovoltaic Performance of p-type Dye-Sensitised Solar Cells Based on Solid and Flexible Electrode Systems
	Habtamu Fekadu Etefa, Walter Sisulu University, South Africa
Video Presentations	
Video 01	Efficient Chemical Recycling of Waste Polyethylene Terephthalate
	Muhamad Rabnawaz, Michigan State University, USA
Video 02	On Paper Coating and Recycling
	Muhamad Rabnawaz, Michigan State University, USA
Day 2 Concludes followed by Certificate Felicitation	

Virtual Program

Scientific Program

Monday
August 19, 2024

7th International Conference on

Recycling and Waste Management

Virtual Presentations

August 19, 2024 | British Summer Time (BST)

Keynote Presentation

12:00 - 12:40	Reforming of Lignocellulosic Biomass Waste for Cogeneration of Green Chemicals and Green Hydrogen **Hong Li,** Nanyang Technological University, Singapore

Oral Presentations

12:40 - 13:00	Ecotoxicity Assessment of Consumer Product-Driven Contaminant Particles in a Marine Environment **Sung Hee Joo,** Metropolitan State University of Denver, USA
13:00 - 13:20	Scope 3 Decarbonation, Role of Microalgae, Constraints and Solutions **Jean-Louis Roux Dit Buisson,** NeoCarbons sa, ZHAW, Switzerland
13:20 - 13:40	Water Quality Index (WQI) of the Engenheiro Ávidos Dam, located in the Piranhas River Basin, Brazilian Semiarid **Érika Alves Tavares Marques,** Universidade Federal de Pernambuco, Brazil
13:40 - 14:00	Philosophical Considerations of Sustainability **Paul Comet,** Comet Environmental Consulting, USA
14:00 - 14:20	Reversing Global Heat Accumulation by Researching Recent Paleoclimatology **Thomas F Valone,** Integrity Research Institute, USA
14:20 - 14:40	Distribution of Vectors of American Visceral Leishmaniasis in the State of Rio De Janeiro/ Brazil: Municipal Vulnerability for Transmission, Ecological Niche Modelling and Predicted Geographic Distribution **Elizabeth Ferreira Rangel,** Instituto Oswaldo Cruz, FIOCRUZ, Brazil
14:40 - 15:00	The Effects of Climate Change on Health in Kenya: Challenges and Prospects **Peter Imatari Emoit,** Dublin City University, Ireland
15:00 - 15:20	The Regionally Optimized Schedule of Supply and Demand for Energy Resources with Impacts on Economic and Environmental Sustainability **Fardin Farahnak,** Iranian Ministry of Energy, Iran
15:20 - 15:40	Scaler Theoretical and Practical Implications of Plastic Waste Segregation and Disposal Practices at the University of Ghana Campus **Victoria Nyebe Sika,** University of Ghana, Ghana
15:40 - 16:00	Evaluation of Environmental Burdens and Potential Decarbonizing Opportunities for Steel Manufacturing in Pakistan **Shamraiz Ahmad,** Sant'Anna School of Advanced Studies, Italy
16:00 - 16:20	Beyond the Hue: Navigating the Impacts of Synthetic Dyes and Pathways to Sustainable Solutions **Madhuri Nigam,** Lady Irwin College, University of Delhi, India
16:20 - 16:40	Low-Cost Activated Carbon from Nitrile Butadiene Rubber Gloves Waste and its Application for the Removal of Phenol in Wastewater **K C Nedzivhe-Mqehe,** University of Johannesburg, South Africa

Day-1 Concludes

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Day-2: August 20, 2024

Oral Presentations

12:00 - 12:20	A Comparative National-Level Analysis of Government Food System Resilience Activities across Four Developed Countries at Varying Stages of Planning
	Jane Lloyd, Springhouse Consulting, New Zealand
12:20 - 12:40	An Assessment of Alternate Fertilizer Potential of Glauconite Deposits in India using Simple Beneficiation Methods
	Tehreen Shaikh, Indian Institute of Technology Bombay, India
12:40 - 13:00	Climate Solutions and Sustainable Entrepreneurship: A Bibliometric Review of Published Articles in 2023
	Ebenezer Takyi, University of Liverpool, UK
13:00 - 13:20	Study of Degradability and Green Waste Management of Polyethylene
	Bochu Du and Ying Ji, Hong Kong Polytechnic University, Hong Kong
13:20 - 13:40	Recycling Trends and Challenges in the Baltic States
	Natalija Cudecka-Purina, BA School of Business and Finance, Latvia
13:40 - 14:00	Treatment of Substandard Rocket Fuel 1,1-Dimethylhydrazine via its Methylene Derivative into Heterocycles Based on Pyrrolo-[3,4c] Quinolines, Cyclododeca[b]piran and Pyrrole
	Elizaveta Sergeevna Ivanova, Ulyanov Chuvash State University, Russia
14:00 - 14:20	Examining Long Term Environmental and Financial Impacts of Missing Highway Connectors
	Orianne K Wang, Westview High School, USA
14:20 - 14:40	Increased Atmospheric CO_2 Transfer to Soil through Mixing of Functionally Diverse Plants during Reforestation and Fallow (Ivory Coast and Congo)
	Armand W Koné, UFR Sciences de la Nature, Université NANGUI ABROGOUA, Ivory Coast
14:40 - 15:00	People's Perspective on Depletion and Degradation on Water in Patna and Kendujhargarh Block of Kendujhar District, Odisha, India - Climate Change Perspective
	Ranjan K Mallick, Ravenshaw University, India
15:00 - 15:20	Understanding the Impacts of Climate Change on African Indigenous Communities and Examples of Mitigation/Adaptation Responses: Case of the Baka and Bantous Local People Living at the Periphery of the Dja Biosphere Reserve
	Nwafi Ngeayi Adi, ACOBIDER, Cameroon
15:20 - 15:40	Implementation of the Global Concepts of Smart Municipalities in Jordan (Greater Amman Municipality as a Case Study)
	Reham M Alreqeb, Aljiza Municipality, Jordan

Day-2 Concludes followed by Vote of Thanks

Day-1
Keynote Presentations

PERCEIVED INEXPENSIVENESS, QUICKNESS, AND EFFORTLESSNESS OF PLASTIC RECYCLING: HOW SITUATIONAL VARIABLES CONTRIBUTE TO THE CIRCULAR PLASTIC ECONOMY

Myriam Ertz, Urvashi Tandon, Walid Addar and Mahdi Takaffoli

LaboNFC, University of Quebec at Chicoutimi, Canada

Abstract

Background: Worldwide, only a small percentage of plastics are recycled, while the rest are dumped in landfills, incinerated, or released into the environment as litter. One commonly proposed solution is improving plastic waste management. Consumers are key stakeholders in this regard because, through their disposal behavior, they can favor the responsible discarding of plastic through recycling. The -significance of consumer engagement in driving circularity has been strongly emphasized in academic and managerial research. However, topical studies often use theoretical models limited to non-controllable internal factors (i.e., psychological), which limits managerial action.

Objective: This empirical study examines the effects of perceived situational – hence, controllable and modulable - factors, such as perceived cost, perceived duration, and perceived effort related to plastic recycling, on plastic packaging waste recycling, through environmental attitudes.

Methods: The research methodology adopted is quantitative, with an online questionnaire administered to a pan-Canadian panel sample of 1,000 respondents. The data collected were analyzed using confirmatory factor analysis and structural equation modeling.

Results: The results reveal a positive impact of perceived situational factors on environmental attitudes. Consumers' perception of lower cost, shorter duration, and reduced effort associated with plastic recycling shapes positive environmental attitudes, which, in turn, positively relate to plastic packaging waste recycling. Furthermore, the results of this research show that environmental attitudes partially mediate the relationship between perceived situational factors and plastic recycling behavior. In other words, the impact of perceived situational factors on plastic recycling behavior is partially explicable by an improvement in environmental attitudes.

Conclusion: This study helps to better understand how the perception of key situational variables (cost, time, effort) related to plastic recycling improves plastic recycling behavior through the mediation of environmental attitude. Consequently, the study reveals that it is possible to act managerially on concrete aspects of plastic recycling to modulate the perception of recycling-related expenses, duration, and effort.

Biography

Myriam Ertz is Full Professor of Marketing at University of Quebec at Chicoutimi, Director of LaboNFC, Tier-2 Canada Research Chair in Technology, Sustainability, and Society, and co-responsible for the Research Network on the circular economy of Quebec (RRECQ). Recipient of *MDPI's Social Sciences 2020 Young Investigator Award* and the *University of Quebec's 2022 Research Succession Award*, she has published over 90 articles on product lifetime extension, responsible marketing, pro-environmental behavior, and the collaborative economy in top-tier journals (e.g., *Renewable and Sustainable Energy Reviews, Journal of Cleaner Production, Resources Conservation & Recycling*). She is a member of Johnson & Johnson's DiCE Advisory Board for circular economy in healthcare. She further authored the

first French handbook on responsible marketing (*Marketing responsible*, JFD Editions), and has experience as book (co-)editor (e.g., IGI Global, Palgrave Macmillan), journal associate editor (*Frontiers in Psychology, Frontiers in Sustainability*), and guest editor (*Sustainability, Discover Sustainability, Revue Organisations & Territoires*). Research interests include Product lifetime extension, responsible marketing/consumption, collaborative economy, circular economy, industry 4.0, innovation.

PRODUCING HYDROGEN AS A BY-PRODUCT FROM FOOD PROCESSING WASTES *VIA* MICROBIAL ELECTROLYSIS

Abhijeet P Borole and Alex J Lewis

Electro-Active Technologies, Inc., USA

Abstract

Production of hydrogen from biological routes has been investigated for many decades, however, economical production from hydrogen via bioprocesses has not been demonstrated commercially. One issue is the inability to extract hydrogen from complex materials like waste and organic materials. We have simplified the path to generate hydrogen from such complex materials by integrating biology and electrochemical catalysis but separating the half reactions. Biology breaks down complex energetic molecules such as sugars and lipids into electrons, protons and CO_2. The electrocatalytic process then combines electrons and protons to generate hydrogen. These two half reactions are separated by membrane at the anode and cathode, enabling generation of pure hydrogen from wastewater or organic feedstocks.

The process identified as microbial electrolysis uses electro-active microbes in the anode to extract electrons efficiently using biological nanowires. The hydrogen productivity, efficiency and recovery from feedstock widely available in California, food processing wastes, will be discussed. The ability to generate high rates of hydrogen production reaching 10 L-H_2/L anode-day or more from winery wastes can enable waste management as well as generation of green hydrogen for use as energy input or transportation. This can benefit the food industry, reducing GHG emissions and making the energy-intensive plants greener and more sustainable.

Day-1
Oral Presentations

SUSTAINABLE WASTE MANAGEMENT MODEL OF HELSINKI METROPOLITAN AREA, FINLAND

Petri Kouvo

Helsinki Region Environmental Services Authority HSY- Lappeenranta University of Technology, Finland

Abstract

The separate collection system for recyclable wastes in the Helsinki Metropolitan region was ranked the second best in a study comparing recycling schemes of European capitals (European Commission 2015). The collection system includes paper, cardboard, glass, metals, biowaste and plastic packages. Residual waste is collected and used in energy production. The collection system, excluding paper, is managed by the Helsinki Region Environmental Services HSY, a public organization owned by four municipalities (Helsinki, Espoo, Kauniainen and Vantaa). Paper collection is organized by the producer responsibility scheme.

The efficiency of the collection system in the Helsinki region relies on good coverage of door-to-door collection. HSY launched new regional waste management regulations in 2020. In the new regulations the number of dwelling units required to source separate waste was lowered to 5 or more dwelling units. New regulations came into force in 2021. Based on source separation regulations all properties with 5 or more dwelling units are required to source separate biowaste, glass and metal package and cardboard waste. This covers about 75 % of the population of the area. Due to European Union Waste Directive and its implementation to the Finnish waste legislation the source separation regulations for biowaste were extended to cover also smaller housing units. From July 2023 on biowaste needs to be source separated at one family houses and dwelling units between 2-4 and either composted at the property or ordered to be collected by HSY.

In Finland the landfill ban has been in force since 2016. Today only minimal amount of waste is landfilled, in HSY area less than 1000 tons per year. The recycling rate of household waste was appr. 47 % in the year 2022 and utilization rate almost 100% due to use of residual waste in energy production.

In collection work of wastes only non-fossil fuels are allowed that minimizes the CO2-emissions of the collection and transportation operations of waste. Use of residual waste in energy production substitutes fossil fuels and mitigates greenhouse gas emissions also in electricity and district heat production. In Finland the waste to energy plants are combined heat and power plants operating on very high total efficiency.

Biowaste is processed primarily by dry anaerobic digestion method and secondarily by composting. Product gas from the digestion process is used for power and heat production. Compost is utilized in topsoil production.

This paper describes among other things the current efficiency of recycling and estimations of increase of recycling rate of household waste due to new regulations. In addition, the effect of collecting packaging waste and biowaste to the volume on mixed waste is presented.

Biography

Petri Kouvo has published tens of referred technical articles and other technical reports. His PhD. work investigated the modelling of heavy

metal emissions during the co-combustion of biomass, peat and waste. In his current position as a director of the Waste Management Division of the Helsinki Regional Environmental Services Authority he is responsible for the waste management of over one million people and several commercial properties living and operation in the Metropolitan area. In addition, Dr Kouvo works as an associate professor at the Lappeenranta University of Technology, Finland. Dr Kouvo was a Chairman of the Board of Finnish Solid Waste Association (KIVO) in 2004-2019. In 2010-2012 Dr Kouvo was a Member of the Board of International Solid Waste Association, ISWA.

Education: Doctor of Technology, Lappeenranta University of Technology; Environmental Studies, University of Turku; Master's in science of Energy Engineering, Lappeenranta University of Technology, LUT.

PREVENTION, REDUCTION AND RECYCLING OF FISHNET POLLUTION IN VIETNAMESE COASTAL WATERS

Max Ehleben and Achim Schmiemann

Ostfalia University of Applied Sciences, Germany

Abstract

Background: Vietnam has a very long coastline, which is more than 2100 miles long and mostly cultivated. In Vietnam, about 280,000 to 730,000 tons of plastic waste are dumped into the sea every year, with ropes, fishing nets and other waste from fishing vessels (6 m and longer) accounting for more than 64,100 tons per year. Studies have shown that 5.7% of fishing nets, 8.6% of traps and cages and 29% of all fishing ropes and other waste are consumed and disposed of in the environment.

Objective: The aim of the project is to adapt suitable recycling technologies and the associated strengthening of environmental awareness in dealing with plastic products.

Methods: Fishing net material from different phases of use is examined using modern analysis methods and categorized with regard to subsequent recycling or reuse.

Results: The main challenge in recycling fishing nets is the production of unmixed material flows, as polyamide fibers are also processed in addition to nets made from polyolefins. In addition, the condition of the nets after several months or years of use with interim repairs must be investigated. Mechanical, thermal and saltwater stress as well as UV exposure cause lasting damage to the nets. Furthermore, the possibilities of returning the fishing net material to its original use or producing alternative products, for example for everyday use, from fishing net materials using simple processing techniques are being evaluated. A total of three demonstration centers will be set up at three Vietnamese universities.

Conclusion: The development of best practice guidelines for the reusability and recyclability of fishing gear strengthens the awareness of small and medium-sized fishing companies for circular economy solutions and their implementation. The conditions will be created to develop suitable framework conditions for the prevention of marine litter from fishing gear and thus promote sustainable circular economy solutions.

Biography

Max Ehleben is a recognized expert in the field of fibre composites. He has more than 15 years of experience in research-related departments in the automotive industry. He has been teaching as a professor at Ostfalia University for more than six years. His areas of specialization include research in the field of lightweight design and biomimetic applications in plastics engineering. He also focuses on sustainability research in the use of renewable raw materials. Since 2021, he heads the Institute for Recycling at Ostfalia. There, a number of recognized experts work together on topics relating to the recycling of plastics. Research interests are lightweight design, biomimetics, polymer recycling and polymer processing.

