



Green Technology for Sustainable Environment 2024

First Conference on Green Technologies in Poland



22-26.09.2024



Poznan, Poland



Poznan University of Technology

Book of abstracts



Organizers



POZNAN UNIVERSITY OF TECHNOLOGY



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This project was supported by the Polish Ministry of Science and Higher Education,
as a part of the „Excellent Science II” Program



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On behalf of the organising committee, we warmly welcome you to **GTSE24** in Poznan, Poland. As a major milestone of the **GTSE** series, this event takes place in the historical charm of Poznan and the industrial heartland of Poland. It is an ideal setting for sharing and disseminating scientific knowledge about innovative technologies and best management practices toward economic prosperity and environmental sustainability.

We have exciting scientific and social programs that will allow delegates to take a deep dive into the some of the most innovative technological developments of the field, explore current and future research directions, share research passion, renew and develop new friendships, and extend their networks. We trust that this will be a productive and fun-filled GTSE conference.

The technical sessions will take place at the PUT Warta Campus in the Lecture Centre (building A-23), providing an ideal setting for productive discussions and knowledge sharing between researchers and industry professionals. Conveniently located in the city center, the Warta Campus offers state-of-the-art educational and research infrastructure. Furthermore, a part of the conference will be hosted at the Kąkolewo Campus, near Grodzisk Wielkopolski. This advanced training and research center, focused on aviation and space technologies, offers an exceptional environment for in-depth exploration and innovation in these areas.



Professor Teofil Jesionowski
Chairperson of the GTSE24'



Professor Jakub Zdarta
President of the GTSE24'
Organizing Committee

About **GTSE** conference series



GTSE24 marks the fourth edition of the **Green Technologies for Sustainable Environment** conference and its **first-ever European edition**. This globally recognized conference series focuses on environmental protection, the advancement of green technologies, sustainable development, and the circular economy. Previous editions have been successfully hosted in:

- 1st edition – Hanoi, Vietnam (2017)
- 2nd edition – Ho Chi Minh City, Vietnam (2019)
- 3rd edition – Taipei, Taiwan (2022).

The scope of **GTSE** covers a broad range of critical topics aimed at addressing environmental challenges through innovative and sustainable technologies. Key focus areas include advanced waste and wastewater treatment and reuse, exploring cutting-edge methods for repurposing waste to enhance resource efficiency. Air pollution control and monitoring are another major themes, with discussions on the latest techniques to mitigate air pollution and improving monitoring systems for environmental protection.

The conference delves into redefining environmental pollutants, examining new and emerging threats while considering evolving regulatory frameworks. Disruptive environmental technologies that have the potential to revolutionize environmental management are also key topics, along with advanced strategies for solid waste and water resource management aimed at reducing environmental impact and promoting circular economy principles.

A special emphasis is always placed on the application of modern technologies, including nanotechnology, for solving environmental issues. Participants explore advanced analytical techniques for more precise environmental monitoring and focus on energy and resource recovery from waste and wastewater, contributing to both sustainability and economic growth.

The rising issue of micropollutants in the environment is also addressed, with presentations on current achievements in detection, ongoing challenges, and future predictions.

The high scientific quality of **GTSE24** has been acknowledged by the Ministry of Education and Science, securing funding through the state's "Excellent Science II" Programme. This recognition underscores the importance of the conference in fostering scientific innovation and progress toward a more sustainable future.

Thank you for joining us and welcome to Poznań!



Professor Long D. Nghiem
Chairperson GTSE series

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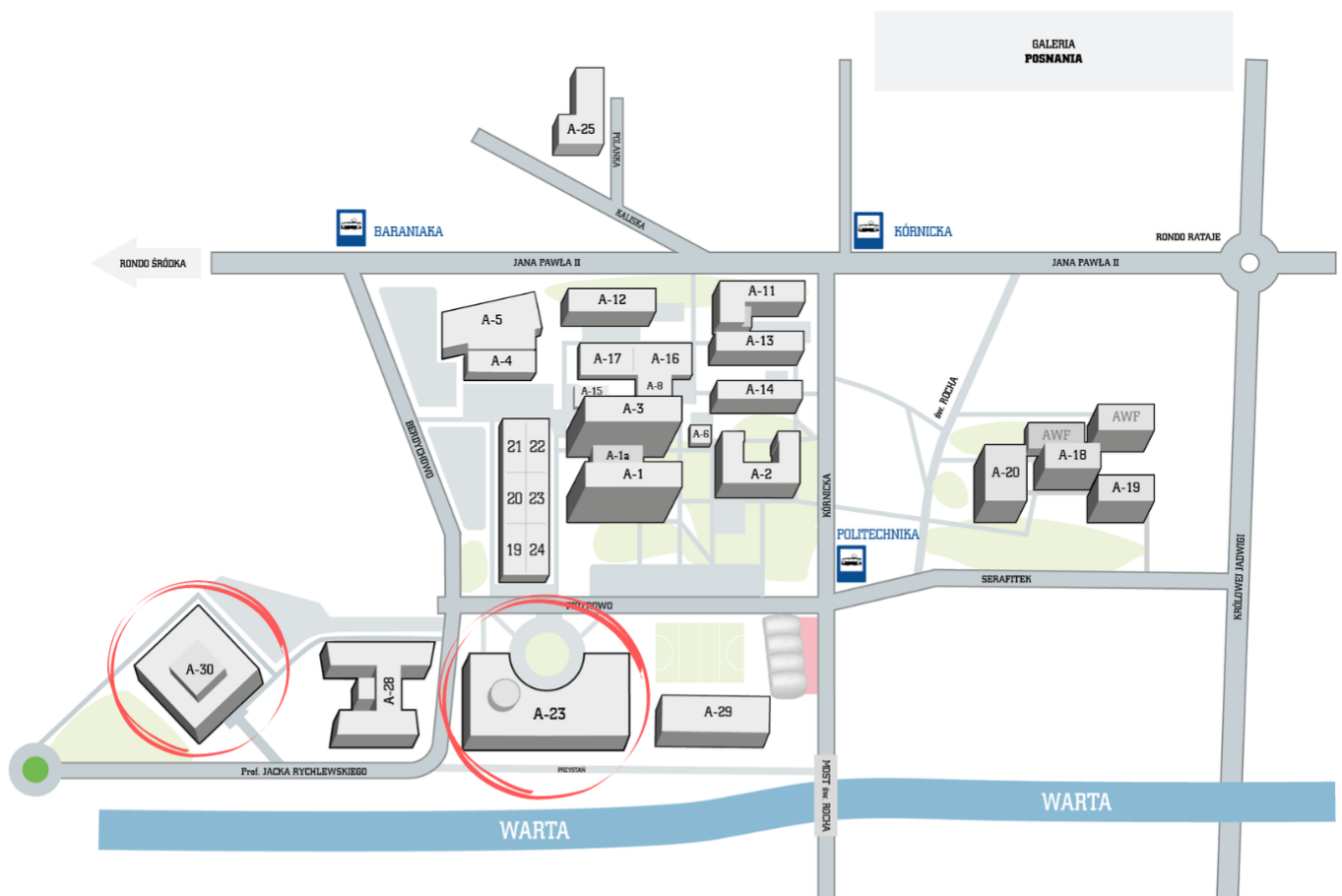
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Prof. Linda Zou, Khalifa University, UAE

Conference venue

Warta Campus



A-23 - Conference venue (Lecture Centre)

A-30 - Gala Dinner



Conference programme

DAY 1

22nd September, Sunday



3.00 p.m. – 4.30 p.m.

Registration

Lecture Centre (A-23), Poznan University of Technology

4.30 p.m. – 6.30 p.m.

Workshop: Meet the Editors (Room 123)

Lecture Centre (A-23), Poznan University of Technology

7.30 p.m. – 10.00 p.m.

Welcome reception (Rooms 51 & 53)

Lecture Centre (A-23), Poznan University of Technology

9.00 a.m. – 11.00 a.m. **Session 1 (Auditorium Aula Magna) | Chairman:**
J. Zdarta, T. Jesionowski
Lecture Centre (A-23), Poznan University of Technology

Opening ceremony

10.00 a.m. – 10.40 a.m. **Plenary 1**
Anne Meyer
Technical University of Denmark, Denmark
*Enzymatic degradation of poly(ethylene terephthalate) (PET):
Novel insight into the significance of PET crystallinity*

10.40 a.m. – 11.00 a.m. **Keynote 1**
Jacob de Boer
Vrije Universiteit Amsterdam, Netherlands
The PFAS problem in Europe and the scarcity of remediation options

11.00 a.m. – 11.30 a.m. **Coffee break (Lobby)**
Lecture Centre (A-23), Poznan University of Technology

11.30 a.m. – 1.30 p.m. **Session 2 (Room 123) | Chairman: A. Meyer**
Lecture Centre (A-23), Poznan University of Technology

11.30 a.m. – 11.50 a.m. **Keynote 2**
Dachamir Hotza
Federal University of Santa Catarina, Brazil
Ceramics processing – A sustainable approach

11.50 a.m. – 12.10 p.m. **Keynote 3**
Suwanna Boontanon
Mahidol University, Thailand; Kyoto University, Japan
*PFAS 'forever chemicals' in water and wastewater:
Occurrence and treatment technologies*

Oral presentations

- 12.10 p.m. – 12.25 p.m. **Luthando Nyaba**
Application of nickel iron layered double hydroxides/ activated carbon (NiFe-LDH@AC) composite for preconcentration and removal of Cr and As from water systems
- 12.25 a.m. – 12.40 p.m. **Lei Zheng**
Ligand-to-metal charge transfer quenching of carbon dots enabled highly selective Hg²⁺ detection in microfluidic
- 12.40 p.m. – 12.55 p.m. **Oliwia Degórska**
Green approach of active pharmaceutical ingredients synthesis
- 12.55 p.m. – 1.10 p.m. **Weronika Badzińska**
Modified electrospun membranes containing immobilized laccase as effective biocatalytic systems

1.30 p.m. – 2.30 p.m. **Lunch break (Rooms 51 & 53)**
Lecture Centre (A-23), Poznan University of Technology

2.30 p.m. – 4.25 p.m. **Session 3 (Room 123) | Chairman: J. de Boer**
Lecture Centre (A-23), Poznan University of Technology

2.30 p.m. – 3.10 p.m. **Plenary 2**
Takahiro Fujioka
 Nagasaki University, Japan
Submerged nanofiltration membrane to achieve low-energy drinking water and wastewater treatment

Oral presentations

- 3.10 p.m. – 3.25 p.m. **Yujie Dai**
Inter-coffee-ring effects boost rapid and highly reliable SERS detection of TPHT on a light-confining structure

3.25 p.m. – 3.40 p.m.

Anna Wolny

An effective biocatalyst for the continuous flow production of C8-C18 carboxylic acid esters derived from biomass-based furfuryl alcohol

3.40 p.m. – 3.55 p.m.

Hoan Thi Kim Tran

Turbidity Monitoring and Lange Probes as Early Warning Systems for Climate Change Impacts on Water Sources

DAY 3

24th September, Tuesday

9.00 a.m. – 11.00 a.m. **Session 4 (Room 123) |** Chairman: L. D. Nghiem
Lecture Centre (A-23), Poznan University of Technology

9.00 a.m. – 9.40 a.m. **Plenary 2**
Ashok Pandey
Centre for Energy and Environmental Sustainability, India
Sustainable waste to energy technologies

9.40 a.m. – 10.00 a.m. **Keynote 5**
Carlos Lodeiro
NOVA University Lisbon, Portugal; PROTEOMASS
Scientific Society, Portugal
Mesoporous silica nanoparticles and functionalized polymers as nanotools for drug, bacteria and metal remediation

Oral presentations

10.00 a.m. – 10.15 a.m. Mthokozisi Mnguni
UIO-66@Fe₃O₄ nanocomposite as an adsorbent in dispersive solid phase extraction of metformin in surface water and wastewater

10.15 a.m. – 10.30 a.m. Aditya Prana Iswara
Strategic Decarbonization Transition in the Power Plant Industry: an Alternative Approach to Direct Coal Phase-out

10.30 a.m. – 10.45 p.m. Thi-Kim-Quyen Vo
Effect of salinity on the efficiency of removing pollutants in synthetic shrimp farming wastewater of the MBG system

10.45 p.m. – 11.00 p.m. Michael Gradzielski
In-situ investigation of humic acid aggregation induced by quaternised chitosan for water treatment

11.00 a.m. – 11.30 a.m. **Coffee break (Lobby)**
Lecture Centre (A-23), Poznan University of Technology

11.30 a.m. – 11.50 a.m. **Keynote 6**
 Hugo Santos
 NOVA University Lisbon, Portugal; PROTEOMASS
 Scientific Society, Portugal
*Absolute quantitative proteomics revealed
 extensive metabolism dysregulation and
 neurodegeneration induced by airborne ultrafine
 particles*

11.50 a.m. – 12.10 p.m. **Keynote 7**
 Tjandra Setiadi
 Institut Teknologi Bandung, Indonesia
*Microalgae-based wastewater treatment: A
 sustainable approach to pollutant remediation and
 resource recovery*

Oral presentations

12.10 p.m. – 12.25 p.m. Lisa Adityaa
*Balancing carbon and nutrient ratio for biomass, lipid and
 protein production in microalgae*

12.25 p.m. – 12.40 p.m. Krzysztof Hajdrowski
Energy transformation in ENEA GROUP

12.40 p.m. – 12.55 p.m. Oliwia Górczyńska
*Electrospun membranes for enzyme immobilization in
 environmental applications*

12.55 p.m. – 1.10 p.m. Dai Quyet Truong
*Utilizing natural zeolite SIR-600 and resin CG-8 for
 ammonium elimination from groundwater: Batch and
 column studies*

1.25 p.m. – 2.30 p.m. **Lunch break (Rooms 51 & 53)**
Lecture Centre (A-23), Poznan University of Technology

2.30 p.m. – 3.50 p.m. **Session 6 (Room 123) | Chairman: C. Lodeiro**
Lecture Centre (A-23), Poznan University of Technology

2.30 p.m. – 2.50 p.m.