DEVELOPMENT OF A DETAILED METHODOLOGY FOR A COST-EFFECTIVE AND LONG-TERM MONITORING OF TRANSBOUNDARY RIVERINE PLASTIC POLLUTION IN THE LOWER MEKONG RIVER BASIN

Kongmeng Ly and Phetsamone Khanophet

Environmental Management Division, Mekong River Commission Secretariat, Lao PDR

Abstract

Background: Plastic has found a wide variety of applications in the Lower Mekong River Basin (LMB) due to its relatively low cost, lightweight, durable, and malleable. The amount of plastic waste produced by the Mekong River Commission (MRC) Member Countries (MCs) were estimated to be about 0.3, 0.2, 3.5 and 3.3 million tons per years, respectively for Cambodia, Lao PDR, Thailand, and Viet Nam. With the Mekong River known as one of the top 10 rivers that collectively carry between 88-95% of plastic into the world's oceans, there is a growing concern among the MRC MCs on the potential effects of plastic debris pollution on freshwater fauna of the Mekong River, in particular when there appears to be knowledge gaps on the flux, transport behaviors and pathways of plastic pollution from the Mekong riverine system to marine environments.

Objective: In response to this grown concern, the MRC MCs have jointly developed a detailed methodology for a cost-effective and long-term monitoring of transboundary riverine plastic pollution, aiming at generating information and knowledge to support decision-making on the management of riverine plastic pollution in the LMB.

Methods: An in-depth analysis of existing methodology for riverine and marine plastic pollution monitoring was conducted to identify the most suitable for the LMB guiding by four key principles – (i) cost-effective; (ii) ability to generate comparable data cross the LMB; (iii) proven track record of use by government agencies to support decision making at country and transboundary river basin levels; and (iv) ability to generate information on status and trends of riverine plastic pollution. The selected methodology was intensively piloted and consulted at both country and regional levels to obtain insight necessary to better adapt the methodology to the situations of the Mekong River.

Results: Following rigorous process of pilots and consultations, three protocols were obtained including the (i) riverine macroplastic monitoring protocol, (2) riverine microplastic monitoring protocol, and (3) microplastic in fish monitoring protocol.

Conclusion: The development process utilized has not only allowed for the methodology to be adapted to the situation of the Mekong River but has also increased ownership of the methodology among the MRC Member Countries allowing it to be integrated into existing MRC routine water quality monitoring network for long-term implementation.

Biography

Kongmeng Ly works as a water quality officer with the Mekong River Commission Secretariat. Under this position, he has spearheaded the development and implementation of multiple regional based water quality monitoring and management policies, including the development of the MRC Riverine Plastic Monitoring Methodology and the MRC Procedures for Water Quality. Research interests include freshwater quality, riverine plastic monitoring and management, remote sensing environmental monitoring.

INNOVATIVE BIOGAS DEHUMIDIFICATION AND DESULFURIZATION SYSTEMS FOR GREEN HYDROGEN PRODUCTION

Wha Jung Kim, Jae Myung Lee and Shin Dong Kim

E&Chem Solution Corp., Republic of Korea

Abstract

Background: The Korean government has decided to implement hydrogen blending in city gas pipes beginning from 2026 to reduce carbon dioxide emissions in line with National Determined Contributions (NDC) goals. Consequently, a reorganization of related systems is underway, and plans are being explored to supply green hydrogen using biogas. To facilitate the supply of green hydrogen, the removal of hydrogen sulfide, an impurity in biogas, is crucial. This is essential to optimize the use of the relatively expensive hydrogen reformer throughout the entire process. Our company has developed a biogas dehumidification and desulfurization system to maximize the performance of existing iron hydroxide adsorbents.

Objective: To establish the groundwork for a system capable of producing green hydrogen through the development of a biogas dehumidification and desulfurization system.

Methods: The dehumidification and desulfurization system is employed to eliminate hydrogen sulfide (H2S) and siloxanes in the dry adsorption process used in facilities producing biogas (e.g. anaerobic digestion gas, landfill gas). The components of the dehumidification and desulfurization system include a moisture remover and dehumidification unit, blower, adsorption tower, and dust remover. The detailed specifications of the equipment vary depending on the air volume, and are divided into 2, 5, 10, and 20CMM(Cubic Meter per Minute) equipment.

Results: Upon application of this system, moisture was condensed in the moisture remover and dehumidification process and reduced to less than 25g/m^2. At the same time, an iron hydroxide-based adsorbent applied to the desulfurization process exhibited the removal of more than 99.9% of hydrogen sulfide from the gas through the chemical reaction. In addition, siloxane was removed during the desulfurization process, achieving a removal rate of over 95%.

Conclusion: The capability to remove hydrogen sulfide at the ppb level enhances the usability of biogas, making it suitable for the green hydrogen production process. As a result, the system has obtained certification as an innovative product from the Ministry of Environment and the Public Procurement Service. Future plans involve active expansion into the biogas utilization business, with a particular focus on its essential role in the green hydrogen production process.

Biography

Wha Jung Kim has worked as a director of research institute of E&Chem Sol. Co. since 2022. He retired from the Chemical Engineering at Konkuk university in Seoul, Korea on Feb. 2021 after 31 years' service as a professor. He has worked in a variety of research areas such as zeolite synthesis, adsorption process, catalytic process, synthesis of platinum nanoparticle for hydrogen fuel cell, synthesis of carbon molecular sieves and graphene. He also served as a dean of Engineering College at Konkuk university and dean of graduate school of Engineering, Konkuk university. He is currently an emeritus professor in Chemical Engineering at Konkuk university, Seoul, Korea. Research interests include biogas desulfurization agent, sulfur denitrification agent for water treatment and odor removal facilities.

RECYCLING OF DISPOSABLE LIGHTERS

Achim Schmiemann and Max Ehleben

Ostfalia University of Applied Sciences, Germany

Abstract

Background: True to the motto "great goals are achieved with small steps", we are dedicated to the recycling of disposable lighters. Disposable lighters withstand high safety requirements during use and are manufactured from high-quality components despite the low sales price. In addition to the high-performance materials they contain, the climate-active residual gases contained in disused lighters suggest a specific recycling treatment.

Objective: To illustrate the volumes of raw materials tied up and worn out by disposable lighters, key figures on the lighter market in the EU and Germany can be used: Consumption of lighters in the EU averages 1.6 billion units, of which one billion are imported. In Germany, 320 million lighters are consumed annually. Worldwide, 10.6 billion are sold each year with a total value of 3.1 billion euros.

Methods: Lighters were collected and recycled in a multi-stage process. Thanks to the recycled plastics styrene acrylonitrile resin (SAN) and polyoxymethylene (POM), the disposable lighters achieve recycling rates of up to 97% in terms of plastic content and up to 75% in terms of total mass. An assessment of the mechanical properties shows that recycled plastics are suitable for technically demanding applications despite the product life cycle and double processing. The lighters were collected and recycled in a multi-stage process.

Results: It was found that the lighters contained an average of 1.9 g of fuel gas. The fuel gas consists of a mixture of the greenhouse gases butane, propane and isobutane. By avoiding the disposal of used lighters into the environment and recycling the raw materials they contain, primary resources and the associated CO_2 emissions can be saved, and the release of climate-damaging hydrocarbons prevented. An assessment of the mechanical properties shows that recycled plastics are suitable for technically demanding applications despite the product life cycle and double processing.

Conclusion: Valuable plastic fractions from used lighters can be recovered and fed back into a recycling loop. Upcycling in the sense of use as 3D printing material is possible. Residual gas emissions from improperly disposed lighters are eliminated.

Biography

Achim Schmiemann is an expert in plastics recycling. He has been researching and teaching in this field for more than 30 years. After working in the chemical industry, he moved to Ostfalia University as a professor. In numerous projects and in close cooperation with various industrial partners, he was able to develop and improve the recycling of plastics from different sources. In particular, he has specialized in the dismantling of complex composite structures and material composites with regard to material recycling. At the end of the processing chain are reusable raw materials. Much of this work has been published, most recently Schmiemann co-authored the book "Recycling of Plastics" (publisher N. Niessner, 2022). Research interests are polymer recycling and polymer processing.

URBAN MINING OF ROADS AND SEWERS - ASSET INFORMATION MANAGEMENT AS PART OF RESOURCE PROTECTION

Alexander Buttgereit and Sabine Flamme

Jade University of Applied Sciences, Germany

Abstract

The construction sector requires a large number of resources, which has a negative impact on the environment. There is therefore great potential for innovation to significantly improve sustainability in construction.

Public authorities, such as cities and municipalities, have a leading role to play in civil engineering during their construction projects and at the same time have a significant influence on resource efficiency. In the "RekoTi" project funded by the Federal Ministry of Education and Research (BMBF), a resource plan for municipal civil engineering is being developed in collaboration between universities, municipalities, and construction companies. This is intended to enable local authorities to identify sustainability potential and increase the resource efficiency of their traffic areas, sewers, and bridges.

To support public authorities in the process and to concretize their options for action, the research consortium is developing a prototypical digital "resource plan for municipal civil engineering" ("RekoTi") over the project period of three years using the example of the city of Münster. The constellation of project partners has been chosen to ensure interdisciplinary cooperation, which will make it possible to identify deficits in existing procedures, develop optimization proposals and apply them on a trial system.

The resulting resource plan

- provides information on the type, location, quantity and, where applicable, quality of resources used as a basis for efficient material flow management,

- shows approaches on how material flows can be managed in the cycle and thus how material flow management can be improved,

- offers suggestions for alternative, resource-efficient construction processes and construction methods for existing infrastructure facilities,

- enables the integration of life cycle assessment data into decision-making processes,

- provides links to asset management systems,

- includes a digital solution (toolbox) based on building information modeling (BIM) and geographic information systems (GIS) and

- includes a guideline that shows the framework conditions and requirements using the example of the city of Münster and is intended to ensure transferability to other municipalities and public authorities.

The "RekoTi" project is thus intended to make a long-term contribution to sustainable resource conservation in public (municipal) civil engineering.

Biography

Alexander Buttgereit has been Professor of Planning, Construction and Maintenance of Roads and Asset Management since April 2022. His work focuses on the resource-efficient construction and operation of transport infrastructure while integrating asset management (AM) and building information management (BIM) methods. Current projects include the calculation of financial requirements for municipal road maintenance, as well as alternative materials for asphalt road construction, the optimized reuse of asphalt and the BIM method in the operational phase of transport infrastructure.

Prior to his professorship, Alexander Buttgereit worked for various municipal road authorities for almost 25 years after completing his studies in civil engineering and passing the 2nd state examination. During this time, his work was characterized by the implementation of financial aspects in pavement management, the development of a construction material recycling concept for cities as well as the introduction and application of management tools and methods of agile working. In particular, his work in the area of leadership and management has led to a qualitative and quantitative improvement in technical and social skills in the department, which is valued in Germany in municipal civil engineering. Research interests are road engineering, road construction and asset management.

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STUDIES ON THE REMOVAL OF RESIDUAL NITROGEN IN LANDFILL LEACHATE USING THE SULFUR-CONTAINING WASTE-BASED SULFUR DENITRIFICATION AGENT

Shin Dong Kim, Jae Myung Lee, Hoa Vu Huu and Wha Jung Kim

E&Chem Solution Corp., Republic of Korea

Abstract

Background: More than 300 m^3/year of iron hydroxide desulfurization agent, effective in biogas and odorous hydrogen sulfide removal, is supplied to Korea. The depleted waste desulfurization agent, previously discarded to landfill, faces challenges with stricter discharge standards for leachate treatment. Addressing the hydrogen sulfide odor issue associated with sulfur-denitrifying carriers demands the development of an innovative carrier.

Objective: To introduce a recyclable sulfur denitrification agent for water treatment, utilizing mine drainage sludge and sulfur-containing waste from hydrogen sulfide removal.

Methods: The process involves utilizing mine drainage sludge with around 150 ppm iron content. Following solid foreign substance precipitation, the sludge is dried to achieve a 60-70% water content. A mixture is prepared as follows; comprising 30 g of mine drainage sludge, 10 g of waste iron sulfide from hydrogen sulfide removal, and 10 g of iron chelate-sulfur sludge from desulfurization using chelate. The mixture is then extruded into pellets and drying, finally producing the denitrifying agent.

Results: In the initial landfill leachate treatment (EBCT 8 hours) for 4 days after the start of the experiment, the nitrate (NO_3-N) was high and the treatment rate was low due to the decreased denitrifying microorganism activity. However, significant improvement was observed on the 5th day, with a removal rate of approximately 90% at the 10th day. In order to shorten EBCT, EBCT was then adjusted to 4 hours after 12 days, and the treatment rate was maintained at about 80%.

Conclusion: Development focuses on a desulfurization agent for biogas pretreatment, utilizing mine drainage sludge. After the pretreatment of biogas, the waste desulfurization agent is recycled to create a carrier for sulfur denitrification. This carrier effectively treats over 90% of untreated nitrogen in nitrate form in landfills, presenting a sustainable and resource-efficient wastewater management solution.

Biography

Shin Dong Kim, the CEO of E&Chem Solution Corp., is the founder and has been at the helm of the company since its establishment in October 2007. He holds a bachelor's ('93), master's ('96), and Ph.D. ('04) in Materials Science and Engineering from Konkuk University. E&Chem Solution Corp. specializes in various environmental, energy, and chemical sectors, undertaking businesses such as biogas pretreatment, odor removal facilities, and the direct production of adsorbents and materials. With a strong presence in the domestic biogas desulfurization agent market, the company has been actively contributed to biogas pretreatment technology associated wtih the achievement of the carbon-neutral goals of 2050 and the production of green hydrogen. Research interests include biogas desulfurization agent, sulfur denitrification agent for water treatment and odor removal facilities.

WATER RECOVERY BY ASSISTED EVAPORATION IN LITHIUM EXTRACTION FROM SOLAR PONDS

Claudio Acuña-Perez, Paula Guerra and Elias Fernandez

Técnica Federico Santa María University, Chile

Abstract

The increasing demand for lithium batteries driven by the rise of electromobility has emphasized the importance of efficient lithium extraction methods. In regions like Salar de Atacama in Chile, lithium is extracted by drilling wells to access a 0.2% lithium solution, which is then concentrated to 6% through evaporation in open-air ponds, taking 12 to 18 months with a daily evaporation rate of 5 to 8 L/m2. While this method offers advantages over mineral ore extraction, it poses challenges in water-scarce areas. Solar ponds, utilizing HDPE and halite granular beds, concentrate lithium with a 30% capital cost and 40% extraction efficiency.

An innovative technology has been proposed as an alternative to solar ponds, involving a preheated dry air bubble injection system in a closed-loop bubbling column. This system uses microbubbles dispersed by an impinging jet gas injector to extract water from the brine through evaporation, with the saturated air condensed to recover distilled water. Tested on brines from Minera Salar Blanco in Chile, the technology achieved an evaporation rate of 80 L/m^2/day for a typical brine.

This development, validated at TRL 5, offers a more efficient lithium extraction method, and promotes sustainability by integrating solar energy utilization and water recovery. With the urgent need for sustainable extraction methods due to significant water losses in lithium carbonate production, this technology presents a promising solution for large-scale applications.

Biography

Claudio Acuña-Perez has thirty years of expertise in process design and sensor development in mining applications. He holds a bachelor's in chemical engineering, a Master's in modeling and process control, and a PhD in mining and metallurgical engineering, specializing in flotation and bubbles hydrodynamics. His innovative projects include nine granted patents (solvent extraction based on hollow drops, new technology for recovering fine particles based on engineered micro glass bubbles, online acid mist analyzers, and technology for direct Enargite transformation to copper sulfide, among others). He has led over 30 national and international research projects (Canada, Finland, Austria, Israel). He published 25 ISI publications and over 90 conference papers, supervised over 130 theses. He isa full adjunct professor in environmental and chemical engineering at the Universidad Católica del Norte (1999-2014) and Universidad Técnica Federico Santa María (2015-). Research interests are circular economy, water treatment and recycling process design.

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DIRECT SORTING TO METAL SPECIES FROM MISCELLANEOUS SCRAP METAL BY THE COMBINATION OF LASER-INDUCED BREAKDOWN SPECTROSCOPY AND MACHINE LEARNING CLASSIFICATION

Shunsuke Kashiwakura, Kazuki Nishizawa, Shoki Kosai and Eiji Yamasue

Ritsumeikan University, Japan

Abstract

Background: Steel is primarily produced from iron ore using the blast furnace method. However, it is anticipated that the proportion of production via electric furnaces will increase to reduce CO2 emissions. Since electric furnace steel is predominantly made from steel scrap, the demand for sorting steel scrap based on its chemical composition is expected to rise. Laser-Induced Breakdown Spectroscopy (LIBS) is one of the promising sorting methods. However, LIBS is an atomic emission spectroscopy technique, and the variety of atomic/ion emission lines from steel makes its analysis very challenging. Therefore, there is a growing need to develop a classification algorithm that does not rely on human expertise, using machine learning for classification in this study.

Objective: Sorting a mixture of miscellaneous scrap metal based on Japanese Industrial Standards using LIBS and machine learning classification algorithms.

Methods: A pulsed laser (Minilite I, Continuum) was focused onto a metal sample using a plano- convex lens with a focal length of 100 mm. The emission from the laser-induced plasma was collected by using a compact spectroscopic detector (AvaSpec-ULS4096CL-EVO, Avantes). Nine aluminum alloys, four steels, eight stainless steels, copper, brass, and zinc were prepared as reference samples, and 1000 LIBS spectra were obtained from each sample. From these spectra, the specific atomic/ion emissions were extracted. They were then processed with the MATLAB 2022b Classification Learner and classified using a third-order support vector machine. Then, 100 new LIBS spectra were obtained from each of the above samples and input the model to verify the accuracy of the classification.

Results: The LIBS spectra from 24 different metal species, 100 each, were compiled into a confusion matrix, yielding an overall accuracy of 82.0%.

Conclusion: By combining LIBS spectra with machine learning algorithms to classify metal species, we achieved relatively high classification accuracy despite the simple equipment configuration.

Biography

Shunsuke Kashiwakura received his Ph.D. from Tohoku University's Graduate School of Environmental Studies and worked as an assistant professor at Tohoku University's Institute for Materials Research before joining Ritsumeikan University, where he is currently an associate professor. He has been researching material circulation and its recycling technology, focusing on metal resources. He has particular expertise in optical sorting technology, particularly Laser-Induced Breakdown Spectroscopy (LIBS), which appears in the Abstract. His academic background is in materials science, especially metal refining, and he has simultaneously been involved in material recycling and its environmental impact assessment, focusing on metals. His current main research theme is optimal material recycling strategies based on his multidisciplinary expertise. Research interests are circular economy, material circulation, sorting.

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HYDROGEN PRODUCTION THROUGH DIRECT PLASTIC DECOMPOSITION BY FE-AL BASED CATALYSTS USING MICROWAVES

Ami Okamoto[1], Shunsuke Kashiwakura[1], Shoki Kosai[1], Genzo Ochiai[2], Hirotatsu Suzuki[2] and Eiji Yamasue[1]

[1]Ristumeikan University, Japan
[2]IHI Corporation, Japan

Abstract

Background: The amount of plastic waste is increasing in the world. In particular, the current recycling method of making hydrogen by gasification from plastic requires large amounts of electricity. This study focuses on chemical plastic recycling using microwaves. Previous studies have highlighted challenges in maintaining hydrogen recovery rates due to catalyst degradation.

Objective: To investigate optimal conditions for sustaining hydrogen yield and continuous recovery, with a focus on hydrogen and hydrocarbon gas generation.

Methods: A microwave generator heated a mixture of catalyst (Al-Fe-O powder) and the grains of polyethylene. Samples were subjected to electric or magnetic fields at power 200W, 500W, and 800W, with heating durations of 500 seconds. The operation was repeated 10 times, adding plastic grains after the end of the first heating experiment and then reheating. Sample temperatures were monitored by a radiation thermometer throughout the experiment. Produced gas during heating was collected by the water replacement method. Gas composition and volume were analyzed using gas chromatography and gas flow meter.

Results: Hydrogen and carbons were successfully generated at 200W, representing a significant reduction in power compared to previous studies. Hydrogen yield remained above 60% even after 10 times repeated heating, a substantial improvement over previous studies' result of approximately 15%. At low power (200W) and temperatures between 573 and 673K, carbon remained solid, resulting in a high hydrogen yield (approximately 90%). At higher power outputs (500 to 800W) and temperatures ranging from 873K to 1073K, carbon was produced as a gas, enabling the potential reuse of the catalyst.

Conclusion: To achieve high-purity hydrogen production, maintaining temperatures within the range of 573K to 673K is crucial. However, to facilitate catalyst reuse, temperatures between 873K and 1073K are necessary to prevent carbon adhesion for decrease the surface area of the catalyst for the heat transfer.

Biography

Ami Okamoto obtained a bachelor's degree degrees in mechanical engineering from Ritsumeikan University, Japan, in 2023. She is now a master's course student of Ritsumeikan University. Her research interest includes recycling engineering and Life Cycle Assessment. Her work focuses on the recycling process under Professor Yamasue Eiji. She had presented a subset of our findings about the method of producing white phosphorus with silicon, carbon-free reductant at Going Green - CARE INNOVATION 2023 in Vienna, May 9 - 11, 2023.

Day-1
Poster Presentations

ENHANCING THE ACCURACY OF BIOSOLIDS COMPOSITE SAMPLING FOR ENVIRONMENTAL ANALYSIS

Lotfi Khiari and Mohamed Zakaria Gouda

Laval University, Canada

Abstract

Biosolids, a highly processed solid byproduct essential to wastewater treatment, significantly contribute to the circular economy by enriching agricultural lands, forests, and rehabilitated mining sites with vital nutrients and organic matter. Their use, however, raises concerns about the potential transfer of contaminants to these ecosystems. Therefore, stringent quality control is imperative to ensure biosolids' safe application, meeting rigorous regulatory standards and criteria.

This research examines biosolids sampling practices worldwide, focusing on key factors, including sample size determination, the application of sampling tools, size reduction techniques, and protocols for packaging, transporting, and storing samples before analysis. The study reveals the inconsistent distribution of inorganic elements in biosolids samples, emphasizing the urgent need for further investigation to understand this variability and achieve representative sampling. It highlights the importance of gathering more data to quantify the heterogeneity of each analyte of interest, enabling the design of an efficient sampling plan, determining the optimal sample size, and calculating the necessary number of subsamples for composite formation using standard and rigorous sampling protocols. Implementing such a systematic approach will yield reliable, precise, and consistent data, vital for shaping environmental policies and promoting the sustainable management of biosolids.

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ANALYSIS OF DECOMPOSITION OF BIOPLASTIC BAGS IN COMPOST

Crystal Cheng[1], Bryan Huang[2], Alan Zhang[2], Max Yang[2] and Linda Shi[3]

[1]*Torrey Pines High School, USA*
[2]*Canyon Crest Academy, USA*
[3]*University of California, USA*

Abstract

Background: A growing awareness of the environment has led to the emergence of biodegradability resources. Global issues such as sustainability and recyclability are major considerations. Governments such as the City of San Diego (SD) advocate organic waste recycling by distributing a kitchen waste pail. However, since compostable bioplastic bags are not allowed in kitchen waste pail, most SD households did not participate in kitchen waste recycling due to reasons such as odor, pests, and inconvenience.

Objective: The primary objective of this project is to demonstrate compostable bioplastic bags are safely and fully compostable under SD local conditions. With remarkable outcomes, we will advocate the use of compostable bioplastic bags for kitchen waste recycling in SD.

Methods: A survey was conducted to explore the root causes of underused kitchen waste pails. Analysis for the primary outcome is the process of compostable bioplastic bag decomposition based on repeated measures design with fixed effects of plastic type (PE vs bioplastic bag containing food scraps vs bioplastic bag cut into squares) and types of compost mixture used. Safety analysis will also be conducted using red worms.

Results: The analysis of survey data indicates that 106/110 (96.4%) of people would compost their kitchen waste if compostable bioplastic bags could be used. Analyses of experimental design for the compost process are ongoing and will be presented at the meeting.

Conclusion: The outcome of composting data indicates that compostable bags can be safely and fully degraded into usable compost fulfilling the City of SD compost criteria.

Biography

Crystal Cheng, a rising junior at Torrey Pines High School and serves as student board member on San Diego Alliance for Asian Pacific Islander Americans, is passionate to service her community. Crystal plans to major in environmental protection. She built a team of youth scientists with common interest, who are passionate learners, problem solvers to global issues such as sustainability, industrial ecology, biodegradability, and recyclability. Observing the underuse of kitchen waste pail, Crystal serves as youth ambassador to connect her peers, City Council, and advisors who are biodegradable industry professionals and Bioengineering scientists for in-depth research on kitchen waste recycling. Research interest is about food waste recycling.

DEGRADATION OF PFOS CONTAMINATED SOIL USING MECHANOCHEMICAL TECHNIQUE

Rahim Shahrokhi and Junboum Park

Seoul National University, South Korea

Abstract

The widespread use of per- and poly-fluoroalkyl substances (PFASs), environmentally persistent halogenated hydrocarbons, in various industrial and commercial applications has caused significant concerns owing to their contamination of soil and groundwater. Among PFAS, perfluorooctane sulfonate (PFOS) stands out as a highly persistent compound with notable bioaccumulation potential, frequently detected in soils and other environmental matrices. Contaminated soils with PFOS require immediate remediation to protect the surrounding environment and human health. Mechanochemical destruction (MCD) is a technique that offers a non-combustion, solvent-free method for degrading PFOS. The efficiency of MCD depends on the co-reagents used for the degradation process. In this study, the influence of pyrite, quartz, and tourmaline as co-reagents for PFOS degradation was evaluated. The results showed that using quartz, tourmaline, and pyrite as co-reagents degraded PFOS by 94.2%, 90.3%, and 82.5%, respectively, after 4 hours.

Biography

Rahim Shahrokhi has mainly focused on a group of chemical compounds called PFASs (Per- and Polyfluoroalkyl Substances), which are widely used in industrial and commercial applications but pose a significant risk to the environment and human health due to their persistence in the environment. In his research he developed an efficient technique for stabilizing and reducing PFAS contaminants in soil, which involves developing adsorbents from various materials and mixing them with PFAS-contaminated soil to immobilize the PFAS pollutants. I addition he is using the mechanochemical destruction techniques for degradation of PFAS. Research interest is about PFAS.

Day-2
Keynote Presentations

IMPROVING METHANE YIELD DURING ANAEROBIC DIGESTION OF WET ORGANIC WASTE

Birgitte K Ahring[1] and Richard Garrison[2]

[1]Bio-Products, Sciences and Engineering Laboratory (BSEL), Washington State University, USA

[2]Clean-Vantage LLC, USA

Abstract

Anaerobic digestion (AD) of wet organic waste materials is limited by the recalcitrance of lignocellulosic materials in waste. As a result the carbon conversion efficiency is low and more than 50% of the organics are still present in the effluent after digestion resulting in low methane yield of the process.

Pretreatment of the waste material is a way to enhance the methane yield and in the presentation we will show results from our extensive studies in our laboratory besides work from pilot and full-scale of using Advanced Pretreatment & Anaerobic Digestion (AWOEx) for significantly improving the Carbon Conversion Efficiency of Wet organic Waste such as Sewage sludge and the Organic Fraction of MSW.

Biogas contains large amount of CO_2 (35 to 45%), which needs to be removed before the biogas can be added to the natural gas grid increasing the cost and environmental burden of the process. Conversion of the CO_2 in the biogas with hydrogen addition is another way of enhancing methane yield from AD while producing renewable natural gas (RNG) from biogas. In the presentation, I will further show results from our work on conversion of CO_2 to more methane using an efficient methanogenic isolate.

The impact of pretreatment along with biological biogas upgrade will finally be discussed.

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RESPONSE SURFACE METHODOLOGY FOR MEMBRANE BIOREACTOR IN WASTEWATER TREATMENT

Sarra Kitanou[1], Mustapha Tahaikt[1], Mohamed Taky[1] and Azzedine Elmidaoui[1,2]

[1]Ibn Tofail University, Morocco
[2]Mohammed VI Polytechnic University, Morocco

Abstract

Performance modeling of wastewater treatment systems has now become an attractive area of investigation for the design, analysis, and optimization of operations. Mathematical modeling of MBR treatment is an effective tool to predict effluent quality. Model calibration is critical to improve the accuracy of simulation. Membrane bioreactors (MBRs) consist of biological reactors combined with membrane separation processes. In this study, the parameters affecting the pollution and treatment efficiency of the MBR process were analyzed and compared in order to understand the pollution removal process sensitivity and their implications for the modeling. First of all, the influence of different operating conditions was examined. Subsequently, a custom design (CD) based on response surface methodology (RSM) was used to perform predictive models and optimize the MBR process. This method is developed to assess the effects of process variables and their interaction on the removal of pollution. The independent variables used in this process are hydraulic retention time (HRT=X1), aeration rate (AR=X2) and transmembrane pressure (TMP=X3) and their interaction to obtain optimal conditions. Good data quality is essential for reliable modeling results as well as for effective control systems. Analysis of variance for developed quadratic models exhibits high significance and applicability. However, models are analyzed graphically for their predictive ability. The RSM showed a good agreement between the model and the experimental data. MBR technology improved pollution removal efficiencies significantly, and the maximum pollution removal could be achieved under the optimum parameters of 15 h HRT, and 14.9 TMP. The most significant difference concerned the elimination of total suspended solids, which amounted to 99.7%. Regarding COD, a low concentration was obtained (15 mg/L) in the permeate. Greater differences were achieved in the case of total nutriments. This work demonstrated the effective use of statistical modeling to enhance MBR process performance to obtain a sustainable and energy-efficient condition.

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UNLOCKING THE POTENTIAL OF PHOSPHATE INDUSTRY AND TANNERY WASTE: SYNTHESIS OF FUNCTIONAL METAL-ORGANIC FRAMEWORKS, MESOPOROUS SILICAS, AND ZEOLITE VIA A SUSTAINABLE INDUSTRY RESIDUE VALORIZATION ROUTE

Youssef Belmabkhou, Ali Mohammed Yimer, Achraf Delhali and Ayalew H Assen

University Mohammed VI Polytechnic (UM6P), Morocco

Abstract

The large-scale production of a variety of end products, such as energy, electronics, fertilizers, etc. has led to a dramatic increase in the number and size of several industries, which then generate hazardous pollutants that are all too often released into the surrounding environment. Increasing levels of pollution is driving the research community to discover new ways to capture toxic pollutants from industrial waste streams and also to valorize industrial waste through the subsequent production of valuable commodities. One way to valorize waste products is to convert them into functional materials. Among the various useful products that can be synthesized from waste, the preparation of porous physical adsorbents has attracted recent attention. Metal-organic frameworks (MOFs), mesoporous silicas, and zeolites are among the various functional solid-state sorbents that have shown huge promise for many industrially relevant applications. However, overcoming obstacles ahead, such as the difficulty of producing those porous sorbents at a scale due to the high cost of the precursors used to assemble them is critical. Preparing porous materials from waste sources could help to overcome the sustainable production challenge while simultaneously valorizing the waste and addressing environmental concerns. There are various types of local and industrial waste, which could be explored. In this work, the transformation of phosphate rock tailings and phosphogypsum, solid waste products generated in huge amounts from the different value chains of the phosphate industry, into advanced Ca-MOFs, heterometallic mesoporous silicas, and zeolites, as well as the simultaneous valorization of tannery effluents and waste plastic bottles into water adsorbing Cr-terephthalate MOFs, will be highlighted. The combination of tannery effluent and organic linker extracted from waste plastic bottles led to a successful assembly of Cr-terephthalate (Cr-BDC) MOFs with potential application for water harvesting. The waste from the phosphate industry served as silica, alumina, and calcium sources leading to the assembly of various zeolites, mesostructured adsorbents, and functional Ca-MOFs, with promising potential for various applications, including carbon capture, heavy metal removal from wastewater, and alcohol dehydration. In some cases, advanced heterostructures with enhanced adsorption properties were obtained that are otherwise difficult to be prepared from pure commercial-grade precursors. The structural attributes of the prepared porous sorbents and their performance in different applications were confirmed by various techniques including XRD, SEM-EDX, FTIR, TGA-DSC-MS, TEM, NMR, ICP-OES, N_2 sorption at cryogenic conditions, CO_2 sorption at different temperatures, and room temperature water, methanol, and ethanol sorption analyses. The advances made in this study represent significant progress in applying sustainability principles and pave the way for circular economy targets.

Day-2
Oral Presentations

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MECHANISM OF WHITE PHOSPHORUS PRODUCTION BY SILICON REDUCTION FROM IRON PHOSPHATE AND ALUMINUM PHOSPHATE

Kazuki Nakayoku, Shunsuke Kashiwakura, Shoki Kosai and Eiji Yamasue

Ritsumeikan University, Japan

Abstract

Background: The recent increase in the unit cost of phosphorus imports has underscored the necessity for alternative resources. Prior research has primarily examined phosphate compounds, such as $FePO_4$ and $AlPO_4$, present in incineration ash of sewage sludge. However, this approach necessitates high-temperature heating and results in greenhouse gas emissions. Thus, we propose employing Si sludge as a reductant, allowing for phosphorus recovery from the ash at lower temperatures (below 1273K, which is lower than the 1273~1773K of the prior research) without direct greenhouse gas emissions.