Keynote 7

Thanh Xuan Bui

HCMUT, Vietnam; VNUHCM, Vietnam

Benefits of co-culture of microalgae and activated sludge in wastewater treatment

Oral presentations

2.50 p.m. – 3.05 p.m.

Mateusz Szczygielda

Downstream separation of functional bioproducts and THERI application in the cosmetic industry

3.05 p.m. – 3.20 p.m.

Lin Chang

Plasmonic metastructures for emerging pollutant detection

3.20 p.m. – 3.35 p.m.

Sultan F.I. Abdillah

Revealing trade-off between carbon and flue gas emissions from power generation plants

3.35 p.m. – 3.50 p.m.

Jacek Diakun

Recycling product model as the solution for modeling recycling properties of the product

3.50 p.m. – 4.05 p.m.

Aleksandra Rybak

Application of aluminium-coated membranes for the immobilization of enzymes: model reactions for the evaluation of enzyme activity

7:30 p.m.

Gala dinner

Faculty of Architecture (A-30), Poznan University of Technology

DAY 4

25th September, Wednesday

9.00 a.m.	Transport to Kąkolewo <i>Transport from the Lecture Centre to Kąkolewo</i>
10.00 a.m. – 11.00 a.m.	Coffee break <i>Kąkolewo</i>
11.00 a.m. – 1.00 p.m.	Discussion panel Paweł Chudzinski and Andrzej Listowski <i>Kąkolewo</i>
1.00 p.m. – 1.30 p.m.	Coffee and sandwiches <i>Kąkolewo</i>
1.30 p.m. – 2.30 p.m.	Poster session <i>Kąkolewo</i>
2.30 p.m. – ... p.m.	BBQ party <i>Kąkolewo</i>
7.00 p.m. & 8.00 p.m.	Transport to Poznań <i>Transport from Kąkolewo to the Lecture Centre in Poznan</i>

DAY 5

26th September, Thursday

9.00 p.m. – 10.40 p.m. **Session 7 (Room 123) |** Chairman: J. Rinklebe
Lecture Centre (A-23), Poznan University of Technology

9.00 a.m. – 9.20 a.m. **Keynote 8**
 Hong Liu
 Chinese Academy of Sciences, China
Water quality system & research methodology

9.20 a.m. – 9.40 a.m. **Keynote 9**
 Cheng Di Dong
 National Kaohsiung University of Science and Technology,
 Taiwan
*The potential of biochar-based catalysts for the
 removal of emerging organic contaminants from
 waste activated sludge via advanced oxidation
 processes*

Oral presentations

9.40 a.m. – 9.55 a.m. Di Wu
*An integrated evaluation strategy for anaerobic digestion
 monitoring based on acid-base balance and
 thermodynamics of volatile fatty acid degradation*

9.55 a.m. – 10.10 a.m. Pravin Ravichandran
*Life cycle and technoeconomic analysis of industrial scale
 biodiesel production from macroalgal biomass through
 biorefinery approach*

10.10 a.m. – 10.25 a.m. Mateusz Łężyk
*Production of polyhydroxyalkanoate (PHA) copolymers
 from methane and valerate using mixed microbial cultures*

10.25 a.m. – 10.40 a.m. Duong T. Nguyen
*Microalgae-derived biolubricants: Challenges and
 opportunities*

10.40 a.m. – 11.10 a.m. **Coffee break (Lobby)**
Lecture Centre (A-23), Poznan University of Technology

11.10 a.m. – 12.45 p.m. **Session 8 (Room 123) | Chairman: T. Setiadi**
Lecture Centre (A-23), Poznan University of Technology

11.10 a.m. – 11.30 a.m. **Keynote 10**
 Grzegorz Lisak
 Nanyang Technological University, Singapore
Towards a zero waste sustainable city through resource recovery, carbon sequestration and a novel decentralised waste management strategy

Oral presentations

11.30 a.m. – 11.45 a.m. **Amanda Pacholak**
Plant-derived surfactants as a novel approach to enhancing antibiotics efficiency

11.45 a.m. – 12.00 p.m. **Filip Brodowski**
Open (mixed) culture fermentation - A platform for biochemicals production from waste

12.00 p.m. – 12.15 p.m. **Diksha Sharma**
Enhanced heavy metal adsorption from wastewater by functionalized nanocellulose derived from pineapple leaf waste

12.15 p.m. – 12.30 p.m. **Ajeet Singh Chauhan**
Synergistic effect of stress with phytohormones for enhanced PUFA production in thraustochytrids

12.30 p.m. – 1.30 p.m.

Lunch break (Rooms 51 & 53)

Lecture Centre (A-23), Poznan University of Technology

1.30 p.m. – 4.00 p.m.

**Session 9 (Room 123) | Chairman: J. Zdarta,
T. Jesionowski**

Lecture Centre (A-23), Poznan University of Technology

1.30 p.m. – 2.10 p.m.

Plenary 4

Damia Barcelo

University of Almeria, Spain

A global vision of climate change and water scarcity with local solutions using advanced technologies for the removal of emerging contaminants

2.10 p.m. – 2.50 p.m.

Plenary 5

Jörg Rinklebe

University of Wuppertal, Germany

Green technologies for a sustainable remediation of contaminated water and soil

2.50 p.m. – 3.30 p.m.

Plenary 6

Long D. Nghiem

University of Technology Sydney, Australia

Microalgae separation and recovery for a new bio-refinery industry

Closing ceremony

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Plenary lectures

ENZYMATIC DEGRADATION OF POLY(ETHYLENE TEREPHTHALATE) (PET): NOVEL INSIGHT INTO THE SIGNIFICANCE OF PET CRYSTALLINITY



Anne S. Meyer

Section for Protein Chemistry and Enzyme Technology Enzyme Technology, Department of Biotechnology and Biomedicine, Technical University of Denmark

Abstract

Products made of plastic have become a useful and ubiquitous part of our life, yet, the accumulation of plastics in landfills, soil and oceans has become a global environmental crisis. The desirable properties of plastics, notably the durability has now become a major drawbacks. One widely used plastic is poly(ethylene terephthalate) (PET), which currently constitutes ~9% of all plastic produced. Taking an estimated 450 years to decompose, it was a sensation when in 2016¹ it was found that the microbe *Ideonella sakaiensis* could grow on and hence degrade PET. Since then, research into enzymes that catalyze degradation of PET has surged. In this presentation, our recent results on the significance of PET substrate crystallinity on enzymatic PET degradation will be presented, and the unique enzyme kinetics of the endo-acting PET degrading enzymes, will be discussed in relation to PET as an insoluble, semi-crystalline polymeric substrate^{2,3}. In addition, a method for controlled modification of PET crystallinity for investigating the efficacy of PET degrading enzymes in response to PET crystallinity⁴ will be outlined, and a new continuous assay for fast exploration and robust kinetic characterization of PET degrading enzymes will be presented⁵. The overall aim of this work is to improve the understanding of enzymatic PET degradation in relation to development of efficient enzymatic PET recycling processes.

The presentation is co-authored by: Thore B. Thomsen, Cameron J. Hunt, and Anne S. Meyer.

¹ Yoshida S et al. Science 2016, 351, 1196-1199.

² Thomsen TB et al. New Biotechnol 2022, 69, 28-35.

³ Thomsen TB et al. ChemSusChem 2023, 16, e202300291.

⁴ Thomsen TB et al. MethodsX 2022, 9, 101815-101823.

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Biographical note

Anne S. Meyer is a Professor of Enzyme Technology, Head of the Protein Chemistry & Enzyme Technology Section at Dept. of Biotechnology and Biomedicine, Technical University of Denmark. The Section comprises 8 professor research groups, in total ~75 persons, incl. ~20 PhD students. She is the group leader of Enzyme Technology in the Section.

Research interests:

- Applied enzyme technology:
 - Enzymatic degradation of plastic
 - Enzyme enzymatic biorefining of biomass, agro-industrial side streams
 - Enzymatic conversion of CO₂
 - Enzymatic synthesis of human milk oligosaccharides.
- Expertise: Bioinformatics, enzyme characterization, assays, kinetics, protein engineering, and carbohydrate chemistry

Publications: About 450 peer-reviewed papers within the field of enzyme catalysis, enzymatic conversion, enzyme discovery, biocatalytic carbohydrate synthesis, and biorefining technology.

Citations: She currently has 21,000+ Web-of-Science citations and W-o-S h-index of 78. (Google Scholar: 35,000+ citations, h-index 98, i10-index 350).



Editorships

Editor: Biotechnology. Advances, Enzyme and Microbial Technology. Ed. Board: New Biotechnology.

Distinctions and awards

2023: The Nils Foss Research Excellence Prize 2023 (pioneering research in enzyme technology)

2023: Knight (R.) of the Royal order of Dannebrog (knighted by the queen of Denmark), Denmark.

2011: PhD Supervisor of the Year at DTU (also nominated in 2018)

2008: Grundfos Innovative Research Award

2005: Danisco Research Award

SUBMERGED NANOFILTRATION MEMBRANE TO ACHIEVE LOW-ENERGY DRINKING WATER AND WASTEWATER TREATMENT



Takahiro Fujioka

Nagasaki University, 1-14 Bunkyo-machi, Nagasaki 852-8521, Japan
Corresponding author's e-mail: tfujioka@nagasaki-u.ac.jp

Abstract

Water and wastewater treatment using nanofiltration (NF) membranes without any pre-filtration processes is a new approach for produced high-quality drinking water and recycled water. This presentation will cover our recent studies examining the feasibility of direct (i.e., no pre-treatment) NF treatment of surface water and wastewater using submerged flat-sheet NF membrane modules. Direct NF treatment of surface water generally resulted in slight membrane fouling. The membrane fouling level varied significantly depending on NF membrane selection. However, regardless of the membrane selection, the membrane foulant was readily removed by sponge cleaning, and the permeability fully recovered. The separation performance of the NF system remained high: total organic carbon removal remained at 80–90% in most sampling occasions. When ferric chloride-based pre-coagulation was applied before the submerged NF system, it considerably reduced membrane fouling. We also evaluated the potential of submerged NF membranes for water recycling applications. As a result, the direct NF of primary wastewater effluent using four types of commercial NF membranes resulted in progressive membrane fouling over 4 d. However, almost all the foulants contributing to hydraulic loss were removed by one-swipe sponge cleaning. This indicated that significant foulants were generally deposited on the membrane surface during direct NF. The NF concentrates (four times concentrated wastewater) were then used for biogas production in an anaerobic digester. The volume of biogas from the NF concentrates formed sufficiently compensated for the energy consumption of direct NF. This study realized a low-energy advanced wastewater treatment utilizing NF concentrates that can also be used for biogas formation.

Biographical note

Dr Takahiro Fujioka is a Professor and the Leader of the Water Treatment group at Nagasaki University. Takahiro has over 22 years of engineering experience in the water industry and academia. He completed his Master's degree at UNESCO-IHE, Netherlands, in 2009 and his PhD at the University of Wollongong, Australia, in 2014. His research interests center on water and wastewater treatment using nanofiltration and reverse osmosis membranes.

Ashok Pandey

Centre for Innovation and Translational Research, CSIR-Indian Institute of Toxicology Research
Corresponding author's e-mail: pandey@cees-india.org; ashokpandey1956@gmail.com

Abstract

Waste-to-energy concept has gained much momentum in recent years as on one hand, it offers unique opportunity to handle and dispose solid wastes (municipal waste as well as agro-industrial wastes), and simultaneously provides alternative sources of renewable energy. Solid waste treatment and management is a major issue worldwide. Several countries lack proper basic waste management infrastructure and awareness. Thus, waste-to-energy could be an attractive solution for resource recovery, which eventually offers potential benefits when works on principles of biorefinery.

Solid waste, especially crop waste and municipal solid waste based research has extensively progressed for the production of chemicals and biofuels. Potential application of such biomasses for the production of liquid and gaseous biofuels and other products on principle of biorefineries has gained more attention for possibilities of bioethanol, biobutanol, biodiesel and other high-value chemicals production, coupled with industrial wastewater treatment. Two major pathways for these include thermochemical conversion and biochemical conversion. Thermochemical processes primarily include pyrolysis, gasification, etc. Biochemical processes adopt the principle of biorefinery generally.

However, process integration is key for both the platform for techno-economic success. The lecture will discuss the issues and perspectives.

Biographical note

Professor Ashok Pandey is currently a Distinguished Scientist at the Centre for Innovation and Translational Research, CSIR-Indian Institute of Toxicology Research, Lucknow, India. His major R&D interests are in industrial/environmental biotechnology and energy biosciences. He has ~1550 publications/communications, which include 16 patents, 120 books, ~1000 papers and book chapters, etc with h index of 134 and >78,000 citations (Google Scholar). Professor Pandey is the recipient of many national and international awards and honours, which include Fellow of the World Academy of Sciences (TWAS), Fellow of the Indian National Science Academy (INSA), Fellow of the National Academy of Science, India (NASI), etc. He is Top Cited Researcher (Top 1% in the world), Clarivate Analytics (2018-2023); Top scientist in Biotechnology (no 1 in India and no 8 in the world), Stanford University world ranking (2020-2023), etc. He is the Founder and President of the Biotech Research Society, India (BRSI) and Founder of the International Bioprocessing Association (IBA).