Objective: The mechanism of phosphorus recovery from the ash of sewage sludge at reduced temperatures while minimizing greenhouse gas emissions was elucidated at the reagents level.

Methods: $FePO_4$ or $AlPO_4$ reagents were combined with Si reagents. Subsequently, the mixture was heated in a tube furnace for one hour. Na_2CO_3 reagent was also incorporated to reduce the melting point. Assuming elemental phosphorus is volatilized and reduced based on proposed reaction equations (1) ~ (3), the volatilization rate of white phosphorus was calculated by dividing the change in sample mass before and after heating by the initial phosphorus sample mass. The phase ratio was calculated from the strongest line intensity and RIR (Relative Intensity Ratio) value of the XRD spectrum.

(1) $4FePO_4 + 6Si \rightarrow P_4(g)\uparrow + 4FeO + 6SiO_2$

(2) $4AlPO_4 + 5Si \rightarrow P_4(g)\uparrow + 2Al_2O_3 + 5SiO_2$

(3) $4AlPO_4 + 5Si + 4Na_2CO_3 \rightarrow P_4(g)\uparrow + 2Al_2O_3 + 5SiO_2 + 4CO_2(g)\uparrow + 4Na_2O$

Results: The maximum volatilization rate of $FePO_4$ was approximately 93% at 1273 K. However, the volatilization rate significantly decreased at heating temperatures below 1073 K. For $AlPO_4$, the volatilization rate remained below 10% without the addition of Na_2CO_3, while the addition of Na_2CO_3 notably increased the volatilization rate.

Conclusion: The method employed in this study effectively reduced phosphate compounds using Si at low temperatures. Moreover, the enhancement of the volatilization rate through Na_2CO_3 addition was also validated.

Biography

Kazuki Nakayoku is currently a master's student in Mechanical Systems at Ritsumeikan University Graduate School of Science and Engineering, and received his bachelor's degree in mechanical engineering from Ritsumeikan University in March 2023. He is passionate about research on energy and resource recycling under the supervision of Professor Eiji Yamasue. Specifically, he focuses on phosphate compounds in sewage sludge and silicon sludge generated in the manufacturing process of semiconductors, aiming to construct an energy-saving and low environmental impact white phosphorus generation process. This will enable the conversion of waste into a valuable resource. Research interest is about mechanical engineering.

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ELEMENTAL PHOSPHORUS PRODUCTION FROM STEEL DEPHOSPHORIZATION SLAG USING SILICON SLUDGE

Haruki Okamura[1], Shunsuke Kashiwakura[1], Shoki Kosai[1], Eiji Yamasue[1], Takuya Kishida[2] and Shoko Murohushi[2]

[1]Ritsumeikan University, Japan
[2]IHI Corporation, Japan

Abstract

Background: In recent years, the price of phosphorus has sky-rocketed, necessitating the development of alternative resources in the world. Dephosphorization slag (hereafter, De-P slag) is attracting attention as such a resource. The production of elemental phosphorus from De-P slag has been investigated, but the high-temperature reduction method using carbon has been mainly used. In this study, the use of Si sludge is proposed. Previous studies have demonstrated that elemental phosphorus can be produced from $Ca_3(PO_4)_2$ and Si reagents at low temperatures and is more energy efficient than conventional techniques.

Objective: The objective of this study is to consider the optimum conditions for the formation of elemental phosphorus in a low-carbon form by reducing slag with Si sludge. In addition, K_2CO_3 will be added to improve the reaction rate, aiming at the increase of a molten phase.

$$2Ca_3(PO_4)_2+5Si+K_2CO_3 \rightarrow P_4+3(2CaO \cdot SiO_2)+K_2O \cdot 2SiO_2+CO_2 \ldots (1)$$

Methods: The sample is mixed with slag, Si reagent (99%, Fujifilm) and K_2CO_3 reagent (99%, Fujifilm) in a screw tube bottle. Heating was performed in a tube electric furnace, and the parameters were mixing weight ratio, heating temperature, and heating time. From the weight before and after heating and the change in mass fraction of phosphorus by XRF analysis, the volatilization rate of phosphorus was determined using the following equation (2), where Wb is the weight of P_2O_5 before heating and Wa is the weight of P_2O_5 after heating.

$$R=(W_b-W_a)/W_b \ldots (2)$$

Results: The volatilization rate was 64% at a slag : Si : K_2CO_3 = 1:0.25:0.3 weight addition ratio, a heating time of 1 hour, and a heating temperature of 1273 K. The volatilization rate reached nearly 80% at 1473 K. Similar volatilization rates were observed when Si was replaced by Si sludge. Samples were observed by SEM after heating at 1473 K, and spherical particles were observed, indicating that the reaction interface area increased due to partial melting by K_2O generated from K_2CO_3, and that the volatilization reduction of elemental phosphorus occurred efficiently.

Conclusion: The formation of elemental phosphorus was confirmed by heating slag mixed with Si and K_2CO_3. The volatilization rate reached about 80%, and it was confirmed that the same volatilization rate could be obtained by substituting Si with Si sludge.

Biography

Haruki Okamura obtained a bachelor's degrees in mechanical engineering from Ritsumeikan University, Shiga, Japan, in 2023. He is now a master's course student of Ritsumeikan University. His research interest includes recycling engineering, waste management, and Life Cycle Assessment. His work focuses on the Elemental phosphorus production from steel slag using silicon sludge under Professor Eiji Yamasue. They are currently applying for a patent for the production of elemental phosphorus from steel slag with Si is currently pending.

RECOVERY OF A HYDRAULIC BINDER (BELITE CEMENT) AND PURE AGGREGATES FROM WASTE CONCRETE FOR A ZERO CO_2- "GREEN CONCRETE"

Winfried Malorny and Agata Wygocka-Domagałło

Wismar University of Applied Sciences, Germany

Abstract

Background: To date, there is no suitable regulated recycling method for the crushed concrete sand (0 - 2 mm) that is produced as a fine fraction when processing concrete from demolition. However, this is the fraction among the various grain sizes of recycled concrete that contains the highest proportion of cement as a recyclable material. For the coarser fractions, recycling methods have been in place for a long time.

Objective: Recovery of a hydraulic binder from waste concrete and realization of a closed material cycle for the mass building material concrete.

Methods: After model tests carried out years ago at the TU Braunschweig with an extensive range of standard cements had already demonstrated the feasibility of recovering a hydraulic binder in a low-temperature / low-energy process, the transferability to real concrete waste was confirmed as a result of further tests. The process uses a combined thermal-mechanical processing technique to activate the cement component by forming a hydraulically active belite cement, which we call RC cement, and to enrich the binder in the process output.

Results: If the coarser fractions from waste concrete processing are also used as input material for the process, aggregates are produced parallel to the RC cement which, in contrast to classic RC aggregates, correspond to the originally introduced gravel. In fact, they are even superior to natural aggregates, as they have a micro-fine film of hydraulically active particles, which strengthens the interfacial transition zone. This was proven by the master's thesis of Henning Rüß: *Laboratory experimental model investigations for the realization of a "green" concrete based on recycled cement and recycled aggregate*, which was awarded the Schwerin 2022 Innovation Prize. This shows the way to a closed cycle for concrete that can be produced completely free of CO_2 emissions in terms of materials and is not inferior to conventional concretes in terms of performance.

Conclusion: The plan is to make this technology, which has been developed on a laboratory scale, available for practical application by transferring it to a highly scalable pilot plant level. It could be particularly suitable for restoring destroyed concrete structures.

Biography

Winfried Malorny is a professor at the University of Applied Sciences, Wismar, Germany. He was appointed professor at Neubrandenburg University of Applied Sciences in 2001 in the field of building materials, building protection/renovation materials and building physics and moved to Wismar in 2011. After graduating in physics at the TU Braunschweig, he worked at the Institute of Building Materials, Concrete Construction and Fire Safety at the TU Braunschweig, at the Civil Engineering Materials Testing Institute (MPA) and in an engineering office for damage analysis, building protection and building restoration until his move to Mecklenburg-West Pomerania. His current main areas of research are polymer-modified high-performance concretes, innovative developments in the field of hydrothermally hardened building materials such as autoclaved aerated concrete and calcium silicate masonry units and, for many years, the recycling of cement-bound building materials. Research interests are materials science and instrumental analytics.

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SUPPRESSION OF HEXAVALENT CHROMIUM (CR(VI)) RELEASE FROM CEMENT BY *IN-SITU* CO_2 MIXING

Junboum Park and Kian Cho

Seoul National University, South Korea

Abstract

In situ CO_2 mixing technology is a potential technology for permanently sequestering CO_2 during concrete manufacturing processes. Although it has been approved as a promising carbon capture and utilization (CCU) method, its effect on the leachability of heavy metals from cementitious compounds has not yet been studied. This study focuses on the effect of *in situ* CO_2 mixing of cement paste on the leaching of hexavalent chromium (Cr(VI)).

The tank leaching test was performed for the measurement of Cr(VI) leaching from cement specimens. To investigate the transformation of the internal structure of materials, the following microstructural analyses were performed; X-ray diffraction (XRD), Thermogravimetric analysis (TGA), and Fourier transform infrared (FTIR). The tank leaching test of the CO_2 mixing cement resulted in a Cr(VI) cumulative leaching of 0.614 mg/m^2 in 28 d, which is ten times lower than those in the air mixing. In comparison to air-mixed samples, CO_2-mixed OPC samples with 28-day curing indicated the following characteristics: (1) the total mass decrease in TGA was 27.89%, which was larger than the 23.55% reduction in air-mixed samples, indicating reduced porosity in CO_2-mixed samples, and (2) more Mc and ettringite were identified in XRD, indicating a potential of the more monochromate or chromate-ettringite formations. Furthermore, the study discovered Cr(VI)-immobilization structures in CO_2-mixed OPC specimens. In CO_2-mixed samples, (1) a large amount of CrO_4^{2-} was immobilized as $CaCrO_4$, which can be seen in the TGA, and a higher Cr-O extension was observed in the FTIR, and (2) the partial disappearance of Mc and increment of $CaCrO_4$ peak were detected in TGA, suggesting the incorporation of the CrO_4^{2-} ion to the internal layer of Mc.

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THE DRIVING FACTORS OF CORPORATE CARBON EMISSIONS: AN APPLICATION OF THE LASSO MODEL WITH SURVEY DATA

Helen Huifen Cai[1], Yongle Chen[2] and Mengyao Xia[3]

[1]*Middlesex University Business School, UK*
[2]*Zhejiang Xinheyi Biotechnology Co.Ldt. China*
[3]*Nanjing University of Information Science & Technology, China*

Abstract

Corporate carbon performance is a key driver of achieving corporate sustainability. The identification of factors that influence corporate carbon emissions is fundamental to promoting carbon performance. Based on the carbon disclosure project (CDP) database, we integrate the least absolute shrinkage and selection operator (LASSO) regression model and the fixed effects model to identify the determinants of carbon emissions. Furthermore, we rank determining factors according to their importance. We find that Capx enters the models under all carbon contexts. For *Scope 1* and *Scope 2*, financial-level factors play a greater role. For *Scope 3*, corporate internal incentive policies and emission reduction behaviours are important. Different from absolute carbon emissions, for relative carbon emissions, the financial-level factors' debt-paying ability is a vital reference indicator for the impact of corporate carbon emissions.

ENHANCING FINE PARTICLE RECOVERY IN THE FROTH FLOTATION PROCESS WITH HYDROPHOBIZED GLASS BUBBLE

Claudio Acuña-Pérez, Héctor Carreño and Alexis Campos

Técnica Federico Santa María University, Chile

Abstract

The froth flotation process is commonly used for recovering minerals or hydrophobic materials, but its efficiency is reduced for fine particles (< 20 μm) due to low collision probability and hydraulic drag forces. To address this challenge, a new technology using hydrophobized glass bubbles (HGB) has been developed to enhance the selective recovery of fine particles in the froth flotation process.

HGBs are hydrophobic glass microspheres that measure 45 microns in diameter with a specific density of 0.37, serving as carriers for fine particles. They undergo a functionalization process through chemical reactions with alcohols containing 4, 8, or 12 carbon atoms, altering their surface and enabling precise control over the degree of hydrophobicity.

Introducing HGBs into Rougher tailings facilitates the preferential attraction of fine particles (sized below 20 microns), resulting in pseudo-particles that can be effectively recuperated using standard flotation cells. Significant metallurgical results have been achieved using Codelco's mineral from the Ministro Hales division, demonstrating the undeniable effectiveness of HGBs in improving recovery rates by up to 8 percentage points in copper recovery and 5 points in silver recovery.

The metallurgical findings have undergone validation via conventional flotation kinetic assessments conducted on tailing rougher pulp, showcasing a remarkable enhancement in copper and silver recovery. This novel technology's substantial promise necessitates a scaling-up validation process at an industrial level.

In conclusion, this new technology using hydrophobized glass microspheres has demonstrated significant potential for improving the selective recovery of fine particles in the froth flotation process. The successful application of this technology in recovering fine fractions (below 20 microns) that are typically irreversibly lost in conventional processes highlights its potential for enhancing the efficiency and sustainability of mineral recovery.

Biography

Claudio Acuña-Perez has thirty years of expertise in process design and sensor development in mining applications. He holds a bachelor's in chemical engineering, a Master's in modeling and process control, and a PhD in mining and metallurgical engineering, specializing in flotation and bubbles hydrodynamics. His innovative projects include nine granted patents (solvent extraction based on hollow drops, new technology for recovering fine particles based on engineered micro glass bubbles, online acid mist analyzers, and technology for direct Enargite transformation to copper sulfide, among others). He has led over 30 national and international research projects (Canada, Finland, Austria, Israel). He published 25 ISI publications and over 90 conference papers, supervised over 130 theses. He isa full adjunct professor in environmental and chemical engineering at the Universidad Católica del Norte (1999-2014) and Universidad Técnica Federico Santa María (2015-). Research interests are circular economy, water treatment and recycling process design.

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SUSTAINABLE SOLID WASTE MANAGEMENT

Hira Khalid, Hassan Javed, Bilal Tanveer and Muhammad Suleman

Lahore Leads University, Pakistan

Abstract

Background: Unregulated municipal solid waste (MSW) produced due to unprecedented increase in population and urbanization, creates hazards to public health and environmental safety. Lahore, the second-largest city of Pakistan generates around 7690 tons/day of MSW and does not possess any land-fill site. However, Lahore has two Engineered Dumping sites which has already exceeded their carrying capacity. Uncontrolled waste is currently disposed of in and around the city. The sheer magnitude and varied nature of this waste pose environmental and health hazards, necessitating a comprehensive and sustainable solution.

Objective: To provide innovative solution for solid waste management in Lahore.

Methods: To address this complex issue, our proposed solution involves an integrated waste management system. The first step is composting, wherein organic waste is transformed into fertilizer. Additionally, plastic and glass waste are reused into composite plastic aggregates (CPA). Furthermore, metal waste undergoes a transformation into metallic studs, contributing to resource conservation and minimizing environmental impact.

Results: Organic waste compost is 27% more effective than ordinary fertilizers. The nutrient content of the soil has increased roughly from 1% to 2% as compared to normal soil. This study evaluates the impact of CPA on the mechanical properties of concrete, including fresh state density, slump variation, compressive strength, flexural strength, and tensile strength. Results show that CPA replacements decrease fresh state density and strength. 7% of metals were extracted to make an alloy from e-waste. While about 23% of the silicon powder was partially used in making the mold, based on the results of our experiments, it was concluded that alloyed steel exhibits superior tensile and yield strength compared to impure steel derived from waste materials.

Conclusion: Implementing an integrated waste management system involving composting, plastic and glass reuse, and metal transformation presents a feasible solution to mitigate the hazards posed by unorganized solid waste in Lahore, contributing to environmental and economic.

Biography

Hira Khalid has her expertise in developing circular and cyclic approach for solid waste management in a developing country like Pakistan where practical solutions are the need of the hour. Her proposed approach is pragmatic and doable. Moreover, she also possesses expertise in design of sustainable biological wastewater treatment plants. She is a young researcher in the field of solid waste management. Her ideology is related to sound socio-economic practices with minimum or no environmental impacts. She has also designed the master plans for solid waste management of various cities of Pakistan in collaboration with ADB. Research interests are circular approach for solid waste management, recycling and bioremediation, composting and regeneration.

MEMBRANE BIOREACTOR VERSUS ACTIVATED SLUDGE PROCESS FOR AEROBIC WASTEWATER TREATMENT AND RECYCLING

Sarra Kitanou, Mustapha Tahaikt and Azzedine Elmidaouia

Ibn Tofail University, Morocco

Abstract

Membrane bioreactor (MBR) systems are one of the most widely used wastewater treatment processes for various municipal and industrial waste streams. It is based on complex interactions between biological processes, filtration process and rheological properties of the liquid to be treated. Its complexity makes understanding system operation and optimization more difficult, and traditional methods based on experimental analysis are costly and time consuming. The present study was based on an external membrane bioreactor pilot scale with ceramic membranes compared to conventional activated sludge process (ASP) plant. Both systems received their influent from a domestic wastewater. The membrane bioreactor (MBR) produced an effluent with much better quality than ASP in terms of total suspended solids (TSS), organic matter such as biological oxygen demand (BOD) and chemical oxygen demand (COD), total Phosphorus and total Nitrogen. Other effluent quality parameters also indicate substantial differences between ASP and MBR. This study leads to conclude that in the case domestic wastewater, MBR treatment has excellent effluent quality. Hence, the replacement of the ASP by the MBRs may be justified based on their improved removal of solids, nutrients, and micropollutants. Furthermore, in terms of reuse the great quality of the treated water allows it to be reused for irrigation.

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PHOTOVOLTAIC PERFORMANCE OF P-TYPE DYE-SENSITISED SOLAR CELLS BASED ON SOLID AND FLEXIBLE ELECTRODE SYSTEMS

Habtamu Fekadu Etefa

Walter Sisulu University, South Africa

Abstract

The effect of carbon dots (C-dots) on the performance of nickel oxide nanoparticles (NiO NPs) based DSSCs was explored in this work. C-dots co-adsorbing with N719 dye on p-type semiconductor synergetically enhance the power conversion efficiency of solar cells. C-dots are the main sensitizer, and N719 tightly adsorbed on carbon dots and NiO behaves as an accelerator of a positive electron transfer and a restrainer of the electron-hole recombination. NiO NPs with a rectangular shape (average size: 11.4 x 16.5 nm) were mixed with C-dots, which were synthesized from CA and EDA. A photocathode consisting of a composite of NiO@C-dots was then used to measure the photovoltaic performance of a DSSC. A DSSC fabricated via the adsorption of N719 sensitizer co-adsorbing with a C-dot content of 12.5 wt% at a 1.5:1 EDA: CA molar ratio was achieved a 9.85% (430 nm of a light source at 50 mW/cm^2 light of intensity) of power conversion efficiency (PCE). This synergetically higher PCE of the NiO@C-dots-based DSSC was due to the larger amount of sensitizer adsorbed onto the composites with a larger specific surface area and the faster charge transfer in the NiO@C-dots working electrode. The most important fact is that C-dots are the main sensitizer and that N719 tightly adsorbed on C- dots, and NiO behaves as an accelerator of a positive electron transfer and a restrainer of the electron-hole recombination. These results reveal that C-dots are a remarkable enhancer for NiO NPs in DSSCs.

Day-2
Video Presentations

EFFICIENT CHEMICAL RECYCLING OF WASTE POLYETHYLENE TEREPHTHALATE

Muhamad Rabnawaz

Michigan State University, USA

Abstract

We introduce a simple and effective method for recycling polyethylene terephthalate (PET). By melting PET (a process known as melt pretreatment), before depolymerization can significantly speed up the recycling process. We also use a cheap and eco-friendly catalyst to help with the recycling. Our findings show that melt pretreatment method enables overall ~eight times less energy than traditional methods that don't use melt pretreatment. Our research suggests that this new method is a better way to recycle PET, which is important because we produce a huge amount of PET waste every year.

ON PAPER COATING AND RECYCLING

Muhamad Rabnawaz

Michigan State University, USA

Abstract

Nearly half of all plastic waste comes from packaging, and concerns over microplastics are pushing the shift towards coated paper as an eco-friendly option. However, most coated papers can't be recycled or broken down naturally. This paper presents a new approach: creating degradable waxes for coating paper. We made these waxes and tested them with techniques like nuclear magnetic resonance, Fourier transform infrared spectroscopy, and gel permeation chromatography. We applied these waxes to kraft paper using both methods that involve solvents and those that don't (like hot pressing). We then tested the paper for how well it resists water and oil, along with other tests important for packaging, such as how well it blocks moisture and how it seals with heat. We also looked into how these waxes break down over time and how the paper can be recycled. Our work suggests that this approach could lead to packaging that's better for the environment and human health.

Virtual - Day 1
Keynote Presentation

REFORMING OF LIGNOCELLULOSIC BIOMASS WASTE FOR COGENERATION OF GREEN CHEMICALS AND GREEN HYDROGEN

Hong Li

Nanyang Technological University, Singapore

Abstract

Climate change and fossil fuel depletion are intertwined global challenges that necessitate urgent action and lead to the sustainability shift towards low-carbon biofuels, renewable energy, and clean hydrogen fuel, as well as green chemicals. High purity hydrogen can be generated from water electrolysis but is hindered by inefficient oxygen evolution reaction (OER) and the possible explosive mixture of oxygen and hydrogen under the condition of partial loading and membrane degradation. There is a widespread effort to replace OER with the more favorable electrooxidation of small organic molecules. Although value-added products can be generated, the production of these organics is process-intensive and costly. Most importantly, they lack the abundance necessary to meet the requirements of a hydrogen economy.

Abundant raw biomass with annual production of billions of tons in nature are promising alternatives to these small organics. Significantly, biomass reforming via electrooxidation (to replace OER) could close the carbon cycle and promote a circular economy. However, the complex structure of raw biomass poses challenges, limiting processability. Consequently, these biomass materials are conventionally used as fuel for electricity generation, leading to CO_2 emission and underutilization of biomass. Therefore, from both resources recovery and carbon abatement perspectives, it is critical to develop advanced electro-refinery system for biomass valorization. To overcome the low processability of raw biomass, highly efficient pretreatment methods were developed and thoroughly investigated.

Herein, fast-growing plant species were featured as promising biomass for reforming due to their rapid carbon fixation within a short timeframe. Their fast growth rate also accompanies a shorter lifespan; hence they release carbon back into the atmosphere only after a short period of storage, rendering advanced carbon storage and utilization crucial. Reforming biomass from fast-growing plant species not only produces green commodity chemicals and hydrogen fuels but also holds promising potential for climate change mitigation.

Biography

Hong Li is currently an Associate Professor in Nanyang Technological University (NTU) Singapore. Before he joined NTU in 2016, he was a postdoc in Stanford University in United States. Dr. Hong Li received a few awards including the prestigious Singapore Millennium Foundation postdoc fellowship and Nanyang Assistant Professorship. Dr. Li's current research focus on renewable energy and sustainability including waste-to-value, green hydrogen generation, passive cooling, etc. Dr. Li has published more than 90 peer-reviewed papers in international journals that have received more than 17, 000 citations. Research interests is about advanced waste upcycling.

Virtual - Day 1
Oral Presentations

ECOTOXICITY ASSESSMENT OF CONSUMER PRODUCT-DRIVEN CONTAMINANT PARTICLES IN A MARINE ENVIRONMENT

Sung Hee Joo

Metropolitan State University of Denver, USA

Abstract

Daily consumption of consumer products, including plastic products, lotions, food, and toothpaste, releases particles to environmental media (e.g. air, water, and soil) and may have various cumulative environmental effects over time. The environment's heterogeneous nature and numerous co-existing contaminants present challenging and complicated issues regarding assessing potential risks, particularly toxicity effects on marine environments. The ocean is a major carbon sink crucial for mitigating global warming potential. However, scant information exists concerning the harm of contaminant particles in oceans. In this paper, a case study on nanomaterials in consumer products is explored for their ecotoxicological effects on marine environments, particularly the synergistic toxicity effects of contaminant particles on marine diatom algae, along with detailed toxicity mechanisms. Further, the changes in the physicochemical properties of marine diatom algae due to exposure to contaminant particles, as an indicator of marine pollution, are discussed.

SCOPE 3 DECARBONATION, ROLE OF MICROALGAE, CONSTRAINTS AND SOLUTIONS

Jean-Louis Roux Dit Buisson
NeoCarbons sa, ZHAW, Switzerland

Abstract

Background: Microalgae can play an important role in decarbonating Scope 3 entrants with bio-green chemicals from recycled Scope 1 & 2 CO_2. Current photosynthetic technologies are not suited for industrial competitive production due to their inherent low productivity and high costs linked to the poor efficiency in transfer of photonic energy (less than 30% yield on power). Energy is 85% of the opex in industrial photosynthesis.

Objective: NeoCarbons has patented and successfully tested a disruptive equipment that has a high power to photon efficiency (85%), and a close to theoretical optimum efficiency in photon usage (90%). Under proper operating conditions a reactor equipped with NeoCarbons' equipment can operate in continuous mode at the optimal productivity point, thus delivering low production costs on a significantly reduced footprint, with no water waste.

Methods: NeoCarbons' equipment was tested at ZHAW in both a 2.5L prototype (to determine versatility with respect to 5 major microalgae strains), and 50L pilot equipment (to determine industrial potential).

Results: 5 x 600 hours runs were successfully performed with *Chlorella Vulgaris* (2) and *Galdieria Sulphuralis* (3 runs, pH2, 42°C). The industrialization readiness of NeoCarbons' equipment was demonstrated: CPU controlled growth of the microalgae, continuous operations at optimal productivity point, versatility in controlling for biomass optimization and/or metabolites optimization. The runs also witnessed no fouling in the reactor, a significant improvement leading to less downtime and lower production costs. The equipment is compatible with sterilization processes (Tandalization at 120 degrees). Samples analyses were performed by a 3D party, ETH-Z. On chlorella vulgaris we obtained 3x the amount of protein compared to other technologies, on *Galdieria Sulphuralis* the quality and content of pigment phycocyanin was qualified as exceptional.

Conclusion: NeoCarbons' equipment is well suited for an industrial remediation of Scope 1 and 2 CO_2 emissions, and the supply of substitutes of fossil-based chemicals as Scope-3 entrants in the foods, feeds, fine chemicals and chemicals (biofuels, -pesticides, - fertilizers etc) industries.

Biography

Jean-Louis Roux Dit Buisson has 25 years of experience in developing and growing technology-based companies. His business developer experience covers materials and processes industries (Hexis Fuel Cells, SmartMonitor preventative maintenance, SuPrem advanced carbon fibers, Sulzer Metco, Sulzer Innotec) and health care industries (Medical devices, pharmaceuticals, biopharmaceuticals diagnostics).
Jean-Louis started his career as a process engineer at Badger USA, and later as a production engineer Advanced Resins at Exxon Chemicals. His management experience includes management and coaching in private and corporate technology-based growth businesses and Health care industries. Jean-Louis has held responsibilities as CEO, M&A, Finance, Marketing, Sales, R&D management and Production responsibilities in large groups, start-ups and SMEs. He has counseled boards on M&As, technology licensing, including strategic integration plans and pricing for value decisions. Jean-Louis holds an MBA from Insead, an MSc in Chemical Engineering from MIT and an Engineering degree from ENSCP Paris-Tech. Research interests are Photosynthesis and light distribution.

WATER QUALITY INDEX (WQI) OF THE ENGENHEIRO ÁVIDOS DAM, LOCATED IN THE PIRANHAS RIVER BASIN, BRAZILIAN SEMIARID

Érika Alves Tavares Marques, Anthony Epifânio Alves, Jonathas Santos de Araújo and Maria do Carmo Sobral

Universidade Federal de Pernambuco, Brazil

Abstract

Background: The Engenheiro Ávidos dam is located in Northeast Brazil in a semi-arid climate. The construction of this dam aims to regularize the water supply problem in the region due to the low levels of rainfall for consecutive years, which compromised the supply of this source. To alleviate water supply problems in the State, the reservoir storage system continues to be the most used option to address water shortages, despite its efficiency being questionable, as water supply becomes compromised during periods of prolonged drought.

Objective: Assess the water quality of the Engenheiro Ávidos Reservoir.

Methods: Data were drawn from the 2009 to 2022 provided by the Ministry of the National Integration. The Engenheiro Ávidos Dam was monitored during 26 campaigns. The sampling points are located upstream of the dam (P1), in the reservoir (P2) and downstream of the dam (P3). To assess water quality, WQI was used.

Results: The WQI of the water of the dam ranged from Bad (27) to Excellent (80) during the study period. Point P2 during the dry period presented the WQI with the best value in the group. Regarding thermotolerant Coliforms and total phosphorus, there was no normal distribution according to the Shapiro-Wilk test (p-value<0.05). Although the quality results were satisfactory, concentrations of pH, BOD, total phosphorus and thermotolerant coliforms were found to be outside the standards established in CONAMA Resolution nº 357/2005 and in Ordinance 518/2004 of the Ministry of Health. According to the literature, in the Piranhas River Basin, sand removal, deforestation, soil salinization, release of effluents, garbage disposal on the banks, inadequate irrigation management, indiscriminate use of pesticides and insufficient sanitation were found.

Conclusion: Given this scenario of water scarcity and environmental impacts in the basin, it is necessary to promote efficient management in order to guarantee water supply to the population.

Biography

Érika Alves Tavares Marques is a PhD in Development and Environment, Master in Environmental Technology, Specialist in Environmental Management and Control, Environmental Management Technologist and Biologist. Her expertise is in water quality and pollution control, having published several articles on the topic. Research interests are water quality and pollution control.

PHILOSOPHICAL CONSIDERATIONS OF SUSTAINABILITY

Paul Comet

Comet Environmental Consulting, USA

Abstract

Minimizing waste generation by use of waste management companies or by using the manufacturer to take extended product responsibility (EPR) to recycle discarded objects are two different directions that can be followed to "complete the recycling circle". Ludwig, 2023, in Germany, uses the example of unwanted washing machines that can be taken back to a specialized washing machine recycling plant or discarded as unsorted scrap by a waste management company.

To fulfil complete "circularity" for every discarded object is probably not realistic. However, the USA automobile industry has largely achieved this. Damaged or obsolete cars are auctioned off, refurbished or cannibalized for spare parts, their organic components stripped away & the chassis shredded or cubed ready for melting at the local steel works. A similar model could be envisaged for other "big ticket" items such as fridges and stoves.

Ludwig 2023 proposes Circular Economy Recirculation Twigs (CER Twigs) as an analytical tool for the description of the many different circles that start at different points in a product's life cycle. These in order to close – the -loop of each cycle. In my view, while the use of CER Twigs may be important in studying the recycling of big-ticket items, they would be impractical for the recycling of small items such as in electronics, where a "mining "metal reclamation model may be more useful.

The largely organic nature of municipal waste may be more practically dealt with by considering it as fuel, for syngas or hydrogen source using gasification or steam reforming methods.

Reference

System Change to Circular Economy and its Impact on the Waste Management Sector | WMW (waste-management-world.com)

REVERSING GLOBAL HEAT ACCUMULATION BY RESEARCHING RECENT PALEOCLIMATOLOGY

Thomas F Valone

Integrity Research Institute, USA

Abstract

Background: Research into 420,000 years of paleoclimatology has uncovered a detailed past of temperature, carbon dioxide (CO_2) levels, and sea levels. This has produced a rich data set of those variables but also a predictive future global hothouse environment and suggestions of a sound method for its reversal. The world's population has tripled (3x) since 1950, with another 50% increase expected by 2100, global annual CO_2 emissions growth rate has quadrupled (4x) since 1950 and global energy demand has quintupled (5x), all in the same time period. This discontinuous combination can be called a "3-4-5 Triad" and the sudden acceleration in all three arenas is too stressful for the environment and the damaging effects will be felt globally for centuries to come unless drastic action is taken.

Objective: To demonstrate that the past 420,000 years of paleoclimatology yield a predictive future global environment roadmap.

Methods: Data was supplied from the Vostok Ice Core and calculations were made to determine temperature, carbon dioxide concentration, and approximate sea level. Extrapolations are made from the Hansen graphic summary for the near (this century) future.

Results: The Hansen graphs also yield an equation from the multilevel data analysis which fits the historical variables of global temperature, carbon dioxide concentration, and sea levels. Furthermore, the equation reasonably condenses 420,000 years of global climate record and reveals a tight correlation between the three variables that can be advantageously manipulated through geoengineering. Comparisons with contemporary published climate predictions yield conclusive validity to the data and method.

Conclusion: By the close examination of paleoclimatology for the past 420,000 years, it is found to be demonstrable that reducing the concentration of this single most prolific heat-trapping gas by geoengineering at the gigaton level, back to pre-industrial levels of less than 300 ppm, can actually give humankind a collective control over the world's rapidly rising average global temperature and once more, a temperate climate to live in and prosper.