A GLOBAL VISION OF CLIMATE CHANGE AND WATER SCARCITY WITH LOCAL SOLUTIONS USING ADVANCED TECHNOLOGIES FOR THE REMOVAL OF EMERGING CONTAMINANTS



Damia Barcelo

Water and Soil Quality Research Group, Department of Environmental Chemistry, Institute of Environmental Assessment and Water Research (IDAEA-CSIC)

Corresponding author's e-mail: damiab@ual.es

Abstract

Most ecosystems are exposed simultaneously to several stressors, in the so-called multiple-stress situation. Key stressors like climate change and water scarcity can limit biodiversity and economic activities in entire regions. One example will be intermittency in water flow with implications for hydrologic connectivity, negative side-effects on biodiversity, water quality, and river ecosystem functioning. Water scarcity can amplify the effects of water pollution by reducing the natural diluting capacity of rivers. Interactions between stressors may be exacerbated by climate change.

Water Scarcity and Climate Change are going hand by hand in most of cases. The relevance of water scarcity as a stressor is most important in semi-arid regions such as the Mediterranean basin, characterized by highly variable river flows and the periodic occurrence of low flows and even no-flows. Climate change previsions forecast an increase in the frequency and magnitude of extreme events. Although extremes are part of the normal hydrologic behaviour in Mediterranean-type rivers, many already show a consistent trend towards decreased discharge. In this respect, the Mediterranean basin is one of the most prominent “hot spots” for potential changes in water availability. Most climate change models conclude that Mediterranean regions will be more affected by summer drought, higher flood frequency and higher temperatures. These changes will probably not be limited to catchments draining into the Mediterranean Sea, but will affect all Mediterranean-type regions worldwide like certain parts of California and Australia among others.

This presentation will describe in the first part the main threats associated with climate change related to global warming and temperature increase around the planet. Strategies for mitigation and adaptation to climate change with the focus on capture green house gases (GHG) will be reported. Among them afforestation and carbon natraltity using phytocapture with algae as well as the use of biochar for environmental remediation and GHG reduction will be mentioned. Examples from the European projects SCARCE and GLOBAQUA on of several river basins: Ebro, Llobregat Guadalquivir and Jucar as well as other European rivers like Adige, Evrotas and Sava will be reported. As main conclusion of the reconnaissance study in Spain was that pesticides like azoxystrobin, imacloprid, carbendazim, propiconazole, permethryn and azinphos-ethyl were identified as most toxic to aquatic biota as compared to other chemical groups like pharmaceuticals or industrial pollutants. Water scarcity increased in general the risk of emerging contaminants present in rivers. New type of pollutants like antimicrobial resistance genes (ARG) and microplastics (MPs) are expected to be relevant under climate change scenario. Examples from Europe, China and Saudi Arabia will be presented.

To overcome pollution problems in rivers under climate change effects, new solutions are required to improve river water quality and quantity like the use of advanced water treatment options. The thing is that conventional WWTPs were not designed to remove some organic compounds such as emerging pollutants. A wide array of micropollutants are usually found in WWTP effluents, so there is a need to develop and evaluate alternative treatments which could be efficient for their elimination. In short, several advanced treatment such membrane bioreactors (MBR), nanofiltration/ ultrafiltration, reverse osmosis, eco-friendly- technologies likes algal-based solutions and advanced oxidation processes like photocatalysis that could improve the removal of many emerging pollutants and thereby diminish their presence in surface waters. An overview of the different water treatment

technologies with practical examples will be reported. In the case of Spain, will report recent examples of water scarcity in the metropolitan area of Barcelona and Catalonia in Spain regions where water reuse and desalination technologies are being used and will increase in the next coming years in order to overcome the permanent problem of water scarcity in this region.

Lastly by improving the water treatment the river water will be of better quality an additional source for different reuse options, like agriculture or groundwater recharge being one of the mitigation strategies against climate change and water scarcity. Direct potable reuse is already being considered in California under the new regulation just released recently that will be implemented from October 1st, 2024.



Biographical note

Full Professor IDAEA-CSIC, Barcelona, Spain since 1999 to date. From 2008-2023, Director of ICRA, Girona, Spain, and from 2016 – 2023 Visiting Professor at King Saud University, Riyadh, Saudi Arabia. Awarded as Doctor Honoris Causa by the Universities of Ioannina, Greece, in 2014 and by the University of Lleida, June 2021 and Almeria, Spain in May 2022. Honorary and Guest Professor at ZAFU, Hangzhou, China in 2019 till March 202 and Foreign Expert of East China University of Science & Technology, Shanghai, China, 2021-2022. From January 2022 till December 2026 he has been appointed Adjunct Professor in Sustainability Cluster, School of Engineering at the UPES, Dehradun, India.

D Barceló has received the following awards: 2023. Prize of the Division of Analytical Chemistry (DAC) of the European Society of Chemistry (EuChemS) Euroanalysis, Geneva, King Hamad Prize for Agricultural Development in the category of Best Agricultural Research & Studies, Bahrain, Distinguished Scientist from the Chinese Academy of Sciences (CAS), Fellow of the Royal Society of Chemistry, FRSC and Member of the Academie Nationale de Pharmacie, Paris; 2012 Recipharm Environmental Award, Sweden and Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW), 5th Award on Water Management & Protection, Saudi Arabia and in 2007 Prize King Jaime I on the Protection of Nature from Generalitat of Valencia, Spain. He has supervised > 67 PhD students, since 1992 – to date. He has been Instructor of short courses at PITTCON, SETAC NA and ExTech conferences since early 2000. D Barceló expertise is on analysis, fate, risk and removal of emerging contaminants, nanomaterials and microplastics from water as well as sewage epidemiology of drugs and proteins using advanced mass spectrometric techniques. Hirsch-Index of 184 or 145 and total number of citations over 149.000 or 99770 thousand (sources Google Scholar or Scopus) and more than 1700 publications. Research.com ranked in 2023 D Barcelo as 3rd and 23rd environmental scientist and chemist, respectively in the world. He has been involved in editorial activities in the following Elsevier journals as co-Editor in chief and editor from 1990 to date: STOTEN, GREEAC, TRAC, Methods X, CSCEE, and COESH. He is also Editor-in-chief of the book series Wilson + Wilson Comprehensive Analytical Chemistry from Elsevier since 1997- today and co-editor-in-chief of the Handbook of Environmental Chemistry book series from Springer since 2007-today and Advances In Chemical Pollution, Environmental Management and Protection) since 2016-today. From 1993 to date he has been editor and co-editor of 39 books on environmental chemistry.

GREEN TECHNOLOGIES FOR A SUSTAINABLE REMEDIATION OF CONTAMINATED WATER AND SOIL



Jörg Rinklebe

University of Wuppertal, School of Architecture and Civil Engineering, Institute of Foundation Engineering, Water- and Waste-Management, Laboratory of Soil- and Groundwater-Management, Pauluskirchstraße 7, 42285 Wuppertal, Germany

Corresponding author's e-mail: rinklebe@uni-wuppertal.de

Abstract

Soil and water around the globe are contaminated with various pollutions including PFAS, PHAHs, toxic elements such as arsenic, cadmium, mercury, antimony and others. In particular, wetland soils are very vulnerable since they serve as producer of food, including rice. Paddy soils are regularly flooded and thus, they underlie large fluctuations of redox conditions. Those changes of redox conditions have considerable impacts on the biogeochemical behavior of toxic elements as well as on pH, carbonate, and carbon solubility, chemistry of iron, manganese, and sulfur as well as on microbial community, which control the mobilization of toxic elements.

Doubtless, the redox potential and pH are master variables in governing those mobilization processes. We are able to conduct experiment in the laboratory to study mechanistically the release dynamics of toxic elements. Also, we are seek for suitable amendments to stabilize those toxic metals in the soil which should be stabile even under dynamic redox conditions. Biochar is considered as one option to fulfill this purpose. Results gained at various scales (laboratory and field scale) will be presented.

Keywords: biochar, toxic element, soil contamination

Biographical note

Dr. Jörg Rinklebe is Professor for Soil- and Groundwater-Management at the University of Wuppertal, Germany. He has been selected as ISI Web of Science Highly Cited Researcher in 2019, 2020, 2021, 2022. Prof. Rinklebe is President of the International Society of Trace Element Biogeochemistry (ISTEB). His academic background covers environmental science, bioavailability of emerging contaminants, and remediation of contaminated sites. His main research is on soils, sediments, waters, plants, and their pollutions and linked biogeochemical issues with a special focus in redox chemistry. He also has a certain expertise in soil microbiology.

Prof. Rinklebe published plenty of scientific papers in leading international and national journals.

According to SCOPUS data base (26.07.2023), he published 496 research papers, which have been cited 26,225.0 times with h-index = 84. Also, he published four books entitled „Trace Elements in Waterlogged Soils and Sediments” (2016), “Nickel in Soils and Plants” (2018), “Soil and Groundwater Remediation Technologies” (2020), “Vanadium in soils and plants” (2022), as well as numerous book chapters.

He is serving as Editor in Chief for Environmental Pollution, and as Editor of the Journal of Hazardous Materials; Co-Editor in Chief of the international journal Critical Reviews in Environmental Science and Technology (CREST) and as guest editor of the international journals Environment International, Chemical Engineering Journal, Science of the Total Environment, Chemosphere, Journal of Environmental Management, Applied Geochemistry, and Environmental Geochemistry and Health. Also, he is member on several editorial boards (Ecotoxicology, Geoderma, Water, Air, & Soil Pollution, Archive of Agronomy and Soil Science).

He is the chair of the first joint international conferences of Biogeochemistry of Trace Elements” (ICOBTE) and “International Conference on Heavy Metals in the Environment” (ICHMET) in September 2023, which will be organized by him. He was an invited speaker (plenary and keynote) at many international conferences.

In 2016 he got an appointment as Honorable Ambassador for Gangwon Province, South-Korea which was renewed in June-2018. Also, he got an appointment as Adjunct Professor at the University of Southern Queensland, Australia, Visiting Professor at the Sejong University, Seoul, South Korea and Guest Professor at the China Jiliang University, Hangzhou, Zhejiang, China.



MICROALGAE SEPARATION AND RECOVERY FOR A NEW BIO-REFINERY INDUSTRY



Long D. Nghiem

School of Civil and Environmental Engineering, University of Technology Sydney

Abstract

This presentation discusses new and emerging separation technologies for efficient and low cost recovery of microalgae biomass for producing transport fuel and platform chemicals. New data for fundamental development and scaling-up of a novel technique to efficiently harvest microalgae will be presented. This new harvesting technology could the cost of downstream processing can be reduced by more than 10 times. Our technique produces tuneable polymer on demand to facilitate algal cell flocculation for subsequent harvesting by a simple mechanical device. By tuning the polymer properties to match microalgae characteristics, our technique can be optimised to ensure the reusability of cultivation solution after harvesting and minimise cell membrane damage. The obtained microalgal biomass can then be further processed to produce platform chemicals, biofuel, animal feed and other valuable bioproducts. These new microalgae harvesting techniques can be a game changer in establishing a microalgae-based biocircular economy.

Biographical note

Prof Nghiem is the Director of the Centre for Technology in Water & Wastewater (CTWW) at UTS. As the Director, he provides research leadership and vision to guide the research activities of CTWW with 27 full time academic core members. Major research strengths of CTWW include water infrastructure, water sensitive urban design, bioengineering and microbiology technologies, and water & waste treatment technologies. His current research work centres around the development of new water technologies for the Water – Energy nexus. Prof Nghiem has published over 400 peer reviewed journal publications (Google h-index = 106 & >37,000 citations). He has supervised to completion 27 PhD and 11 MPhil students. Prof Nghiem currently serves as an Editor-in-chief of Environmental Technology & Innovation and Editor of Journal of Membrane Science.



Keynote lectures

THE PFAS PROBLEM IN EUROPE AND THE SCARCITY OF REMEDICATION OPTIONS



Jacob de Boer

Vrije University Amsterdam, The Netherlands

Abstract

The last opinion of the European Food Safety Authority (EFSA) that recommended a very low daily intake (4.4 ng/kg bodyweight per week) and low safe levels in human blood (6.9 µg/L in serum) for per- and polyfluorinated alkyl substances (PFAS), has initiated many research projects on the occurrence and effects of these substances in the environment, food and humans, as well as attempts to remediate polluted areas. Since the 1950s PFAS have been used in many applications, such as in fire extinguishers, outdoor wear, furniture, glues, packaging materials, skiwax, and many others. Due to its high persistence, caused by the extremely strong C-F bond, PFAS levels have built up worldwide in the environment and in humans. Especially around airports, where fire brigades used a lot of PFAS-containing foam during their training, a high accumulation of PFAS in the soil can be found. In addition, the environments around PFAS-producing industries are all heavily contaminated. NGO's and governments are now looking for options to remediate those areas. However, biodegradation is no option until now as no bacteria have been found that can degrade the PFAS molecules. Phyto-remediation experiments are being carried out but obviously require quite some time. The few options that are promising are a supercritical water treatment and an option to bake bricks from PFAS-contaminated sediments. The only other option left is incineration at high temperatures (>1200 °C) but that requires a lot of energy and is therefore expensive.