Biography

Thomas F Valone - Physicist and licensed professional engineer, Dr. Thomas F. Valone is also an author and editor of several books including most recently, ***The Future of Energy*** (Nova Science Pub. 2020), as well as over 100 articles. Dr. Valone has lectured widely at government and organizational venues. He is President of Integrity Research Institute and formerly a physics teacher at Erie Community College, a USPTO patent examiner, and a Research Scientist for Scott Aviation. He has appeared on CNN, A&E, History and Discovery Channels, besides a few commercial energy videos. Dr. Valone has been a speaker for the Earth Transformation Conference, Whole Person Healing Conference, Joint Propulsion Conference (AIAA).

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DISTRIBUTION OF VECTORS OF AMERICAN VISCERAL LEISHMANIASIS IN THE STATE OF RIO DE JANEIRO/ BRAZIL: MUNICIPAL VULNERABILITY FOR TRANSMISSION, ECOLOGICAL NICHE MODELLING AND PREDICTED GEOGRAPHIC DISTRIBUTION

Elizabeth Ferreira Rangel[1,2], Margarete Martins dos Santos Afonso[1,2], Bruno Moreira de Carvalho[3], Artur Augusto Velho Mendes Júnior[4], Cristina Maria Giordano Dias[5], Lucas Keidel[5], Patrícia Soares Meneguete[5] and Sandro Antônio Pereira[4]

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[4]Instituto Nacional de Infectologia, FIOCRUZ, Rio de Janeiro, Brazil
[5]Secretaria de Estado de Saúde do Rio de Janeiro, Brazil

Abstract

Background: Leishmaniasis is sensitive to climate and environmental changes, vectors species are dependent on climate.

Objective: This study aims to identify vulnerable municipalities, mapping the spatial distribution of disease, vectors (*Lutzomyia longipalpis* and *Migonemyia migonei*), predict spatial distributions using ecological niche modelling based on climate and environmental variables.

Methods: The occurrence of vectors, human and canine cases of AVL were obtained by the National Information System on Notifiable Diseases of RJ and literature; association with non-correlated bioclimatic variables: temperature, precipitation, altitude. Enhanced Vegetation Index Models were based on algorithms: bioclim, logistic regression, random forest, maximum entropy, and support vector machines; were run in R and the final maps were designed in QGIS.

Results: The database included 42 records of *Lu. longipalpis* and 88 of *Mg. migonei*, present in 19 and 31 municipalities, respectively from RJ. Model outputs had TSS scores between 0.5 and 1, and the ones with TSS<0.7 were excluded from the final predictions. Both vectors are predicted to occur sympatric in the metropolitan region, coastal lowland, parts of the green coast and South of the Northern region. *Migonemyia migonei* is predicted to occur additionally in the middle Paraíba, Center-South, Northwest and Southern green coast. In the last three years in RJ, 48% municipalities registered human transmission, 52% were vulnerable and 29% of which were receptive (with vectors); having only 37% municipalities with vectors.

Conclusion: Although the impacts of climate change must be noted, these results contribute to knowledge of ecology and distribution of AVL vectors in Rio de Janeiro. Recently, has been observed increasing transmission in urban areas. These studies provide future scenarios for surveillance and prevention planning, and also contribute to the knowledge of ecology and distribution vectors in RJ.

Acknowledgement for Financial Support: Climate Change National Institute of Science and Technology/ INCT (Climate Changes) Brazil; National Council for Scientific and Technological Development/

CNPq; Research Support Foundation of the State of Rio de Janeiro/ FAPERJ; Oswaldo Cruz Institute, FIOCRUZ/ Rio de Janeiro, Brazil.

Biography

Elizabeth Ferreira Rangel - Public Health Researcher at the Oswaldo Cruz Institute, Oswaldo Cruz Foundation. She is coordinator of the National and International/Regional Reference Laboratory (PAHO/WHO) in Entomological Surveillance, Taxonomy and Ecology of Leishmaniasis Vectors, at the Oswaldo Cruz Institute, since 2004. Consultant to the Health and Environment Surveillance Secretariat, Ministry of Health, for the National Leishmaniasis Program. He is a member of the Expert Committee of the Leishmaniasis Control Program of the Pan American Health Organization. He is a member of the WHO Expert Advisory Panel on Parasitic Diseases (Leishmaniasis). She is Coordinator of the Fiocruz Reference Network for Leishmaniasis. Deputy Director of Reference Laboratory and Biological Collections, at the Oswaldo Cruz Institute. Coordination of the Health Sub-component of the National Institute of Science and Technology in Climate Change. Research interests are entomological surveillance, taxonomy and ecology of Leishmaniasis vectors, climate and environmental changes.

THE EFFECTS OF CLIMATE CHANGE ON HEALTH IN KENYA: CHALLENGES AND PROSPECTS

Peter Imatari Emoit

Dublin City University, Ireland

Abstract

The health sector of many countries in Sub-Saharan Africa (SSA) has deteriorated due to extreme events associated with climate change. This paper explores how extreme climate change events are worsening and affecting the health of many poor people in Kenya. The public's exposure to extreme weather events affects production and the economy's growth. The greatest challenge faced in SSA is the early detection, treatment, and control of emerging and spreading diseases linked to climate change. Climate change has also accelerated the emergence of air and waterborne diseases that have challenged the survival of many species. Moreover, the unclean air has also threatened human health due to pollution, exponentially increasing the spread of pathogenic diseases. This paper will, therefore, use secondary data to demonstrate how extreme climatic events such as floods and drought contribute to the increase of respiratory, vector-borne and waterborne diseases. A systematic literature review of studies on climate change and health in Kenya will be conducted by searching PubMed and Web of Science. The articles that will be reviewed will describe the effects of climate change on health in Kenya. To ensure eligibility, the full text of the articles selected will be screened.

This study will contribute to a better understanding of the dynamic effects of climate change on health, explore a way forward in reducing disease strategies, and benefit communities and households vulnerable to extreme events.

THE REGIONALLY OPTIMIZED SCHEDULE OF SUPPLY AND DEMAND FOR ENERGY RESOURCES WITH IMPACTS ON ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY

Fardin Farahnak
Iranian Ministry of Energy, Iran

Abstract

1. Introduction

The world's primary environmental challenge is achieving maximum environmental sustainability. This ambitious goal requires a shift towards comprehensive global integration, characterized by strong adherence to sustainability principles under an efficient enforcement system. Contrary to the linear economic system, this transition aligns well with the fundamentals of the circular economy. Below, we review trends in natural resource consumption, related challenges and risks, and strategies for sustainable resource use. The innovation of this research is presented as a hypothetical model targeting maximum global integration to achieve environmental sustainability. We then discuss how this approach contributes to economic sustainability.

2. Global Resource Consumption Trends

- According to the United Nations Environment Programmes Global Resources Outlook, natural resource consumption is expected to increase by 60% by 2060 compared to 2020 levels. This growth is driven by urbanization, industrialization, and population expansion.
- Key resources include food crops, wood for energy, fossil fuels (petroleum, coal, and natural gas), metals (iron, aluminum, copper), non-metallic minerals, land, and water.

3. Challenges and Risks

- Rising resource demand leads to severe consequences such as biodiversity loss, water stress, climate change, and air pollution.
- Disrupted supply chains for critical goods and resources are among the top risks identified in the World Economic Forum's Global Risks Report 2024.

4. Strategies for Sustainable Resource Use

- **Decoupling:** Balancing resource use to decrease environmental impact while increasing well-being, through more efficient and effective resource use.
- **Policy Instruments:** Implementing policies that promote sustainable consumption and production patterns, particularly in resource-intensive sectors such as agriculture, forestry, construction, and energy production.
- **Renewable Energy Transition:** Shifting from fossil fuels to renewable energy sources (solar, wind, hydro, biomass) can significantly reduce carbon emissions.
- **Resource Efficiency:** Promoting efficient resource use in cities and countries contributes to achieving the UN Sustainable Development Goals (SDGs).
- **Incorporating Environmental Impacts:** Converging the in-practice optimized combination of the resources to the so-called socially optimized combination of them.

5. Optimizing the Supply and Demand of Energy Resources

The first step in this initiative is to clearly define the goal: an optimal economic combination of energy production and consumption with minimal environmental impact, assuming maximum global integration. This involves a hypothetical combination of optimal production and consumption levels of energy resources in different regions, continuously updated. This model serves as a benchmark for national and international programs, enhancing accountability for environmental outcomes.

- **Consideration of Costs and Environmental Impact:** Evaluate the usage costs and environmental impacts.
- **Removal of Political Barriers:** Envisioning a utopia where resources can freely cross borders.
- **Regional Optimization:** Account for variations in resource availability, infrastructure, capacities, and potentials.
- **Separate Analysis by Region:** Analyze geographical regions individually for different resources.
- **Sustainability Criteria:** Ensure no decrease in national production and welfare, include transportation and utilization costs, and consider current and feasible extraction, transmission, and consumption capacities.

6. Conclusion

Urgent action is needed to transform global resources' supply and demand patterns. By aligning policies, technology, and international cooperation, we can advance toward a more sustainable and resilient future. Identifying regional economic potentials for supplying global resource needs and optimize resource supply with economic justification, while considering transmission, transformation, and adaptation costs, supports the principles of the circular economy—reducing production and consumption, and promoting reuse and recycling. Therefore, let's go toward establishing a dynamic comprehensive map of the sustainable supply potentials of the resources by the regions.

7. References

- United Nations Sustainable Development Goals
- Global Resources Outlook
- World Economic Forum Global Risks Report 2024

SCALER THEORETICAL AND PRACTICAL IMPLICATIONS OF PLASTIC WASTE SEGREGATION AND DISPOSAL PRACTICES AT THE UNIVERSITY OF GHANA CAMPUS

Victoria Nyebe Sika

University of Ghana, Ghana

Abstract

I report on research conducted on plastic waste (mainly bottled and sachet water) segregation and discard behavior practices at the University of Ghana campus, Jones-Quartey Building (JQB). The study aims to document students and faculty's behaviors toward plastic waste segregation (mainly bottles and sachets) at one of the largest lecture hall complexes on campus. I used interviews, observations (including participant observations), and focus group discussions to gather data for this study. Three core objectives underpin the study. The first objective is to identify the extent to which students and faculty patronize the segregation bins. Secondly, I documented the motivational drive for plastic waste segregation. Finally, I explore the variable scales by which the discard behavior at this little enclave in Ghana could have broader implications for archaeological practice, environmental sustainability, and climate change devoid of international boundaries. The study revealed that socioeconomic status and safety are key factors that determine the use of bottled or sachet plastic water containers. Regarding the patronage of plastic segregation, the frequency of emptying the bins was a key consideration. This indication suggests that if the segregation bins are regularly emptied, users will patronize them. The study has implications for environmental sustainability and the archaeology of plastics in the future.

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EVALUATION OF ENVIRONMENTAL BURDENS AND POTENTIAL DECARBONIZING OPPORTUNITIES FOR STEEL MANUFACTURING IN PAKISTAN

Shamraiz Ahmad, Hania Rubab, Tiberio Daddi, Shahid Ikramullah Butt and Riaz Ahmad

Sant'Anna School of Advanced Studies, Italy

Abstract

Background: In Pakistan, the iron and steel industry is a leading manufacturing sector that plays a significant role in the national economy. However, it consumes a significant amount of energy, produces various emissions and generates wastages. An assessment of environmental burdens may enable to review and improve the environmental outlook of this sector.

Objective: As there is limited research on this topic, the objective of this study is to evaluate the environmental impacts of a mini steel mill (manufacturing plant), located in Pakistan.

Methods: For this study, the system boundary includes scrap melting, continuous casting, and rolling processes, representing the gate-to-gate steel production. Primary data were collected from a steel production plant, located in Islamabad. The study utilizes SimaPro V9.4 software as the modeling tool and the Recipe method to map various impact categories. A comprehensive cost analysis is conducted to assess the financial implications for renewable energy transition.

Results: The scrap melting process was found with higher environmental impacts in most of midpoint impact categories, including global warming, acidification, ozone depletion, etc. This was mainly because of the energy intensive nature of melting process and coal-based energy generation at the plant. After melting, it was the continuous casting process that generated more impacts and it was followed by the rolling process. At the endpoint (damages) level, the scrap melting caused more damages to all three areas of protection. Cost analysis showed that while transitioning to a solar energy system, the payback period for the case study plant was estimated to be six years.

Conclusion: The results of alternative scenarios were compared with the baseline scenario to show the reduced environmental impacts and discuss potential decarbonizing opportunities and costs implications. Overall, this study offers valuable insights for the policymakers, practitioners and related researchers who are seeking to promote sustainable and cleaner steel production, especially in developing world.

Biography

Shamraiz Ahmad's research interests include sustainability performance evaluation and life cycle assessment of products, systems and innovative technologies, circular economy, open innovation, and sustainable business practices. He has written many articles for various high quality international journals, in the areas of industrial food production, metal and glass manufacturing, leather manufacturing, wastewater and sludge treatment, electronic waste management, etc.

BEYOND THE HUE: NAVIGATING THE IMPACTS OF SYNTHETIC DYES AND PATHWAYS TO SUSTAINABLE SOLUTIONS

Madhuri Nigam and Niharika Jain

Lady Irwin College, University of Delhi, India

Abstract

Background: While the story of synthetic dyes is often celebrated for its technological breakthroughs and industrial achievements, it also harbors a darker tale of multifaceted challenges. As synthetic dyes have become increasingly prevalent and diverse over time, their pervasive presence in our surroundings has catalyzed a range of environmental consequences. From the pollution of water bodies due to the discharge of dye effluents to the contamination of soil and groundwater from dye manufacturing processes, the environmental footprint of synthetic dyes is undeniable. These pollutants also have far-reaching implications for human health and well-being.

Objective: This review aims to delve deeply into the intricate ramifications of synthetic dye usage on both environmental ecosystems and human health, offering a comprehensive analysis of existing mitigation strategies and regulatory frameworks. By scrutinizing the efficacy of current approaches, it aims to pinpoint gaps and limitations while proposing forward-thinking, sustainable alternatives to address the persistent challenges posed by synthetic dye pollution.

Methods: Academic databases and relevant sources were systematically searched for the review, applying the inclusion criteria. Data were extracted from selected studies, and the findings were synthesized to address the objectives.

Results: Synthetic dye pollution persists as a pervasive threat, despite mitigation and regulatory efforts, with adverse effects felt across ecosystems and human populations. Gaps in current approaches, such as inadequate enforcement and a dearth of sustainable alternatives, are identified in the review, highlighting the pressing need for holistic solutions.

Conclusion: This review underscores the pressing imperative for strategies to combat synthetic dye pollution. Recommendations advocate strengthening regulatory enforcement, fostering innovation in sustainable dye production such as dye extraction from waste sources, adopting innovative technologies, and promoting international cooperation to mitigate the global impact of synthetic dye pollution. By embracing sustainable practices and collaborative strategies, stakeholders can safeguard the environment and public health for future generations.

Biography

Madhuri Nigam, Associate Professor – Department of Fabric & Apparel Science, Lady Irwin College (University of Delhi). Department in Charge from January 2020. Madhuri Nigam has been in academics for 21 years. Her area of specialization is Textiles and apparel. She has been working on life cycle assessment for several years. She has developed 52 Life Cycle Inventory (LCI) datasets for the SRI project for Eco invent. Additionally, she has reviewed around 206 EF 3.00 compliant LCI data sets for EU funded PEF project of Eco invent.

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LOW-COST ACTIVATED CARBON FROM NITRILE BUTADIENE RUBBER GLOVES WASTE AND ITS APPLICATION FOR THE REMOVAL OF PHENOL IN WASTEWATER

KC Nedzivhe-Mqehe and BO Ojo and N Mabuba

University of Johannesburg, South Africa

Abstract

Background: The global usage of nitrile butadiene rubber (NBR) gloves has increased over the past few years. This was influenced by the Covid-19 pandemic which has raised high health risks across the world. The biggest problem with this kind of glove is that they are designed for a single use and discarded leading to the generation of high volume of waste. Currently waste gloves are disposed through incineration and landfill. These kinds of methods offer a quick reduction of waste. However, the biggest challenge with these methods is that CO_2 is produced into the atmosphere, land deposition results in accidental fires posing a high risk to living organisms.

In attempting to resolve this issue, several countries are forced to stipulate more stringent requirements for waste management. One of the requirements is to generate the need for innovative technologies to eliminate waste.

Objective: This study aims to recycle waste NBR gloves by using it as the precursor for synthesis of activated carbon. The activated carbon will be used to remove toxic phenol in wastewater.

Methods: Waste NBR gloves was washed, and pyrolyzed at 500°C for 1 hour. H_3PO_4, $ZnCl_2$, KOH and H_2O_2 were used to activate char. The mixture was kept at room temperature for 24 hours. The pretreated samples were washed with deionized water and oven dried at 110°C for 24 hours. Batch adsorption method was used for adsorption of phenol in wastewater.

Results: Activated carbon was characterized using Zeta potential, Elemental analyzer, FTIR, TGA, SEM, XRD and BET. The optimum removal of phenol achieved was 78, 55, 62 and 73 % for AC-H_3PO_4, H_2O_2, KOH and $ZnCl_2$ respectively.

Conclusion: The significance of this research is to develop a new way of recycling waste NBR gloves which is generated in large quantities in academic institutions, hospitals and pharmaceutical industries.

Biography

K C Nedzivhe-Mqehe is vastly experienced in managing various laboratory activities and waste recycling. Her passion and expertise have been instrumental in the structuring of research laboratories at the University of Johannesburg. Recycling used gloves has been a continuous challenge that her research aims to address. Research interest is about waste management.

Virtual - Day 2
Oral Presentations

A COMPARATIVE NATIONAL-LEVEL ANALYSIS OF GOVERNMENT FOOD SYSTEM RESILIENCE ACTIVITIES ACROSS FOUR DEVELOPED COUNTRIES AT VARYING STAGES OF PLANNING

Jane Lloyd, ERH Moore, Lyndsey Dowell and Roni Neff
Springhouse Consulting, New Zealand

Abstract

Background: The COVID-19 pandemic, extreme weather events, and the Russian invasion of Ukraine have highlighted global food system vulnerabilities and a lack of preparedness and prospective planning for increasingly complex disruptions. This has spurred an interest in food system resilience. Despite the elevated interest in food system resilience, there is a lack of comparative analyses of national-level food system resilience efforts. An improved understanding of the food system resilience landscape can support and inform future policies, programs, and planning.

Methods: We conducted a cross-country comparison of national-level food system resilience activities from Australia, Aotearoa New Zealand, Sweden, and the United States. We developed upon and adapted the resilience framework proposed by Harris and Spiegel to compare actions derived from thirteen national food system resilience documents. We coded the documents based on the actions taken by the governments including: the food system resilience attributes utilized, the part of the food supply chain, the specific shocks or stressors, the implementation level, the temporal focus of action, and the expected impact on food security. We analyzed and compared countries' coded categories and subcategories, and category combinations.

Results: The results showed that these countries are addressing some of the same issues, are using multi-pronged policy actions to address food system resilience issues and are focused on both retrospective reviews and prospective models of disruptive events to inform their decisions. Some work has been done towards preparing for climate change and other natural disasters, and less preparing has been done for other shocks or stressors.

Conclusions: This paper develops and applies a framework rooted in literature to understand the content of national level food system resilience documents. The analysis identified potential gaps, concentrations, and themes in national food systems resilience. The framework can be applied to augment existing policy, create new policy, as well as to supplement and complement other existing frameworks.

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AN ASSESSMENT OF ALTERNATE FERTILIZER POTENTIAL OF GLAUCONITE DEPOSITS IN INDIA USING SIMPLE BENEFICIATION METHODS

Tehreen Shaikh[1], Tathagata Roy Choudhury[1], Santanu Banerjee[1] and P V Sunder Raju[2]

[1]Indian Institute of Technology Bombay, India
[2]CSIR-National Geophysical Research Institute, India

Abstract

Background: India meets its needs for agricultural potassium fertilizers through imports from countries like Canada, Russia, and Belarus largely. The necessity for an indigenous source is due to the depleting reserves of potash fertilizer and the ever-increasing demand in the market. Glauconitic soils help to avoid the problem of early salinization in agricultural fields, releases nutrients slowly, and enhances soil fertility The glauconitic content rarely increases by 20% and hence the need for enhancing its concentration before direct application to soil is researched.

Objective: To assess the fertilizer potential of glauconite mineral as an alternate source of potash fertilizer

Methods: Data were drawn by analyzing physical, chemical, and mineralogical characteristics of glauconite mineral through various geochemical techniques (XRF, XRD, ICP-AES, Magnetic separator). Samples of the glauconite mineral was collected from all the deposits across India. A series of simple beneficiation techniques was utilised to extract the maximum composition of that mineral. The characteristic of glauconite mineral is its magnetic nature, which was the basis of the study.

Results: Mineralogy of bulk samples from Phanerozoic sediments yielded 15% to 20% glauconite. The sieving process led to further enhancement of glauconite in the resultant fraction. A moderate to high content of glauconite is fractionated, in comparison to the bulk counterparts. The magnetic concentrate of glauconite, derived from the magnetometer at an optimum current shows a significant increase ranging from 35% to 57% across magnetic, sub-magnetic concentrates of different rock fractions.

Conclusion: Glauconite can be a good alternative of potassium fertilizers because of its readily exchangeable potassium ion. Precambrian glauconites, instead of having larger concentrations of glauconite occur in partially cemented sandstones and is difficult to process. However, the Phanerozoic glauconites are weakly consolidated and can be processed easily. Fractionation and reworking on these finer fractions can be easily utilized for further extraction processes.

Biography

Tehreen Shaikh has her expertise in Geosciences, with an inclination towards sedimentology, sustainability, and hydrogeology. She is passionate about nature and practices greener alternatives in her routine life. She is currently working for a consultancy exploring solutions for sustainable design and engineering. Her implication of the techniques that can be beneficial for the enhancement of fertiliser is a pathway to a global scale issue of potassium import, for countries dependent largely on import. She has derived this hypothesis based on her strong academic knowledge and her background of teaching, research, and evaluation. These techniques have been used in India for the first time and globally, only second to Russia. The foundation is based on Rudmin et al 2017, which studies economical techniques for concentration of glauconitic mineral as an alternate fertilizer for potash source. The techniques have been used, enhanced and newer methods have also been diagnosed for the same outcome. Research interests are sedimentology and sustainability.

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CLIMATE SOLUTIONS AND SUSTAINABLE ENTREPRENEURSHIP: A BIBLIOMETRIC REVIEW OF PUBLISHED ARTICLES IN 2023

Ebenezer Takyi, Isaac Atta Senior Ampofo, Kwame Nkrumah Hope and Collins Kuffour

University of Liverpool, UK

Abstract

Background: The Sustainable Development Goals (SDGs) indexing shows how fiercely the world is competing to accomplish the SDGs in the next ten years and provide sustainable well-being for all. By the end of the twenty-first century, the World Economic Forum predicts that 200 species would go extinct each year and that climate-related calamities will cost the US economy 10% of its GDP. There is no denying the truth of climate change and attempts to adapt to it have been the subject of in-depth research worldwide.

Objective: The goal of the study was to fill up knowledge gaps in sustainable entrepreneurship and climate solutions.

Methods: The study used VOS viewer analysis and bibliometric evaluation to methodically examine and visualize the body of existing literature. These methods improved the research's capacity to offer significant new information and suggest important avenues for further investigation at this crucial nexus between entrepreneurship and climate change.

Results: For research areas, Environmental Sciences Ecology recorded the highest of 2869 articles, amounting to 58.3%. This is followed by Science, Technology and other topics which recorded 2033 articles, amounting to 41.3%. Development studies and psychology recorded the lowest published articles of 45 representing 0.914%. Sustainability as a source had the highest of 1202 articles with 940 citations and 75 total link strength. The research sheds light on the detrimental consequences of extreme weather events and environmental regulations, but it is unclear how business owners may increase their resilience and modify their approaches to prosper in a changing climate.

Conclusion: Climate innovation-fostering entrepreneurial ecosystems should be actively supported and encouraged by policymakers. This entails setting up finance channels, incubators, and accelerators especially for companies creating resilience, adaptation, and mitigation strategies for the climate.

Biography

Ebenezer Takyi, Data Scientist, Researcher and Entrepreneur is currently studying with much interest in the application of data science skills in many fields especially in climate data analysis. He studied MPhil Computer Science at the University of Energy and Natural Resources, Sunyani, Ghana and currently undertaking an MSc in Data Science at Oslomet – Oslo Metropolitan University, Oslo, Norway. Team member of DHEFEUS through the collaboration of Oslomet and the University of Lisbon (Instituto Dom Luiz). Working on a research project to enhance the knowledge of compound weather/climate events, namely drought and heatwaves with the application of data science skills. Research interests are machine learning and climate change.

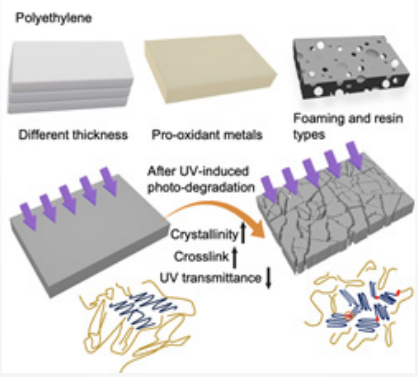
STUDY OF DEGRADABILITY AND GREEN WASTE MANAGEMENT OF POLYETHYLENE

Bochu Du and Ying Ji

Hong Kong Polytechnic University, Hong Kong

Abstract

Like most commodity plastics, polyethylene presents a significant challenge due to its low biodegradability and large quantities. Most conventional studies have focused on the biodegradation of polyethylene and waste mitigation. This study investigates the photo-degradability of polyethylene sheets under UV weathering conditions as defined by ASTM D5208. The impact of multiple factors such as metal stearates, thickness, foaming, and polyethylene resin types are explored through the characterization of the carbonyl index, molecular weight, tensile properties, and crystallinity. The results show that thickness, foaming, and resin types significantly impact the rate of photo-oxidation, especially when there is only one factor a single iron demonstrating a single increasing trend to accelerate the photo-degradation of polyethylene sheets. Thick polyethylene sheets (1.2 mm) exhibited heterogeneous oxidative progress between the face and back sides, resulting in the unsynchronized development of carbonyl groups and a delayed rate of molecular weight decrease. Additionally, foaming and resin types could significantly influence the photo-degradation rate by impacting UV transmittance and crystallinity, thereby hindering photo-degradation. Furthermore, the use of UV radiation, in combination with these optimized factors, could be a promising method for accelerating the degradation of polyethylene, thereby reducing its environmental impact. As the degradation of polyethylene progressed, the increase in crystallinity and the formation of crosslinks prevented further oxidative cleavage of the polyethylene chain. These findings provide valuable insights into the factors affecting the photo-degradability of polyethylene sheets, offering potential strategies for the formulation design of photo-degradation and mitigating the environmental impact of polyethylene wastes.



Biography

Bochu Du is a research graduate student from The Hong Kong Polytechnic University. She is a female scholar who has made significant strides in her field, demonstrating a commitment to academic excellence and a passion for knowledge. In this capacity, she has been able to apply her academic knowledge to practical research, contributing to her field and further developing her skills. Her academic and research training has not only allowed her to delve deeper into her area of interest but has also provided her with the opportunity to contribute to the broader community. Ms. Bochu Du has been working with biodegradable and bio-sourced materials, enhancing the degradability of commodity plastics, sustainable manufacturing, processing and green applications. Research interest is about degradation.

RECYCLING TRENDS AND CHALLENGES IN THE BALTIC STATES

Natalija Cudecka-Purina
BA School of Business and Finance, Latvia

Abstract

Background: Waste recycling is a niche that has huge potential for the successful implementation of the circular economy as well as for fostering transition from waste to resource management. Latvia along with Estonia and Lithuania have made major improvements in the field of waste management for the last 25 years – shifting from uncontrolled and illegal waste dumping to development of sophisticated and state of the art waste management system with sanitary landfills, waste sorting system, deposit refund system, waste recycling facilities and waste-to-energy plants. Although, being members of European Union for all three Baltic states means the obligation to fulfill the mandatory targets, set in the Waste Framework Directive.

Objective: To examine the current achievements and main challenges of waste recycling in the Baltic States.

Methods: Data on waste recycling has been obtained as a secondary data from Early warning reports published by the EU, as well as local statistical data. The data analysis will also engage a multilevel-model approach as well as systems dynamics.

Results: The recycling rate for household waste in Lithuania in 2021 accounted for 45.2%, in Latvia – 44%, and in Estonia – 30.6%. The target set in the EU WFD for 2020 was 50% and for 2025 is 55%. It is also essential to mention that unfulfillment of the targets can be followed by financial liabilities and/or infringement.

Conclusion: Although there is still a strong perception that circular economy is mostly about waste management, which is undoubtedly wrong, it does play a significant role in CE by possessing thousands of tons of potential valuable resources. This is why it is of crucial importance to understand i) how to divert these resources from the waste flow and ii) if they do enter the waste flow, how can we benefit from them in the most effective way by upcycling.

Biography

Natalija Cudecka-Purina, Assoc. Prof., Phd in Business Administration with a focus on circular economy and Sustainability for waste landfills. Natālija has over 15 years' experience in Sustainability, being involved in development of Latvian waste management system – implementation of infrastructural projects on dumpsite closure and recultivation, construction of sanitary landfills and waste sorting infrastructure. Followed by almost 10 years' experience in public sector in policy planning and strategy development. In the role of Associate Professor, Natalija has developed a range of study courses and continues scientific research in the field of sustainability, waste management, circular economy (LIFE, Erasmus +, Horizon, COST actions, etc.). Current research interest is on circular economy and industrial symbiosis, how to keep the resources in the economic cycle as well as to foster inter-sectoral and cross-sectoral cooperation. Research interests are circular economy, industrial symbiosis, resource efficiency and waste management.

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TREATMENT OF SUBSTANDARD ROCKET FUEL 1,1-DIMETHYLHYDRAZINE VIA ITS METHYLENE DERIVATIVE INTO HETEROCYCLES BASED ON PYRROLO-[3,4C] QUINOLINES, CYCLODODECA[B]PIRAN AND PYRROLE

Elizaveta Sergeevna Ivanova, Oleg Evgenievich Nasakin and Yhtiar Kadyrow

Ulyanov Chuvash State University, Russia

Abstract

Background: 1,1-Dimethylhydrazine (Heptyl, rocket fuel (UDMH)) is characterized by extremely high toxicity, teratogenicity and the ability to constantly absorb water from the atmosphere, losing its energy characteristics. To utilize UDMH in huge amounts, it is involved into immediate reaction with a formalin solution to form significantly less toxic 1,1–dimethyl-2-methylene hydrazone (MDH). MDH is polymerized under acidic conditions followed by its incineration, yielding a substantial amount of nitrogen oxides.

Objective: This study aims to develop environmentally friendly laboratory method of UDMH recycling via MDH.

Methods: MDH was obtained by careful addition of UDMH to formalin solution (40%) stirring the reaction mixture at 0-5°C for an hour. NaOH was added until two layers were formed. The water layer was separated from the organic layer. The organic layer was distilled with the provision of a rectification column at 64°C. Tetracyano ketones (TCEKs) were obtained by the general procedure: appropriative ketones were mixed with tetracyanoethylene (TCNE) in dioxane along with a catalytic amount of hydrochloric acid. The progress of the process was determined via a test for hydroquinone (blue TCNE complex). After the blue color ceased to appear, the dioxane solution was maintained at 0–5°C in the freezer for 10 min. Then, cold distilled water was added to the frozen reaction mixture in a volume equal to the dioxane solution to cause precipitation. The desired product was filtered off and washed with water. Each TCEK was mixed with MDH in equal amount in EtOAc. The reaction mixture was stirred at room temperature till the precipitation. The target products were filtered off and recrystallized from isopropanol. The structures were confirmed by IR, ^{1}H, ^{13}C NMR and mass spectroscopy methods.

Results: These MDH-based syntheses in one stage yield bi- and tricyclic compounds that exhibit structural similarities with well-known drugs. These structures are presented in figures 1 and 2.

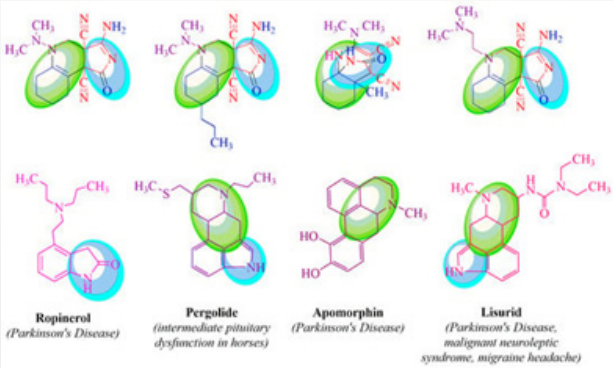

Figure 1. Adducts of MDH and TCEKs and neuroprotective drugs.