Dachamir Hotza

Federal University of Santa Catarina, 88040-900 Florianópolis, SC, Brazil
Corresponding author's e-mail: *d.hotza@ufsc.br*

Abstract

The industry continuously seeks environmentally friendly processes with low energy consumption, aiming to not compromise product quality. The ceramic industry faces the challenge of manufacturing high-performance goods sustainably and cost-effectively. This industry, employing numerous workers globally, requires raw materials with specific purity and availability and utilizes energy from both renewable and fossil sources. Significant concerns have arisen from waste and emissions during ceramic manufacturing. This presentation discusses alternative ceramic processing methods that minimize environmental impacts, involving the entire production chain from design to disposal. Life cycle assessment tools in the design phase can evaluate products and processes [1]. During processing, low-energy raw materials and additives should be prioritized [2]. Renewable energy sources like biofuels and solar energy could replace or supplement non-renewable sources [3]. Techniques such as energy and mass balances and heat transfer modeling can optimize energy use [4]. Ultimately, minimizing emissions and waste, and maximizing the use of recycled materials, are crucial [5].

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Acknowledgments: CAPES, CNPq, and FAPESC are acknowledged for their support.

Biographical note

Dachamir Hotza received his Bachelor's degree in Chemical Engineering (1988) and a Master's in Mechanical Engineering (1991) from the Federal University of Santa Catarina (UFSC); Ph.D. in Materials Engineering (1996) from the Hamburg University of Technology (TUHH), Germany. He has been a Full Professor at UFSC since 2014, specializing in Chemical Technology and Materials Engineering with a focus on processing, sustainability, and nanotechnology. He is a Fellow of the American Ceramic Society (2023) and a Fulbright Chair in Sustainable Development (2024).

PFAS 'FOREVER CHEMICALS' IN WATER AND WASTEWATER: OCCURRENCE AND TREATMENT TECHNOLOGIES



Suwanna Kitpati Boontanon^{1,2*}, Chettiyappan Visvanathan¹

¹*Graduate Program in Environmental and Water Resources Engineering, Department of Civil and Environmental*

Engineering, Faculty of Engineering, Mahidol University, 999 Phutthamonthon 4 Rd. Salaya, Phutthamonthon, Nakhon Pathom, 73170, Thailand;

²*Graduate School of Global Environmental Studies, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto, 606-8501, Japan*

Corresponding author's e-mail: suwanna.boo@mahidol.ac.th

Abstract

The widespread use of per- and polyfluoroalkyl substances (PFAS), along with their mobility and persistence have resulted in PFAS contamination in drinking water globally. This includes not only the predominant perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) but also various other PFAS. They are released into the environment by industries and consumers, accumulated in the environment, as well as in animal and human bodies. PFAS are highly stable and persistent in the environment, bioaccumulate, and pose toxicity throughout the food chain thus known as “forever chemicals”. PFAS have been detected in food packaging, textiles, cosmetic and personal care products, wastewater treatment plants, and water environments. In 2022, the US EPA implemented stricter standards for PFAS in drinking water, establishing interim lifetime health advisory levels of 0.004 ng/L for PFOA and 0.02 ng/L for PFOS. Most drinking water worldwide exceeds these levels. Due to their chemical structure, PFAS are highly stable. Conventional treatment processes, such as those involving biological treatment or chemical oxidation, face significant challenges in degrading PFAS. One of the most challenges in remediation of PFAS-laden water at contaminated sites has been the prohibitively high cost because the “contamination is extensive and toxic, but concentrations are low”. Direct degradation of PFAS in bulk water was found cost-prohibitive. A complete and cost-effective treatment of trace concentrations of PFAS in water is necessary. To overcome this barrier, the development and optimization of ‘trap-&-zap’ or “concentrate-&-destroy” technologies to enhance the removal and then destruction of PFAS in water are proposed and discussed.

Biographical note

Dr. Suwanna Kitpati Boontanon is Associate Professor in Environmental Engineering at Mahidol University, Thailand, and having a joint appointment at the Graduate School of Global Environmental Studies, Kyoto University. She is the leader of Emerging Contaminants and Environmental Innovation Research Laboratory that aims for in-depth understanding in the fate and behaviors of emerging contaminants, including persistent organic pollutants, pharmaceutical and personal care products, antimicrobial resistance, microplastics in the environment as well as their risk assessment. Her work in the field of emerging contaminants covers development of innovative water and wastewater treatment technology to enhance water quality and minimize energy consumption.

MESOPOROUS SILICA NANOPARTICLES AND FUNCTIONALIZED POLYMERS AS NANOTOOLS FOR DRUG, BACTERIA AND METAL REMEDIATION



Carlos Lodeiro,^{1,2} José Luis Capelo-Martínez,^{1,2} Elisabete Oliveira,^{1,2} Hugo M. Santos,^{1,2} Javier Fernández Lodeiro,^{1,2} Adrián Fernández Lodeiro,^{1,2#} Silvia Nuti,^{1,2} Joana Galhano,^{1,2} M. Paula Duarte,³ Andisiwe Bangani,^{4,5} Philiswa Nosizo Nomngongo^{4,5}

¹BIOSCOPE Research Group, Chemistry Department, LAQV@REQUIMTE, NOVA School of Science and Technology, NOVA University Lisbon, Caparica 2829-516 Portugal

²PROTEOMASS Scientific Society, Praceta Jerónimo Dias, 12/2^a, Costa de Caparica, 2825-466 Caparica, Portugal

³MEtRICs/DCTB, FCT, NOVA University Lisbon, Caparica 2829-516, Portugal

⁴Department of Chemical Sciences, University of Johannesburg, Doornfontein Campus, P.O. Box 17011, Doornfontein, 2028, South Africa.

⁵Department of Science and Innovation-National Research Foundation South African Research Chair Initiative (DSI-NRF SARCHI): Nanotechnology for Water, University of Johannesburg, Doornfontein, 2028, South Africa

Corresponding author's e-mail: cle@fct.unl.pt | clodeiro@bioscopegroup.org.

Abstract

Antibiotics, while invaluable in treating bacterial infections and saving lives, pose significant environmental challenges due to their widespread use and subsequent release into various ecosystems. These environmental problems stem from several factors. The presence of antibiotics in the environment exerts selective pressure on bacteria, favoring the survival and proliferation of antibiotic-resistant strains. This can occur in natural environments as well as in settings where antibiotics are used extensively, such as hospitals, and farms. Antibiotic-resistant bacteria can spread through water, soil, and even air, posing risks to human health and ecosystems. Some antibiotics can be toxic to aquatic organisms, affecting fish, invertebrates, and other aquatic life. Chronic exposure to low concentrations of antibiotics can disrupt physiological processes, impair reproduction, and reduce overall biodiversity in aquatic ecosystems.

In this communication, we will present the synthesis of different metallic core or free mesoporous silica nanoparticles (MSNs-MCM-41) via the Stöber Method and used to encapsulate antibiotics, toxic metals and drugs such as ofloxacin (OFLO), doxorubicin (DOX), and epirubicin (EPI) individually as well as in combinations. These loaded nanocarriers underwent release and antibacterial assays to evaluate their efficacy towards different GRAM positive and GRAM negative bacteria, such as *Escherichia coli*, *Staphylococcus aureus*, methicillin-resistant *Staphylococcus aureus* (MRSA), *Enterococcus faecalis*, and *Pseudomonas aeruginosa*. Significant reductions in bacterial viability were observed across all bacterial strains, including resistant strains like MRSA, underscoring the potential of these nanomaterials in combating antibiotic resistance and environmental implications. Ecotoxicological studies are in progress to expose them with real environmental samples [1-6]. The nanostructured MCM-41 particuls have been used as an adsorbent ultrasound-assisted dispersive micro solid-phase extraction (UA-D- μ -SPE) of cefadroxil (CFDX) and cephalixin (CPLX) in water samples in South Africa. These results demonstrate the potential application of MCM-41 for the removal of cephalosporin antibiotics from aquatic environments [7].

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Present Address: Department of Electrical and Computer Engineering, Nanotechnology Imaging and Detection Laboratory, Nicosia, University of Cyprus – Cyprus.



Thanks to the financial support by the Associate Laboratory LAQV-REQUIMTE - Clean Processes and Technologies, as well as the PROTEOMASS Scientific Society (Portugal) for funding support (General Funding Grants 2022-2024). The FCT-MEC Portugal is acknowledge by the grants PTDC/QUI-COL/1517/2020 and EXPL/QUI_COL/0263/2021.

Biographical note

C. Lodeiro published 310 documents (By GS) in international peer-review journals, with 6363 citations (March 2024). 85% of these papers were published in first quartile high impact factor publications such as NanoRes (IF: 9.9), J Mat. Chem A (IF: 11.9), J. Mat. Chem. C (IF: 6.6), J. Haz.Mat (IF: 13.6) and Biomaterials (IF: 14.0). Research interests are Synthesis of Probes, Chemosensors, and Emissive Smart Materials for detection, MS/spectrometry applied to Proteomics and Supramolecular Chemistry, Preparation and Functionalization of Metallic and Soft Nanoparticles for Optical, Catalysis and Antibiotic Resistance studies. Environmental detection and remediation of Mercury using NPs and Dyes. Dr. Lodeiro is the Co-head of the BIOSCOPE Research Group, CEO of the PROTEOMASS Scientific Society, and Coordinator of the Research Line in Health and Wellbeing of the LAQV-REQUIMTE, Portugal.

ABSOLUTE QUANTITATIVE PROTEOMICS REVEALED EXTENSIVE METABOLISM DYSREGULATION AND NEURODEGENERATION INDUCED BY AIRBORNE ULTRAFINE PARTICLES



Hugo M. Santos,^{1,2} Gonçalo Martins^{1,2}, Luis Carvalho,^{1,2} Carlos Lodeiro,^{1,2} José Luis Capelo-Martínez,^{1,2}

¹BIOSCOPE Research Group, Department of Chemistry, LAQV-REQUIMTE, NOVA School of Science and Technology, NOVA University Lisbon, 2829-516 Caparica, Portugal

²PROTEOMASS Scientific Society, 2825-466 Caparica, Portugal

Corresponding author's e-mail: hmsantos@fct.unl.pt

Abstract

Exposure to ultrafine particulate matter (UPM) is associated with various health issues, yet its detailed impact on cell functions is not fully understood [1, 2]. A thorough investigation into how UPM affects cellular proteomes revealed significant changes, particularly in critical pathways such as glycolysis, gluconeogenesis, pyruvate metabolism, the Citrate cycle (TCA), and the Pentose phosphate pathway (PPP). Through the use of label-free absolute quantification of the proteome, we observed notable alterations in the levels of enzymes, including phosphoglycerate kinase (Pgk), hexokinase 1 (HK1), Malic Enzyme 3 (Me3), and Hydroxyacyl-CoA Dehydrogenase (Hagh), suggesting a cellular adaptive mechanism to UPM involving adjustments in ATP generation, glucose metabolism, and the conversion process from malate to pyruvate. Proteins such as Aldoa, Aldoart1, and Aldh2 were identified as playing key roles in several pathways, indicating their critical function in metabolic regulation and response to UPM exposure. Our findings also uncover potential weaknesses in how cells produce energy, manage oxidative stress, and sustain mitochondrial health, potentially connecting to the development of neurodegenerative diseases. The observed changes in kinase activity and antioxidant protein levels highlight the possible effects on neuronal communication and the defense against oxidative stress. This research underscores the significant and complex impact of UPM on cellular mechanisms, pointing to the urgent need for more in-depth studies and proactive measures.

[1] Ljubimova, J. Y. *et al.* Coarse particulate matter (PM_{2.5–10}) in Los Angeles Basin air induces expression of inflammation and cancer biomarkers in rat brains. *Scientific Reports* 2018 8:1 8, 1–11 (2018).

[2] Araújo, J. E. *et al.* Proteomic changes driven by urban pollution suggest particulate matter as a deregulator of energy metabolism, mitochondrial activity, and oxidative pathways in the rat brain. *Science of The Total Environment* 687, 839–848 (2019).

PROTEOMASS Scientific Society is acknowledged by the funding provided to the Laboratory for Biological Mass Spectrometry Isabel Moura (#PM001/2019 and #PM003/ 2016). This work received support from Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior (FCT/MCTES) through the projects LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020 and UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020. H.M.S. acknowledges the Associate Laboratory for Green Chemistry-LAQV (LA/P/0008/2020) DOI 10.54499/LA/P/0008/2020 funded by FCT/MCTES for his research contract. L.B.C. is supported by the FCT/MCTES PhD grant 2019 (SFRH/BD/144222/2019).

Biographical note

H.M. Santos published 130 documents (Scopus) in international peer-reviewed journals, with over 2300 citations (March 2024). His work, particularly in proteomics and mass spectrometry, has garnered over 2,300 citations, with a Field-Weighted Citation Impact of 1.22 to 1.65. Key publications include *Anal. Chem.* (2020), *Commun Med* (2023). *BMC Med* (2021). *Clin Proteomics* (2023) and *Talanta* (2024). Dr. Santos has played a pivotal role in academic mentorship, having

supervised 6 completed PhD theses (with 2 more in progress), guided 3 postdoctoral researchers, and served as a mentor to 11 visiting PhD candidates. Additionally, his academic leadership extends to overseeing 12 master's theses (with 2 underway) and 13 undergraduate projects, showcasing his commitment to nurturing the next generation of scientific talent.



MICROALGAE-BASED WASTEWATER TREATMENT: A SUSTAINABLE APPROACH TO POLLUTANT REMEDIATION AND RESOURCE RECOVERY



Awalina Satya¹⁾, Tjandra Chrismadha¹⁾, Ika A. Satya²⁾, Azalea D.M. Satya³⁾, Nina Artanti⁴⁾, Hakiki Melanie⁴⁾, Rosidah Rosidah¹⁾, Miratul Maghfiroh¹⁾, Eva Navisyah¹⁾, Gunawan Gunawan¹⁾, Nofdianto Nofdianto¹⁾, Helen Julian⁵⁾, Ardiyan Harimawan⁵⁾, **Tjandra Setiadi⁵⁾**

¹⁾ Research Centre for Limnology and Water Resources-National Research and Innovation Agency- Rep. of Indonesia (BRIN), KST Soekarno, Jl. Raya Bogor-Jakarta km46, Cibinong, Bogor 16911, Indonesia

²⁾ Research Centre for Computation, National Research and Innovation Agency- Rep. of Indonesia (BRIN), Komplek Cisit, Jl. Sangkuriang, Coblong, Bandung 40135, Indonesia

³⁾ Department of Chemical and Environmental Engineering, Faculty of Science and Engineering, University of Nottingham Malaysia, Jalan Broga, Semenyih 43500, Selangor Darul Ehsan, Malaysia;

⁴⁾ Research Centre for Advance Chemistry- National Research and Innovation Agency- Rep. of Indonesia (BRIN), Gd 452, KST BJ Habibie, Setu, Tangerang Selatan 15314, Indonesia

⁵⁾ Department of Chemical Engineering, Faculty of Industrial Technology- Institut Teknologi Bandung, Jl. Ganesa No 10, Bandung 40132, Indonesia)

Corresponding author's e-mail: tjandra.setiadi@itb.ac.id

Abstract

The rapidly increasing global human population is causing significant environmental disturbances, including soil, water, and air contamination. Urbanization and industrialization contribute to anthropogenic pollution, adversely affecting ecological stability and exacerbating climate change. Pollutants enter water bodies from various point and non-point sources, with wastewater discharge being a major contributor. Conventional wastewater treatment methods are often costly and resource-intensive, highlighting the need for sustainable alternatives.

Microalgae have emerged as a promising and cost-effective method for pollutant remediation. They utilize mechanisms such as bioaccumulation, biosorption, and intracellular degradation to remove contaminants from wastewater. As a result, microalgae-based wastewater treatment (MBWT) offers a viable solution for environmental resource recovery and sustainable development efforts. Photobioreactors (PBRs) play a crucial role in these processes, as they provide a controlled environment for microalgae cultivation. Microalgae are photosynthetic organisms capable of producing valuable and environmentally benign products.

The biomass derived from MBWT can serve as a potential feedstock for various industrial applications, including biofuels, bio-fertilizers, pharmaceuticals, and natural colorants. This review primarily focuses on the cultivation of microalgae in both open and closed photobioreactors. It examines key parameters that influence PBR performance, such as irradiance, mixing, pH, temperature, nutrients, mass transfer, and capital-operating costs. Additionally, the review discusses the specific conditions required for the growth of wastewater microalgae, including the types of wastewater species and their properties.

By understanding these factors, researchers and industry professionals can optimize microalgae cultivation for effective wastewater treatment and biomass production. This integrated approach has the potential to address environmental pollution while contributing to the development of sustainable and economically viable industrial processes.

Biographical note

Prof. Tjandra Setiadi is a full professor in the Department of Chemical Engineering at Institut Teknologi Bandung (ITB), Indonesia. He directed the Centre for Environmental Studies (2007-2021) and the Centre for Resource Efficient and Cleaner Production Indonesia (2014-2018). His research focuses on bioprocess engineering for industrial wastewater treatment, biopolymer production, lignocellulosic enzymes, and bio-based products. He is a fellow of the University of Tokyo's Faculty

of Engineering (2019) and a registered professional engineer in Indonesia and with the ASEAN Federation of Engineering Organizations (AFEO).



BENEFITS OF CO-CULTURE OF MICROALGAE AND ACTIVATED SLUDGE IN WASTEWATER TREATMENT



Xuan-Thanh Bui

Key Laboratory of Advanced Waste Treatment Technology & Faculty of Environment and Natural Resources, Ho Chi Minh City University of Technology (HCMUT), Vietnam National University Ho Chi Minh (VNU-HCM), Ho Chi Minh City 700000, Viet Nam.

Corresponding author's e-mail: bxthanh@hcmut.edu.vn

Abstract

Microalgae are well recognized as living bioreactors for the synthesis of valuable byproducts such as proteins, lipids, carbohydrates, and pigments. By cultivating multiple strains of different species, one strain could compensate for an enzymatic activity lacking in the other and increase nutrient cycling, establishing a synthetic conglomerate based on a symbiotic connection. In practice, mixed culture (microalgae:activated sludge) of photobioreactors were investigated at different conditions. This work was not only to determine the optimal ratio for pollutant remediation, biomass granulation and biomass production but also to explore the role of microorganisms in the co-culture system. Microalgae played a dominant role in nitrogen removal via biological assimilation while activated sludge was responsible for improving organic pollutants removal. The mixed biomass processes excellent settling ability and less energy consumption which satisfies the practical operation.

Keywords: Co-culture system; Activated sludge; Microalgae; Energy consumption; Wastewater treatment; Biomass production.

THE POTENTIAL OF BIOCHAR-BASED CATALYSTS FOR THE REMOVAL OF EMERGING ORGANIC CONTAMINANTS FROM WASTE ACTIVATED SLUDGE VIA ADVANCED OXIDATION PROCESSES



Chang-Mao Hung^{1,2}, Chiu-Wen Chen³, Cheng-Di Dong^{1,2,3*}

¹ Institute of Aquatic Science and Technology, College of Hydrosphere Science, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan

² International Doctoral Degree Program in College of Hydrosphere Science, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan

³ Department of Marine Environmental Engineering, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan

Corresponding author's e-mail: cddong@nkust.edu.tw

Abstract

Increasing the production of voluminous waste activated sludge (WAS) remains a major engineering challenge of biological wastewater treatments. WAS contains unstable organic matter and emerging organic contaminants. Biochar (BC) can be made readily from lignocellulosic biomass-based residues by thermochemical conversion in oxygen-free environment. BC activates oxidants to generate stable free radicals because of unique physicochemical properties, such as biocompatibility, highly graphitized porous structure, and abundant and diverse surface functional moieties. The mechanisms and performance of BC-based materials pretreatment of WAS laden with emerging organic contaminants are seldom studied. The combination of oxidant and BC is a green approach for catalytic conversion of emerging organic contaminants to degradable organics amenable to further bio-process, which further improved the efficacy and cost-effectiveness for WAS treatment. This work provides new insights into the chemical and biological mechanisms by which BC promotes emerging organic contaminants biodegradation in WAS via radical-driven carbon advanced oxidation process.

Biographical note

Dr. Cheng-Di Dong is a Chair Professor at the Department of Marine Environmental Engineering, National Kaohsiung University of Science and Technology (NKUST), Taiwan. His research topics include waste-to-resources, biotechnology, nanotechnology, novel catalytic materials and biochar for environmental applications. His h-index ~63 and more than 15460 citation. He has won several scientific awards and grants from renowned academic bodies. Dr. Dong currently serves as Editor of *Sustainable Environment Research*, and he is Editorial Board Member of *Bioresource Technology*.

TOWARDS A ZERO WASTE SUSTAINABLE CITY THROUGH RESOURCE RECOVERY, CARBON SEQUESTRATION AND A NOVEL DECENTRALISED WASTE MANAGEMENT STRATEGY



**G. Lisak^{1,3}, A.W.K. Law^{2,3}, W.P. Chan¹, L.Y. Ge¹, A. Veksha¹, W.Q. Chen¹, X. Yang¹,
S.C. Wong¹, Z. Tsakadze¹, C.W. Low¹, R. Aryal¹, C.J.L. Foo¹, K. Zhao¹, C.W. Mao¹, J.L.
Guo¹, G. Soon², H.L. Trinh², R. Silva¹, H.M. Ong¹**

¹Resource Recovery Programme, Nanyang Environment and Water Research Institute, Nanyang Technological University, 1 Cleantech Loop, Clean Tech One, 637141, Singapore

²Environmental Sensing Modelling and AI Machine Learning Programme, Nanyang Environment and Water Research Institute, Nanyang Technological University, 1 Cleantech Loop, Clean Tech One, 637141, Singapore

³School of Civil and Environmental Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798, Singapore

Corresponding author's e-mail: g.lisak@ntu.edu.sg

Abstract

Movement towards low carbon and a more circular economy presents an opportunity for a unique Thermo-Disintegration Waste to Resource (TDWR) system from Bluefield Renewable Energy Pte Ltd (BRE) and complementary innovative technologies from Nanyang Technological University (NTU) to jointly harness the energy and valuable resources from challenging waste streams by converting the wastes into high quality char and syngas for effective decentralised waste management in a city (Singapore). The proposed rapid pyrolysis technology is capable to convert raw wastes to green energy and resources. The TDWR system is a containerized, mobile, modular, stackable and scalable system. It is capable of strategically decentralise waste management and processing diverse waste streams at elevated temperature, and generating char and syngas, which can be applied directly or be upgraded for many different applications ranging from green renewable energy, chemicals synthesis, horticultural application and the production of carbon nanomaterials. In this project, TDWR system is upgraded and optimised to further extend its capacity for resource recovery and to promote high-tech char generating facility, exporting biochar to agricultural industries and modified char, activated carbon and carbon nanomaterials for chemicals and manufacturing industries, in the region and worldwide.

We applied this concept to design a new pyrolysis-based process for synthesis of biogenic multi-walled carbon nanotubes (MWCNTs) and H₂ from biomass. It was demonstrated that the conversion of hydrocarbon compounds in pyrolysis gas into MWCNTs and H₂ is detrimentally influenced by accompanied CO₂ released from biomass decomposition. Capturing CO₂ with a calcium sorbent upgraded the pyrolysis gas into a suitable gaseous precursor for downstream production of MWCNTs and H₂-rich gas. Furthermore, the results suggest that CO₂ capture with the sorbent has a potential to outperform a liquid alkaline scrubber owing to avoided liquid organic waste generation, sorbent regenerability and higher H₂ recovery from biomass pyrolysis gas.

Acknowledgment

*This research is supported by A*STAR under its RIE2025 Industry Alignment Fund – Industry Collaboration Projects (IAF-ICP) Programme (Award I2101E0006). This research is also supported by the National Research Foundation, Singapore, and PUB, Singapore's National Water Agency under its RIE2025 Urban Solutions and Sustainability (USS) (Water) Centre of Excellence (CoE) Programme which provides funding to the Nanyang Environment & Water Research Institute (NEWRI) of the Nanyang Technological University, Singapore (NTU). Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not reflect the views of National Research Foundation, Singapore and PUB, Singapore's National Water Agency.*

Biographical note

Dr. Lisak joined NTU Singapore in 2016 as assistant professor and was tenured in 2022 to associate professor. Since 2017, he is a director of Residues and Resources Reclamation Center (in 2022 converted to Resource Recovery Programme) and since 2024 he is Deputy Executive Director at Nanyang Environment and Water Research Institute. Since 2019, he is the associated editor of *Chemosphere* (IF= 8.1), Elsevier. Since 2024, he is co-editor-in-chief of *Environmental Research*, (IF= 7.7), Elsevier. Since 2021, he is a member of the Technical Committee for Circularity of Materials under the purview of Environment and Resources Standards Committee, Enterprise Singapore. Since 2022, he is a member of the External Advisory Panel for Environmental Sustainability (EPES), Ministry of Defence (MINDEF/SAF). Since 2024 he is a member of National Environmental Agency's Advisory Committee on Hazardous Substances and Toxic Wastes. His interests cover sustainability, waste to energy, waste to resources, and CO₂ capture and utilization.

Krzysztof Hajdrowski

Biographical note

Krzysztof Hajdrowski is a graduate of the Faculty of Electrical Engineering of the Poznań University of Technology. He completed his studies in 1995. In 2002, he defended his doctoral thesis at the same university. He completed postgraduate studies in development and market management in the electrical power industry, managerial skills and the training programme 'Project Management for Executives - PMI'. After graduation, he worked at Poznan University of Technology and then at



Energetyka Poznan. He is currently the head of the Innovation Office at ENEA S.A. In the past, he was also a member of the management board of ENEA Innowacje. He deals with the topics of development and implementation of innovative green technologies in the power industry. As part of his professional work, he has also carried out many other tasks, including: implementation and monitoring of the company's strategy, implementation of project management methodology, benchmarking studies, implementation of key performance indicators and optimisation programmes. He cooperates with the Polish Committee for Standardisation, the Polish Electricity Transmission and Distribution Association, the Association of Polish Electricians and other industry organisations.

He is the author and co-author of more than 150 scientific and popular science articles in the field of electrical power engineering, new technologies and standardisation.