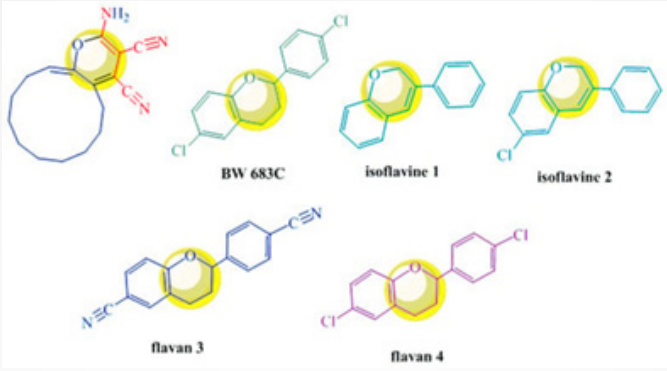

Figure 2. Adduct of cyclododecanone and MDH and antiviral compounds.

Conclusion: The obtained compounds have interesting structural scaffolds that are promising for molecular design and pharmaceutical chemistry.

«This research was funded by the Russian Science Foundation, grant number 23-23-00656»

Biography

Elizaveta Sergeevna Ivanova is the aspirant of Ulyanov Chuvash State University, Russia. She has 4 publications in national and international journals. She presented papers in more than 50 national conferences. Research interests are about syntheses based on dimethylhydrazine, its derivatives and tetracyanoethylene.

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EXAMINING LONG TERM ENVIRONMENTAL AND FINANCIAL IMPACTS OF MISSING HIGHWAY CONNECTORS

Orianne K Wang[1,2] and Deli Wang[3]

[1]Westview High School, USA
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Abstract

Background: California State Route 56 (SR-56) connects Interstate 5 (I-5) and Interstate 15 (I-15) for San Diego's North County region. However, there are no connectors from westbound SR-56 to northbound I-5 and from southbound I-5 to eastbound SR-56. Vehicles connecting the highways must take circuitous routes through multiple traffic lights and ramp meters.

Objective: To examine the long-term environmental and financial impacts of the lack of ramps connecting W-56 and N-5, and to understand the engineering design's impacts on sustainability.

Methods: By defining start/end points or landmarks for vehicles to exit/enter westbound SR-56/northbound I-5 or southbound I-5/eastbound SR-56, respectively,

- We measured trip times for vehicle to exchange highways, frequencies, and average vehicle occupancies at different times of the day and days of the week.
- Using trip times on connectors of the other direction as references, we studied the average delay time due to the missing highway connectors, estimated daily and annual additional CO_2 emissions due to the slow-down and equivalent monetary losses owing to time wasted.
- Google's Vision AI was employed to facilitate data analysis.

Results: The average delay time for vehicles connecting westbound SR-56/northbound I-5 and southbound I-5/eastbound SR-56 ranges from 1 to 3 minutes, resulting in a cumulative annual waste of half a million hours. Environmentally, it results in over 3,000 metric tons of additional CO_2 emissions and an equivalent monetary loss exceeding $10 million each year. These numbers are underestimated because data were collected between 4am to 10pm in a day.

Conclusion: Engineering decisions significantly impact the environment and sustainability. Long-term sustainability considerations should guide design, leveraging new technologies such as big data and AI to successfully meet traffic needs and keep pace with urban development. Although this study is conducted on a local case in San Diego, California, we believe the conclusion is universally true!

Acknowledgement: The authors are grateful to Dr. Ricardo Basurto-Dávila, Chief Evaluation Officer of the County of San Diego, for his generous support to this project by providing constructive advice and insightful guidance on designing the experiments.

Biography

Orianne K Wang is passionate about the environment, having started to eat vegan foods at 10 years old after learning about the pollution caused by cow farming in 4th grade. She began working on this project in 2022 during her spring, summer, and winter breaks while attending Westview High School in San Diego, California. She is currently a senior at Shanghai American School (SAS) in China.

Deli Wang received his B.S. degree in Polymer Chemistry from the University of Science and Technology of China and his Ph.D. degree in Materials Science from the University of California, Santa Barbara (UCSB). After his postdoctoral research at Harvard University, Deli worked at the University of California - San Diego (UCSD), from 2004 to 2014, as a professor in the Department of Electrical and Computer Engineering. He currently works on renewable energies and smart microgrids at Reshine Renewables Inc. Research interests are sustainability, environment sensing and monitoring, renewable energy, waste to energy and water.

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INCREASED ATMOSPHERIC CO_2 TRANSFER TO SOIL THROUGH MIXING OF FUNCTIONALLY DIVERSE PLANTS DURING REFORESTATION AND FALLOW (IVORY COAST AND CONGO)

Armand W Kone, Michel K Yao and Lydie-Stella Koutika
UFR Sciences de la Nature, Université NANGUI ABROGOUA, Ivory Coast

Abstract

Background: The agricultural sector generates about 30% of the global CO_2 emissions, making it a major contributor to climate change (CC). Conversely, agricultural soils can play a key role in CC mitigation by sequestering atmospheric carbon, provided that effective agroecological practices are implemented.

Objective: This study draws on case studies conducted in West and Central Africa to show how the mixture of plant species shedding litter with contrasting characteristics can promote soil organic carbon (SOC) storage during reforestation and fallow.

Methods: In the semi-deciduous forest zone of Côte d'Ivoire (Oumé), monocultures of teak (*Tectona grandis*) and cocoa (*Theobroma cacao L.*) that shed recalcitrant and moderately recalcitrant leaf litters, respectively, were investigated alongside a mixture of *T. grandis, Gmelina arborea, Terminalia ivoriensis* and *Terminalia superba*, shedding soft and recalcitrant leaf litters. In the forest-savanna transition zone (Taabo), the mixed fallow of the herbaceous *Chromolaena odorata* with the shrub legume *Cajanus cajan* was compared to the respective pure fallows. In Congo, the mixed tree stands of *Acacia mangium* (high-quality leaf litter) with *Eucalypt urophilla* (low-quality leaf litter) was compared to the respective pure stands.

Results: In Oumé, the SOC mineralization rate (C_{min}) and stock (0-10 cm depth) in the mixed tree stand were found to be higher than in the pure stands of teak (+9% and +16%, respectively) and cocoa (+27% and +26%). In Taabo, the mixed fallow exhibited higher SOC stock (0-10 cm depth) relative to *C. cajan* (+38%) and *C. odorata* (+13%). In Congo, the stock of SOC in the mixed tree stand was higher than in the pure stands of *A. mangium* (+35%) and *E. urophilla* (+30%).

Conclusion: Mixing functionally diverse plant species provides an effective natural solution to mitigate climate change, which should be promoted in sub-Saharan Africa.

Biography

Armand W Kone graduated in 2009 with a PhD in Soil Ecology/Agroecology. He is an Associate Professor at Nangui Abrogoua University, Abidjan, Côte d'Ivoire. His research work relates to sustainable soil management in natural ecosystems (forest and savanna), forest plantations, and agro-ecosystems. He has sharpened his expertise in getting actively involved in national, regional and international projects as principal investigator, head of work team or participant. He attended and presented scientific works at about 20 conferences nationally and internationally. He has a proven track-record in publishing scientific articles in high rank international journals on topics relating to soil ecology, agroecology, soil fertility, carbon and nutrient cycling and crop production. He currently acts as a reviewer for international journals and is an active member of 4 international research networks.
Research interests are soil ecology, agroecology, agroforestry, soil organic carbon, soil biology, soil microbial activity and crop production.

PEOPLE'S PERCEPTION ON DEPLETION AND DEGRADATION ON WATER RESOURCE IN PATNA AND KENDUJHARGARH BLOCK OF KENDUJHAR DISTRICT, ODISHA, INDIA - CLIMATE CHANGE PERSPECTIVE

Ranjan K Mallick and Sibabrata Das
Ravenshaw University, India

Abstract

Climate change poses a significant threat to water resources globally, with potential impacts on water availability, quality, and accessibility. Kendujhar, located in the eastern part of India, plays a crucial role in Odisha's economy due to its rich mineral resources and diverse ecosystem. The present study is based on the data and information collection from various secondary as well as primary sources. Precisely four data collection methodologies were applied: (a) Interviewing key informants based on designed questionnaire or check list (b) documentary research (c) organizational mapping (d) Focused Group Discussions. Both quantitative and qualitative data analysis methods have been employed in carrying out the analysis of data collected from primary and secondary sources. The analysis has been done with the help of spread-sheet application. The field survey for this study has been carried out and around the villages of the mining and industrial areas which are major contributor of water consuming related activities. The data for the present study has been collected using structured questionnaire structured questionnaire from 23 villages (13 from Kendujhar Sadar and 10 from Patna) comprising 178 households (121 from Kendujhar Sadar and 58 from Patna) and collected from various NGOs, Government Officials and Organizations involved in mining activities in both these blocks. However, the region faces challenges related to water scarcity, making it particularly vulnerable to climate change impacts.

Based on the survey data, a minority of villagers in Patna Block are satisfied with the quality of water. Overall, only 43% of villagers reported being satisfied, whereas 57% reported being unsatisfied. Erendei village has the lowest satisfaction rate at 0%, while Ghatbalijadi village has the highest satisfaction rate at 100%. The dissatisfaction level is 87.5% in, 71.4% in Kothanghar, and 62.5% in Dumuria. The average satisfaction level across all villages is 64%. This suggests that most people are at least somewhat satisfied with the water quality. However, there is a wide range of satisfaction levels between villages, from a low of 10% in Badapalasa to a high of 96% in Tikaragumura. This suggests that there are significant variations in water quality and access between different communities.

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UNDERSTANDING THE IMPACTS OF CLIMATE CHANGE ON AFRICAN INDIGENOUS COMMUNITIES AND EXAMPLES OF MITIGATION/ ADAPTATION RESPONSES: CASE OF THE BAKA AND BANTOUS LOCAL PEOPLE LIVING AT THE PERIPHERY OF THE DJA BIOSPHERE RESERVE

Nwafi Ngeayi Adi

ACOBIDER, Cameroon

Abstract

Background: Mitigating climate change, addressing waste and pollution, and ensuring environmental sustainability are among the world's most pressing issues. Increasing temperatures and sea levels, changing precipitation patterns and more extreme weather are threatening human health and safety, food and water security and socio-economic development in Africa and the global planet in general. According to a new report devoted exclusively to the continent. The State of the Climate in Africa 2019 report, a multi-agency publication coordinated by the World Meteorological Organization (WMO), provides a snapshot of current and future climate trends and associated impacts on the economy and sensitive sectors like agriculture. It highlights lessons for climate action in Africa and identifies pathways for addressing critical gaps and challenges.

Globally, there are an estimated 370 million indigenous people whose livelihoods are being negatively affected by climate change by means of an increased frequency and intensity of extreme weather events such as droughts, floods, storms, cyclones, as well as heatwaves, among others. While climate change is an environmental challenge that developed countries have largely contributed toward from anthropogenic activities, the negative impacts are being felt among poorer countries, particularly vulnerable indigenous communities who ordinarily live low carbon lifestyles. Additionally, many indigenous communities have been confined to the least productive and most delicate lands because of historical, social, political, and economic exclusion. Furthermore, less consideration has been given to indigenous groups during formulation of climate-change mitigation strategies, making them vulnerable to its effects. Notwithstanding, many indigenous communities have enduringly used various indigenous and local knowledge (ILK)-derived coping mechanisms passed from generation to generation. and promoting local technologies that help reduce carbon emissions and energy consumption. Also important is to develop and put in practice adequate governance frameworks that enable the sharing and re-use of environmental waste. At the same time, more focus needs to be placed on promoting environmental education and building awareness on environmental sustainability within the protected areas and local communities.

Objective: To understand the strategies derived from Indigenous Local Knowledge that indigenous groups have used to deal with ecological uncertainty (a.k.a. environmental risk) such as droughts, food insecurity, and loss of, or displacement from land, and how they build resilience against climate-related stresses and shocks.

Methods: Data were collected from the field Survey through focus group discussions with local communities living at the borders of protected areas around the Dja Biosphere Reserve in Eastern Cameroon. A sample of 350 households was selected. Data were collected from 200 women actively involved in agriculture and Non-Timber Forest Products Collection and 150Men who are mainly cocoa farmers. Data

were analysed using a regression analysis approach.

Results: Indigenous communities have been constantly adapting to the effects of environmental stresses over a very long period with numerous climate-change adaptation mechanisms being adopted in recent decades. However, more recent impacts of climate change have placed significant strain on these communities as indigenous people are impacted in idiosyncratic ways by climate change (e.g., reduction in crop yields, water scarcity, and exposure to malnutrition) and also Apart from the matters described in the background of study , there are further barriers to climate change adaptation that are often seen across the continent in general and the northern and eastern regions of Cameroon in particular, namely the unequal global vulnerability of populations, differential responsibility, and unequal power in decision-making concerning policymaking, thus undermining the resilience capability of indigenous communities. As seen in the studied communities are making their best efforts to address these barriers. There are examples that show that indigenous people's knowledge is one important component to the success of policies that aim to increase adaptation. For instance, the Afar communities have extensive experience in adapting to the impacts of climate change using their ILK via understanding the biophysical observations, and the community's perception was matched with the temperature trends using conventional weather-forecasting systems. Similarly, the Borana people have been using indigenous collective resource-governance systems, traditional social insurance and safety-net systems, and weather-forecasting systems based on changes in animal behaviors, as well as the movement and alignment of stars and divining animal entrails, which have proven to be reliable for centuries despite the challenges posed by an increasingly variable climate, thus allowing acclimatization to drought challenges.

Conclusion: Africa and the small island developing States are the regions facing the largest capacity gaps regarding climate services. Africa also has the least developed land-based observation network of all continents. Africa has made great efforts in driving the global climate agenda. This is demonstrated by the very high levels of ratification of the Paris Agreement – over 90%. Many African nations have committed to transitioning to green energy within a relatively short time frame. Clean energy and agriculture are, for example, prioritized in over 70% of African NDCs. This ambition needs to be an integral part of setting the economic development priorities of the continent.

One promising approach throughout the continent to reducing climate related risks and extreme event impacts has been to reduce poverty by promoting socioeconomic growth, in the agricultural sector. In this sector, which employs 60% of Africa's population, value-addition techniques using efficient and clean energy sources are reported to be capable of reducing poverty two to four times faster than growth in any other sector.

Biography

Nwafi Ngeayi Adi is an expert in leading Civil Society organizations and other NGO like the GIZ (German International Cooperation for Development) in designing, conceiving, and implementing Community development projects with approach focusing on Community driven Conservation of biodiversity and rural development in tropical landscapes and Savana zones. His long-term experience (12years) and research work in the areas of developing strategies to adaptations to climate change has greatly contributed in building the capacities of 200local communities towards resilience to climate change. Empowering over 2000 women actively involved in Agriculture and Non-Timber Forest Product valorization has helped to Improve the sustainable management of natural resources around the Dja Biosphere Reserve. He is currently the CEO and President Founder of the CSO named ACOBIDER (Association for the Conservation of Biodiversity and Rural Development) with headquarters based in Bertoua Eastern region Cameroon. Research interests are biodiversity conservation, environmental sustainability and local development.

SWOT ANALYSIS AND STRATEGIES TO DEVELOP PROJECTS SUSTAINABILITY IN JORDAN

Reham M Alreqeb

Aljiza Municipality, Jordan

Abstract

Many developed countries in Europe, Asia, and North America have turned to the Smart City system. This has been attempted by either retrofitting the established cities or creating new cities to provide their services instantly to citizens. Success stories of smart city projects have spread recently in various regions of the Middle East, and Amman is not among those successes.

This study explores the implementation of the global Smart Municipality concepts at the local level, Specifically, Greater Amman Municipality (GAM). This research went through two stages, namely a qualitative technique that included interviews with experts. Secondly, a case study in which four constructed projects in terms of smart city concepts were chosen in GAM to check the Smart Municipality Project Assessment Matrix (SMPAM) to show relationships between the challenges and the project areas.

The research results showed that GAM approaches the implementation of the global concept of a Smart City in Amman. The executive committee for innovative solutions stated that the main dimensions that had been applied in GAM are city Mobility and Environment projects area. On the contrary, marginal regions in the adoption of smart projects are limited to living and social services.

According to the study results, Amman could become a smart city by 2030, so this research suggested a roadmap to implement the smart city concepts as a smart solution for local municipalities in Jordan.

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