Oral presentations

APPLICATION OF NICKEL IRON LAYERED DOUBLE HYDROXIDES/ ACTIVATES CARBON (NIFE-LDH@AC) COMPOSITE FOR PRECONCENTRATION AND REMOVAL OF CR AND AS FROM WATER SYSTEMS



Boitumelo P. Khunou¹, Philiswa N. Nomngongo^{1,2,*}, Luthando Nyaba^{1,2*}

^{a)} Department of Chemical Sciences, University of Johannesburg, Doornfontein, Johannesburg 2028, South Africa

^{b)} Department of Science and Innovation-National Research Foundation South African Research Chairs Initiative (DSI-NRF SARChI) in Nanotechnology for Water, University of Johannesburg, Doornfontein, Johannesburg 2028, South Africa

Abstract

A nickel-iron layered double hydroxides/activated carbon (NiFe-LDH@AC) composite was synthesised via hydrothermal assisted ultrasonic exfoliation and its structural properties and morphologies were characterised using various analytical characterization techniques. These include transmission electron microscopy (TEM), scanning electron microscopy coupled with energy dispersive spectroscopy (SEM-EDS), Fourier transform infrared (FT-IR) spectroscopy, Brunauer–Emmett–Teller (BET) and X-ray diffraction (XRD). The material was applied as an adsorbent for preconcentration and removal of As and Cr. The target analytes were quantified using inductively coupled plasma optical emission spectroscopy (ICP-OES). Under the optimal conditions, the preconcentration method was validated with respect to linearity, limits of detection (LOQ), accuracy, limits of quantification (LOQ) and precision. The linear ranges were 0.1-150 µg/L and 0.07-100 µg/L for As and Cr, respectively. The precision was investigated in terms of repeatability and reproducibility. The results were expressed in terms of relative standard deviation (%RSD) and the values were less than 5%. The LOD and LOQ ranged from 0.021-0.031 and 0.1-0.07 µg/L for As and Cr, respectively. Finally, the accuracy was validated by successfully analysing spiked samples and the recoveries ranged from 92.6-99.2%. The adsorbent was then explored for the removal of target analytes and adsorption capacities were 102 mg/g and 92.6 mg/g for As and Cr, respectively. The metal ions adsorption was evaluated using kinetics and isotherm models and the results followed pseudo second-order kinetics and Langmuir isotherms. Finally, the removal efficiency for spiked effluent wastewater samples ranged from 89.7-100%.

Biographical note

Dr Luthando Nyaba is currently a lecturer and a researcher at the University of Johannesburg in South Africa (RSA). I obtained my PhD (Chemistry) in 2021 at the University of Johannesburg (RSA). His research interests involve method development, adsorption, watertreatment, designing nanomaterials and studying their application in various analytical techniques. He has published 12 research articles scientific journals and presented in 10 international scientific meetings.

LIGAND-TO-METAL CHARGE TRANSFER QUENCHING OF CARBON DOTS ENABLED HIGHLY SELECTIVE Hg²⁺ DETECTION IN MICROFLUIDIC



Lei Zheng^a, Rongzhen Ma^b

^a Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, Chongqing, 400714, China

^b College of Resource and Environment, Southwest University, Chongqing, 400715, China

Corresponding author's e-mail: zhenglei@cigit.ac.cn

Abstract

Carbon dots have emerged as highly efficient and versatile fluorescent probes for detecting and quantifying Hg²⁺. Nonetheless, elucidating the fluorescent detection mechanism remains challenging due to the complex structure and surface functionalities of carbon dots. This study reported a nitrogen-doped carbon dots (N-CDs) via ligand-to-metal charge transfer fluorescent quenching mechanism for Hg²⁺ detection, which was verified through experimental analysis and density functional theory calculation. Besides excitation independent emission feature, the synthesized N-CDs demonstrated high selectivity of Hg²⁺ over 23 potentially interfering environmental ions. The structures of 2-hydroxy-N,N-dimethylbenzamide and amide functional groups were identified as the determinants of the relatively high quantum yield (53.33%). N-CDs also exhibited a linear relationship with Hg²⁺ concentration in the range of 0-120 μM, with a limit of detection of 7.091 nM. Notably, N-CDs were employed in a customized microfluidic dynamic monitoring platform, demonstrating robustness in receiving efficient fluorescence signals and sensitivity with a satisfactory limit of detection. The acceptable accuracy and recovery of Hg²⁺ detection in tap water and river water highlighted the potential practical application of the synthesized N-CDs. In general, this study aims to provide a promising portable system for on-site early warning of water pollution.

Biographical note

Dr. Lei Zheng is an Assistant Professor of Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences. His research interests focus on the development of fluorescent nanomaterials in smart device for rapid contaminants detection. He completed his PhD in University of Technology Sydney in 2020. He has published over 20 peer-reviewed journal papers in specialized journals such as Journal of Membrane Science and multidisciplinary journals such as Total of Environmental Science. He has also secured several early-career supporting research grants including National Natural Science Foundation of China and the Special Research Associate Foundation of Chinese Academy of Science.

Oliwia Degórska, Natalia Zasada, Jakub Zdarta

*Poznan University of Technology, Berdychowo 4, 60-965, Poznań, Poland
Corresponding author's e-mail: oliwia.degorska@doctorate.put.poznan.pl*

Abstract

With the rising focus on environmental impact and heightened awareness, efforts to reduce the use of toxic and harmful substances in chemical processes have intensified. The synthesis of active pharmaceutical ingredients (APIs) has seen considerable advancements through the adoption of innovative technologies and methodologies [1]. Traditionally, API synthesis relied heavily on metallic catalysts, which often required harsh reaction conditions and presented environmental challenges. The shift towards enzyme-based catalysis signifies a major step toward sustainable and eco-friendly alternatives. This shift represents a breakthrough in pharmaceuticals and pharmacology, offering enhanced selectivity and improved reaction efficiency. Enzyme-based catalysis not only reduces the environmental impact but also leverages the inherent advantages of biocatalysts, such as mild reaction conditions and high specificity. Hydrolases are immensely valuable in biocatalysis due to their exceptional specificity. Unlike conventional chemical catalysts that often produce undesirable by-products, hydrolases exhibit high substrate specificity, selectively targeting specific bonds within molecules. This precision allows for efficient synthesis of desired compounds, minimizing waste and maximizing yield [2].

In this research we focused on the development of novel biocatalyst based on poly(ionic liquid) hydrogel material with entrapped lipase. During these studies the activity of formed biocatalyst was established, resulting in increased activity in comparison with a free form of the enzyme. What is more, the aforementioned catalyst was applied in the synthesis of the enantiomer of API (S)-atenolol to obtain the enantiomerically pure product. The adoption of biocatalysis in the pharmaceutical industry represents a major breakthrough in creating more sustainable and environmentally friendly production methods, significantly reducing the industry's overall environmental footprint.

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This work was supported by the National Science Center, Poland, under research grant no. 2023/49/N/ST8/03038.

Biographical note

I am a PhD student and researcher at Poznan University of Technology, focusing on the asymmetric synthesis of APIs using biocatalysts and the development of novel biocatalytic systems through enzyme immobilization processes on supports.

I hold a Master of Science in Engineering, specializing in Biocatalysis and Material Engineering. My research is driven by a passion for merging scientific discovery with environmental sustainability and the contributions to science and innovation have earned me multiple scholarships and awards, particularly for achievements in sustainability solutions and academic entrepreneurship. My expertise includes the development of new materials, the fabrication of innovative biocatalytic systems tailored to specific processes, and the optimization of asymmetric synthesis of APIs.

**ENHANCED HEAVY METAL ADSORPTION FROM WASTEWATER BY
FUNCTIONALIZED NANOCELLULOSE DERIVED FROM PINEAPPLE LEAF WASTE**

^a Department of Seafood Science, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan

^b Department of Marine Environmental Engineering, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan

^c Institute of Aquatic Science and Technology, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan

¹Equal contribution

Corresponding author's e-mail: cddong@nkust.edu.tw (C.D. Dong)

Abstract

Due to the rapid economic and industrial development, the water quality from natural resources has deteriorated over the years, causing a devastating effect on public health and the ecosystem. Therefore, incorporating low-cost green wastewater treatment methods may help mitigate the problem of water pollution and contribute to the United Nations' sustainable development goals (SDGs). In recent years, nanotechnology has introduced a range of innovative materials based on nanocellulose (NC), which show promise for wastewater reduction and purification. The present study applied a novel low-cost and green deep eutectic solvent-based method to extract high-quality nanocellulose from pineapple leaf biomass. The NC embedded with pineapple leaf was synthesized, characterized, modified and examined as a nano adsorbent for removing cadmium metal from an aqueous solution. The impact of pH, temperature, and contact duration on the adsorption levels of Cd (II) has been investigated which resulted in 98.27% adsorption by phosphorylated nanocellulose. SEM, TEM, FTIR, TGA and BET techniques determined the morphology and attachment of functional groups on pineapple leaf NC.

Keywords: Sustainable development goals; Nanocellulose; Wastewater treatment; Lignocellulosic biomass; Pineapple leaf; Pretreatment; Deep eutectic solvents

Biographical note

Passionate and driven Ph.D. scholar in the field of Biomass valorization for the production of environment-friendly products like biofuels, prebiotics-xylooligosaccharides, nanocellulose for heavy metals removal (wastewater treatment) using green extraction approaches (Deep eutectic solvents combining ultrasonication and microwave), seeking opportunities to apply expertise in bioprocess optimization and development. Committed to advancing sustainable solutions through innovative research in bioproducts development and environmental applications. Eager to contribute knowledge and skills to cutting-edge research projects, collaborate with interdisciplinary teams, and make significant contributions to the field of environmental biotechnology.

MODIFIED ELECTROSPUN MEMBRANES CONTAINING IMMOBILIZED LACCASE AS EFFECTIVE BIOCATALYTIC SYSTEMS



Weronika Badzińska, Ewelina Czajka, Teofil Jesionowski, Filip Ciesielczyk

Poznan University of Technology, Berdychowo 4, 60-965 Poznań, Poland
Corresponding author's e-mail: weronika.badzinska@doctorate.put.poznan.pl

Abstract

Economic development and climate changes have led to environmental pollution which become a serious problem due to rapid urbanization and industrialization, resulting in adverse health effects by incorporating foreign contaminants into the natural ecosystem [1]. In order to degrade these pollutants in the global environment, bioremediation using microorganisms and enzymes have been exploited. However, free enzymes exhibits various limitations for example problems with separation from post reaction mixture, poor operational stability and reusability, as they are inactivated. In order to improve stability and long life of biocatalytic systems different attempts are proposed. In presented work laccase has been immobilized on PMMA (poly(methyl methacrylate)) electrospun fibres modified with inorganic/biopolymer hybrid systems containing e.g. cellulose and chitosan. Such a material selection was done due to its highly porous structure, adjustable stability, and excellent biocompatibility [2]. The produced biocatalytic systems were used for removal of selected dyes from model wastewaters. The produced systems, before and after enzyme immobilization, were thoroughly characterized in order to determine the effectiveness of the immobilization processes performed as well as the efficiency of dyes removal. The produced biocatalytic systems containing cellulose and chitosan-based modifiers shown greater compatibility with laccase which resulted with higher amount of immobilized enzyme as well as membrane loading and better efficiency of pollutants removal. This clearly shows that modification of electrospun membranes with specific additives can improve its compatibility with enzyme, which on the other hand enables production of stable and effective biocatalytic systems.

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The work was carried out as part of OPUS project (no. 2021/43/B/ST8/01854) financed by the National Science Centre Poland.

Biographical note

Weronika Badzińska MSc. Eng. is a doctoral student at Poznan University of Technology. She holds a Master's degree in Chemical Technology received at Faculty of Chemical Technology (Poznan University of Technology). Her research explores design, production and characterization of membrane modifiers as well as preparation of novel group of electrospun membranes, with a focus on hybrid additives of various origin dedicated to composite membrane and related environmental applications. Weronika Badzińska's scientific interests include also materials science, surface chemistry, chemical technology, as well as environmental engineering.

INTER-COFFEE-RING EFFECTS BOOST RAPID AND HIGHLY RELIABLE SERS DETECTION OF TPHT ON A LIGHT-CONFINING STRUCTURE



Yujie Dai

Chongqing Institute of Green and Intelligent technology, Chinese Academy of Sciences, 400714, Chongqing, China.
Corresponding author's e-mail: daiyujie@cigit.ac.cn

Abstract

Triphenyltin chloride (TPhT) is a widely applied toxic compound that poses a significant threat to humans and the environment. Surface-enhanced Raman spectroscopy (SERS), capable of non-destructive, rapid, and trace detection, is desirable to better evaluate its distribution and content. However, a sensitive method with simple measuring protocols which maintains excellent reproducibility remains challenging. Here, we proposed an inter-coffee-ring effect to accelerate the sampling and measuring process while maintaining highly reproducible results. Two overlapping coffee-rings are formed through sequenced drying of gold nanorod colloids and a gold nanorod TPhT mixture on a superhydrophobic light-confining structure. Both the gold nanorods and the TPhT are enriched in the overlapping region. The gold nanorods reordered in such an area under the inter-coffee-ring effect yielded vast numbers of consistent hotspots at the sub-2 nm level. Such consistency leads to excellent SERS performance under the light-confining effect induced by the nanoarray substrates. The detection limits of the probe molecule R6G reached 10–12 M, and TPhT reached 10–8 M while achieving excellent stability and reproducibility, and a linear regression coefficient above 0.99 was achieved for TPhT. Crucially, the visible nature of the inter-coffee-ring overlap enabled rapid measurements, thus providing robust support for detecting environmental pollutants.

Biographical note

Associate professor Yujie Dai works at Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences. Her research interest is in plasmonic sensors and organic electrochemical transistors for emerging pollutants detection. She has published several papers in *Journal of Power Sources*, *Environmental Toxicology and Chemistry*, *RSC Advances*, and so on.

AN EFFECTIVE BIOCATALYST FOR THE CONTINUOUS FLOW PRODUCTION OF C8-C18 CARBOXYLIC ACID ESTERS DERIVED FROM BIOMASS-BASED FURFURYL ALCOHOL



Anna Wolny¹, Jakub Zdarta², Teofil Jesionowski², Anna Chrobok¹

¹ Silesian University of Technology, Bolesława Krzywoustego 4, 44-100, Gliwice, Poland

² Faculty of Chemical Technology, Poznań University of Technology, Berdychowo 4, 60-965 Poznań, Poland

Corresponding author's e-mail: anna.wolny@polsl.pl

Abstract

The use of lignocellulosic biomass presents a promising path for sustainable chemical production, supporting circular economy and carbon neutrality principles. With growing need for selective catalysts and eco-friendly production methods, biocatalysis has become a key solution. Enzymes, due to their biodegradability and high activity in mild conditions, ensure environmental safety and effectiveness of synthesis. However, challenges remain in enhancing enzyme recycling and stabilization in chemical processes [1].

To address these challenges, we investigated immobilization techniques using various silica-based supports. Research indicates that hydrophobic surfaces boost lipase activity, and surface modifiers like alkyl groups on silica improve catalytic performance [2]. Consequently, we modified the MgO·SiO₂ matrix with triethoxy(octyl)silane (C8) to retain the material's hydrophobic properties. This modified matrix functioned as both a support and stabilizer for adsorbed lipase from *Aspergillus oryzae* (LAO). By integrating expertise in biocatalyst design and support surface chemistry, we demonstrated continuous flow system for furfuryl ester synthesis using the MgO·SiO₂-C₈-LAO biocatalyst.

Initial batch system studies revealed excellent catalytic activity of MgO·SiO₂-C₈-LAO in esterification reaction of furfuryl alcohol and caprylic acid, achieving 90% conversion in 45 minutes. The biocatalyst also showed versatility with other acids (C8-C18), achieving high conversions in short reaction times. Encouraged by these results, we shifted to continuous flow synthesis, effectively enhancing biocatalytic ester production. This transition allowed us to reach a 97% conversion of furfuryl alcohol under optimized flow parameters. The space-time yield for the active MgO·SiO₂-C₈-LAO in the continuous flow system was 458.4 (gh⁻¹mL⁻¹mg⁻¹) [3].

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This work was funded by the National Science Centre, Poland. Grant no. UMO-2023/49/N/ST8/01633 (PRELUDIUM-22).

Biographical note

Anna Wolny is a PhD student at the Joint Doctoral School of the Silesian University of Technology. Her research interests include enzymatic heterogeneous catalysis, the modification of materials with ionic liquids, flow chemistry, the kinetic resolution of racemates, and the conversion of biomass-derived furan-based compounds. Anna Wolny improved her skills during the research stay at Monash University in Australia, Montanuniversität Leoben in Austria as well as through participation in research projects with industry partners (GAZAP S.A, Orlen Południe). Currently, Anna is leading her own project, PRELUDIUM-22, granted by National Science Centre, Poland.

TURBIDITY MONITORING AND LANGE PROBES AS EARLY WARNING SYSTEMS FOR CLIMATE CHANGE IMPACTS ON WATER SOURCES



Hoan Thi Kim Tran*, Arici Silvia, Sabrina Sorlini***

**Department of Civil Engineering, Architecture, Land and Environment and Mathematics, University of Brescia, Brescia, Italy, Email: sabrina.sorlini@unibs.it, h.tranthikim@unibs.it;*

***A2A Ciclo Idrico – Brescia, email: silvia.arici@a2a.eu*

Keyword(s): Lange probes, Climate change, water treatment

Abstract

Turbidity, which measures the cloudiness or haziness of water due to suspended particles, is a crucial parameter for monitoring the quality of drinking water sources. While turbidity itself does not pose a direct health risk, high levels can compromise disinfection processes and stimulate bacterial growth, increasing the risk of waterborne illnesses. Climate change is expected to intensify weather events like heavy rainfall and storms, which can cause significant spikes in turbidity levels at water sources. Continuous turbidity monitoring using probes like the Lange probe (*Online Sensors and Controllers: Digital Controllers (Transmitters)*, n.d.) installed at the Mompiano water source in Brescia, Italy, can serve as an early warning system for detecting sudden changes in water quality due to climate-related events. These probes continuously measure turbidity, along with other parameters like pH, conductivity, and redox potential, providing real-time data that can trigger automatic isolation of the water source from the distribution network when turbidity exceeds safe thresholds.

The World Health Organization (WHO) (World Health Organization (WHO), Guidelines for Drinking-Water Quality, 1a Edizione, Vol. 1., 1984) recommends maintaining turbidity below 1 Nephelometric Turbidity Unit (NTU) in treated water to avoid compromising disinfection processes. At Mompiano drinking water plant, the automatic isolation occurs when turbidity exceeds 1 NTU in raw water for more than 5 minutes, preventing the distribution of turbid water that could pose health risks. Mompiano plant doesn't have any specific unit treatment for the removal of turbidity. This continuous monitoring and automated response system enables prompt action to ensure water safety during extreme weather events, which are expected to become more frequent and intense due to climate change.

By integrating turbidity monitoring and automated control systems, the water utility can implement a management practice towards a higher resilience to climate change, safeguarding public health and ensuring a reliable supply of safe drinking water.

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THE IMPACT OF FUNGICIDE MICROPOLLUTANTS ON THE HUMAN BODY AT THE CELLULAR LEVEL



Gabriela Sokołowska¹, Agata Jabłońska-Trypuć¹, Monika Naumowicz², Urszula Wydro¹, Elżbieta Wolejko¹, Rafał Krętowski³, Marzanna Cechowska-Pasko³, Javier Esteban Mozo⁴

¹ Department of Chemistry, Biology and Biotechnology, Faculty of Civil Engineering and Environmental Sciences, Białystok University of Technology, Wiejska 45E Street, 15-351 Białystok, Poland

² Department of Physical Chemistry, Faculty of Chemistry, University of Białystok, Ciołkowskiego 1K Street, 15-245 Białystok, Poland

³ Department of Pharmaceutical Biochemistry, Medical University of Białystok, Mickiewicza 2A, 15-222 Białystok, Poland

⁴ Departamento de Biología Aplicada e Instituto de Bioingeniería, Universidad Miguel Hernández de Elche, Avda. de la Universidad s/n, 03202 Elche (Alicante), Spain

Corresponding author's e-mail: a.jablonska@pb.edu.pl

Abstract

Fungicides, which are a group of pesticides, are one of the important types of micropollutants in the human environment. They fit into the definition of micropollutants because they are persistent, difficult or not at all susceptible to biochemical decomposition, disturb biological balance and are not indifferent to living organisms [1]. An example of such a compound is boscalid. Its common use and related presence in the environment are associated with the possibility of its penetration into the human body both through the skin and in the digestive tract. Our previous results indicate the EDC activity of boscalid. Therefore, in this work we focused on examining the mechanisms of fungicide toxicity using human cell lines as an *in vitro* biological model for xenobiotic toxicity testing. Additionally, a novelty in our work is the simultaneous verification whether berberine - a compound of plant origin is able to eliminate or at least reduce the toxic effect of the fungicide. The obtained results allow us to conclude that boscalid triggers and induces mechanisms related to oxidative stress and apoptosis in human cells, causing increased generation of various types of disorders at the cellular level. Therefore, we conclude that fungicides present in food may pose a potential threat to humans and this fact requires further, in-depth studies. However, the cytoprotective effect of berberine with antioxidant activity, seems promising.

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The Acknowledgements: This work was financially supported by the Ministry of Education and Science, Poland, under the research project number WZ/WB-IIŚ/6/2022.

Biographical note

Dr. hab. Agata Jabłońska-Trypuć, prof. PB, works at the Department of Chemistry, Biology and Biotechnology of the Faculty of Civil and Environmental Sciences of the Białystok University of Technology. Her research interests focus on the study of toxicity and cytotoxicity of selected environmental pollutants, both complex matrices such as landfill leachates, sewage sludge and single pollutants such as selected pesticides. In her research she mainly focuses on molecular analyses using human cell lines as an *in vitro* biological model for studying xenobiotic toxicity.

UIO-66@Fe₃O₄ NANOCOMPOSITE AS AN ADSORBENT IN DISPERSIVE SOLID PHASE EXTRACTION OF METFORMIN IN SURFACE WATER AND WASTEWATER



Abigail Goitumetswe Sekopelo^{1,2}, Mthokozisi Mnguni^{1,2}, Philiswa Nosizo
Nomngongo^{1,2*}

¹Department of Chemical Sciences, University of Johannesburg, Doornfontein Campus, P.O Box 17011, Doornfontein, 2028, South Africa

² Department of Science and Innovation-National Research Foundation (DSI-NRF SARChI) in Nanotechnology for Water, University of Johannesburg, Doornfontein, 2028, South Africa

Corresponding author's e-mail: pnnomngongo@uj.ac.za

Abstract

Over the years, magnetic nanocomposite materials have gained much attention as suitable adsorbents for separating and preconcentrating pollutants from water [1]. Consequently, this study fabricated UiO-66@Fe₃O₄ nanocomposite as a sorbent for dispersive solid phase extraction (dSPE) of metformin (MET) in waters. The nitrogen adsorption-desorption analysis showed that the nanocomposite exhibits a large surface area, pore volume, and narrow pore diameter of 567 m² g⁻¹, 0.370 cm³ g⁻¹, and 2.64 nm, respectively. The scanning electron microscopy (SEM) and transmittance electron microscopy (TEM) confirmed the spherical morphology of Fe₃O₄ and the successful formation of the nanocomposite. This study reported the extraction, preconcentration, separation and determination of metformin (MET) in South African waters. The dSPE method in tandem with a high-performance liquid chromatography-diode array detector (HPLC-DAD), was optimized by investigating the effect of sample pH, mass of adsorbent (MA), extraction time (ET), elution time (ET) and eluent volume (EV) on the extraction and preconcentration of MET. Under optimal conditions, the method recovered 85.6-101% from ultrapure water, surface water, and wastewater. Moreover, the limit of detection (LOD) and limit of quantification (LOQ) for MET were 0.030-0.25 µg L⁻¹ and 0.20-1.0 µg L⁻¹, respectively, with a percentage relative standard deviation (%RSD) of 1.9-4.9. The MET concentrations in studied surface water, wastewater influent, and wastewater effluent samples ranged from 612-731, 22.6-56.7, and 0-1.67 µg/L, respectively. The dSPE (UiO-66@Fe₃O₄)/HPLC-DAD method was rapid and simple and demonstrated suitability for monitoring and quantification of MET in South African surface water and wastewater for the first time.

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Biographical note

I am currently a Postdoctoral researcher at the University of Johannesburg in South Africa (RSA). I obtained my Doctorate (Chemistry) in 2022 at the University of KwaZulu Natal (RSA). Under the same institution, I received a Masters degree *cum laude* in Chemistry which focused on studying the kinetics of biological reactions. My research interests involve designing nanomaterials and nanocomposites and investigating their application in various modes of solid-phase extraction (SPE) techniques. The main focus is separating, preconcentration, and analyzing emerging contaminants from water (surface water and wastewater) using chromatographic techniques.

STRATEGIC DECARBONIZATION TRANSITION IN THE POWER PLANT INDUSTRY: AN ALTERNATIVE APPROACH TO DIRECT COAL PHASE-OUT



Nguyen Thi Thuy^{1,2}, Aditya Prana Iswara^{3,*}, Le Tieu Phung^{2,4}, Truong Hoai Huu Hieu^{2,4}, Vo Thi Thanh Thuy^{2,4}, Lam Pham Thanh Hien^{2,4}, Nguyen Lan Thanh^{2,4}, Nguyen Nhat Huy^{2,4,*} Sultan Fat Ihza Abdillah⁵

¹School of Environmental Engineering, International University, Quarter 6, Linh Trung Ward, Thu Duc City, Ho Chi Minh City, Vietnam

²Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc City, Ho Chi Minh City, Vietnam

³Master of Disaster Management, Postgraduate School, Universitas Airlangga, Airlangga St. no 4-6 Surabaya, Indonesia

⁴Faculty of Environment and Natural Resources, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet St., Dist. 10, Ho Chi Minh City, Vietnam

⁵Center of Environmental Risk Management, Dept. of Environmental Engineering, Chung Yuan Christian University
Corresponding author's e-mail: aditya.prana@pasca.unair.ac.id, nnhuy@hcmut.edu.vn

Abstract

Climate change stands as a paramount global concern, compelling imperative transformative measures across diverse industries, notably within the power plant sector. Governments worldwide are actively embracing ambitious net-zero carbon or emissions policies to mitigate the far-reaching impact of climate change. The power plant industry, occupying a distinctive position, grapples with challenges in aligning with decarbonization goals while concurrently addressing the escalating energy demand. The industry faces a critical dilemma: the imperative of phasing out coal, a substantial source of emissions, while ensuring a dependable and sustainable energy supply. Achieving a transition toward sustainable practices mandates a strategic and deliberate approach that harmonizes environmental goals with the imperative for energy security.

This study systematically analyzes the current landscape of the power plant industry, providing an in-depth examination of challenges, prevailing policy frameworks, and the intricate balance between urgency and strategic decision-making. Beyond advocating for decarbonization, the paper underscores the paramount importance of recognizing and appreciating programs that make substantial contributions to carbon reduction or attain zero emissions. This review significantly enriches the ongoing industry discourse by offering a comprehensive understanding of the multifaceted challenges and opportunities inherent in the decarbonization trajectory of power plants.

Keywords: Decarbonization behaviour, powerplant industry, policy net zero carbon/emissions

Acknowledgment

The authors would like to sincerely thank Irjend Pol. (Purn) Dr. Juansih, Dra., S.H., M.Hum. (Center Of Women Empowerment In Law Enforcement Research Fund of Postgraduate School, Universitas Airlangga), for the fund granted in this research.

Biographical note

Aditya Prana Iswara P.hD. is the Head of the International Partnership of Postgraduate School at Universitas Airlangga. He specializes in environmental management and technology. He is also part of the Technical Team of Environmental Ministry Regulation and National Life Cycle Guideline of the Ministry of Environment and Forestry, published in 2021. In addition, Aditya is the Coordinator of the Life Cycle Assessment and Eco-Innovation National Evaluation held by the Ministry of Environment and Forestry. He is developing research in environmental sustainability and policy, pollution health literacy, and environmental disaster risk reduction.

EFFECT OF SALINITY ON THE EFFICIENCY OF REMOVING POLLUTANTS IN SYNTHETIC SHRIMP FARMING WASTEWATER OF THE MBG SYSTEM



Mai-Duy-Thong Pham^{1,2}, Thien-Tai Nguyen^{1,2}, Thi-Dieu-Thuy Nguyen^{1,2}, Dang-Tue-Minh Nguyen^{1,2}, Thi-Kim-Quyen Vo^{1,3}, Ky-Phuong-Ha Huynh^{1,2}, Chitsan Lin⁴, Phuoc-Dan Nguyen^{1,2}, Xuan-Thanh Bui^{1,2,*}

¹Key laboratory of Advanced Waste Treatment Technology, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet street, district 10, Ho Chi Minh City, Vietnam.

²Vietnam National University Ho Chi Minh, Ho Chi Minh City, Vietnam.

³Ho Chi Minh City University of Industry and Trade, Vietnam

⁴National Kaohsiung University of Science and Technology, Taiwan.

Corresponding author's e-mail: bxthanh@hcmut.edu.vn

Abstract

Applying microalgae-bacteria granule (MBG) to wastewater treatment is a potential direction due to its good wastewater treatment ability and high biomass recovery ability. MBG system can adapt to adverse environmental conditions and high salinity is one such condition. This study evaluates the wastewater treatment ability of the MBG system and the change in MBG properties at different salt concentrations. Four cylindrical stirred sequencing batch photobioreactor (SPBRs) with a working volume of 3 L were operated in parallel under natural lighting conditions. Synthetic shrimp farming wastewater was prepared at different salinities from 0 to 15,000 mg/L named S_c, S₅, S₁₀, and S₁₅ corresponding to salinities of 0; 5,000; 10,000; and 15,000 mg/L. NH₄⁺-N and TP removal of salt-adding SPBRs were higher than the control one. According to the increase in salinity, the removal efficiency of NH₄⁺-N slightly increased and the removal efficiency of TP increased sharply. The research results showed that high salinity above 10,000 mg/L negatively affects MBG's size, stable ability, and Chlorella-a content in biomass. Thus, the MBG system can be used to treat wastewater with salinity less than 10,000 mg/L.

Keywords: Microalgae-bacteria granule; Pollutant removal rate; salinity; Synthetic shrimp farming wastewater.

Biographical note

Dr. Quyen obtained Bachelor and Master degrees in the field of Environmental engineering at Ho Chi Minh City University of Technology (Vietnam). Then, she got Ph.D. degree in the field of Environmental engineering and Energy at Myongji University (Republic of Korea). At the present, she is a lecturer. Her research focuses on the fields of biological wastewater treatment (sulfur-based autotrophic denitrification, algae-based treatment process, bioplastic production). She has 21 publications (including 12 ISI, 7 international non-ISI, 2 national papers). Additionally, she has played the role of project investigator/key member for 5 projects funded by international/national organizations.

IN-SITU INVESTIGATION OF HUMIC ACID AGGREGATION INDUCED BY QUATERNISED CHITOSAN FOR WATER TREATMENT



Mingyu Yuan¹, Heriberto Bustamante², Michael Gradzielski¹

¹*Stranski-Laboratorium für Physikalische und Theoretische Chemie, Institut für Chemie, Technische Universität Berlin, Straße des 17. Juni 124, 10623 Berlin, Germany*

²*Sydney Water, Parramatta NSW 2125, Australia*

Corresponding author's e-mail: michael.gradzielski@tu-berlin.de

Abstract

In water treatment processes, the interaction between humic acid (HA)—a primary constituent of natural organic matter (NOM) in raw water, which negatively affects the quality of drinking water—and polycations plays an important role.[1] When polycations are added in sufficient quantities, they effectively neutralize the resulting complexes with humic acid, leading to their precipitation.[2] To develop sustainable solutions, this study explores the use of differently modified cationic (quaternized) chitosan (qCs), derived from natural waste, as polycations.[3] We investigated the phase behaviour of HA and various qCs across different mixing ratios and pH values. This phase study showed that precipitation occurs at much lower charge ratio for qCS compared to poly(diallyldimethylammonium chloride) (PDADMAC). The formed aggregates in solution were studied by means of dynamic light scattering, showing how their size increases upon polycation addition. Furthermore, SAXS experiments showed that on the size range of ~20 nm qCS leads to marked hydrophobic domains. Additionally, the HA-qCs aggregation process was examined in-situ using light diffraction techniques to elucidate the impact of chain structure on flocculation tendencies and kinetics. By understanding the interactions between HA and qCs on a physico-chemical basis, our findings are promising to enhance water treatment processes in industrial applications.

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Acknowledgements: We acknowledge funding from Deutsche Forschungsgemeinschaft (DFG), GR1030/26-1.

Biographical note

Michael Gradzielski is full professor for Physical Chemistry/Molecular Materials Science at the TU Berlin (Germany) since 2004. His fields of research comprise colloid science, surfactants, amphiphilic polymers, hydrogels, polyelectrolytes, and nanoparticles, with an emphasis on correlating macroscopic behaviour with the mesoscopic structure. Before joining TU Berlin he studied chemistry at the Universität Bayreuth (Germany) and the University of Wisconsin-Madison and pursued postdoctoral research work at the Ecole Normale Supérieure, Paris (France).

BALANCING CARBON AND NUTRIENT RATIO FOR BIOMASS, LIPID AND PROTEIN PRODUCTION IN MICROALGAE



Lisa Aditya^a, Unnikrishnan Kuzhiumparambil^b, Peter J. Ralph^b, Van T. Tra^a, Md Abu Hasan Johir^a, T.M.I. Mahlia^a, and Long D. Nghiem^{a, #}

^a Centre for Technology in Water and Wastewater, University of Technology Sydney, Ultimo NSW2007, Australia

^b Climate Change Cluster, University of Technology Sydney, Ultimo NSW2007, Australia

[#]Corresponding author's e-mail: Duclong.nghiem@uts.edu.au

Abstract

Microalgae have emerged as a platform for producing alternative biofuel to phase out petroleum oil. Microalgae can efficiently capture and convert CO₂ into lipids, proteins, and carbohydrates, thus playing an important role in the sustainable aviation fuel roadmap [1]. Despite its significant potential, several technical challenges remain, including low biomass and lipid yield, which lead to high production costs. Balancing the cultivation conditions to scale up microalgae production involves adjusting various factors. Using sodium bicarbonate (NaHCO₃) as an inorganic carbon source accelerates the absorption process [2], but an imbalance of NaHCO₃ and other nutrient ratios could lead to a counterproductive effect on biomass production [3]. This study investigated a series of NaHCO₃ concentrations in two different growth media, Maxigro and Cell Hi HP. The result showed that increasing the concentration of NaHCO₃ in microalgae cultivation allows for the use of lower concentrations of the growth media to achieve optimal growth. Moreover, the growth media composition significantly influences microalgae growth, morphology, and biochemical production. For MaxiGro, despite having higher total nitrogen and phosphorus, it lacks in phosphate form, resulting in lower protein production. MaxiGro has higher magnesium and calcium, which leads to higher lipid production. On the other hand, Cell Hi HP has higher potassium and iron, which supports higher protein production. Moreover, both growth media and NaHCO₃ significantly affect FAME production. Methyl pentadecanoate and methyl palmitoleate are less affected by changes in NaHCO₃ concentrations but are significantly influenced by the growth medium concentration. Methyl decanoate is less influenced by the type of growth medium but showed significant effects on different concentrations of NaHCO₃. This finding suggests that controlling C/N ratios is crucial for improving both the quantity and quality of microalgae biomass. This study could provide a helpful guide for tailoring biomass cell content.

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Biographical note

Lisa is a PhD candidate at the University of Technology Sydney, focusing on microalgae cultivation and harvesting. She completed her master's degree at the Gdańsk University of Technology, where she familiarised herself with microalgae through her thesis on the utilisation of *Nannochloropsis oculata* in treating effluents from the deammonification process in Sequential Batch Reactors. Under the supervision of Professor Long D. Nghiem, she continues to explore this field and has published several papers on this subject.

APPLICATION OF ALUMINIUM-COATED MEMBRANES FOR THE IMMOBILIZATION OF ENZYMES: MODEL REACTIONS FOR THE EVALUATION OF ENZYME ACTIVITY



Agata Zdarta, Agata Pera, Aleksandra Rybak

Institute of Chemical Technology and Engineering, Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, 60965 Poznan, Poland

Corresponding author's e-mail: agata.zdarta@put.poznan.pl

Abstract

Aluminum-coated and gold-coated membranes are being used for the identification and characterisation of micro- and nanoparticles in natural waterways, marine life, and consumer products, including mineral water and other beverages. These micropollutants are becoming a significant global concern, particularly in terms of their environmental and toxicological impact [1]. The most problematic co-contaminants in environmental samples are cellulose and protein. In the presented study, enzymes that are specifically designed to degrade these co-contaminants were immobilized on aluminium-coated and gold-coated membranes with the objective of creating biologically active membranes for the purpose of one-step enzymatic sample treatment and filtration. Subsequently, an additional enzyme, laccase, was tested. The resulting biomembranes were subjected to comprehensive characterisation, during which their kinetic parameters were determined under a range of conditions. The catalytic activity of free and immobilized cellulase was evaluated by measuring the quantity of reducing sugars (glucose) produced during the hydrolysis of the cellulose substrate. The concentration of glucose was quantified using the DNS method [2]. The activity of the free enzyme and the laccase immobilized onto the biocatalytic membranes was calculated from spectrophotometric measurements during continuous monitoring of the ABTS oxidation reaction [3]. Protease activity was analysed using the Folin-Ciocalteu reagent, based on Sigma's Non-specific Protease Activity Protocol developed by Cupp-Enyard (2008) [4]. The performed model reactions enabled comparison of the properties of the created biocatalytic systems.

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Acknowledgements

The research leading to these results has received funding from the National Science Center (Poland) under Project number 2022/47/D/ST8/02677.

Biographical note

M.Sc. Aleksandra Rybak, a graduate of the Department of Chemical Technology (M.Sc. obtained in 2024, professional engineering degree obtained in 2023). She will commence her doctoral studies in chemical sciences in chemical technology in October 2024. The SONATA 18 project contractor has proposed the use of bioactive membranes as tools in the analysis of microplastic pollution in environmental samples. The research area is centred on the following four key areas: biomembranes, enzyme immobilisation, microplastics and their environmental impact.

ELECTROSPUN MEMBRANES FOR ENZYME IMMOBILIZATION IN ENVIRONMENTAL APPLICATIONS



Agata Zdarta, Marcin Wysokowski, Oliwia Górzyńska

Institute of Chemical Technology and Engineering, Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, 60965 Poznan, Poland

Corresponding author's e-mail: agata.zdarta@put.poznan.pl

Abstract

Microplastics, tiny plastic particles less than 5 millimeters in size, have become a significant environmental concern due to their overwhelming presence and harmful impact. These particles originate from various sources, including the breakdown of larger plastic debris, microbeads in personal care products, and synthetic fibers from clothing. Microplastics infiltrate marine ecosystems, soil, and even the air, posing threats to wildlife and human health. The persistence and widespread distribution of microplastics make them challenging to manage, highlighting the urgent need for comprehensive measures to reduce plastic pollution [1].

Membranes are the most effective method for physical separation of microparticles. These systems use semi-permeable membranes to filter out contaminants, including microplastics, by trapping particles while allowing clean water to pass through. Enzymatic treatment, on the other hand, enables the removal of contaminants under mild conditions, which is particularly important for research on microplastics. Environmental scientists are developing new sample preparation procedures that allow for the effective separation of polymers of various shapes and sizes present in the environment [2].

The aim of this study was to produce systems based on bionic hybrid membranes that served as matrices for the immobilization of enzymes from different catalytic groups. The membranes were fabricated using electrospinning and the biopolymers chitosan and polylactic acid were used as substrates. Afterward, a thorough characterization of membrane parameters was performed. Various enzymes were then immobilized, including protease, laccase, and lipase. The catalytic activity of the generated membrane-enzyme systems and their electrokinetic potential were investigated, and work was then undertaken to increase the activity of the systems and immobilize them as efficiently as possible.

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The research leading to these results has received funding from the National Science Center (Poland) under Project number 2022/47/D/ST8/02677.

Biographical note

MSc Oliwia Górzyńska is a young researcher, educated in Poland, Poznan University of Technology, where she did her BSc in Chemical Engineering and MSc in Electrochemistry. She currently works on a project under Dr. Eng. Agata Zdarta's supervision, entitled „*Bioactive membranes as tools in microplastic pollution count in the process of environmental samples analysis*”.

UTILIZING NATURAL ZEOLITE SIR-600 AND RESIN CG-8 FOR AMMONIUM ELIMINATION FROM GROUNDWATER: BATCH AND COLUMN STUDIES



Dai Quyet Truong^{1*}, Le Minh Tran², Tien Vinh Nguyen^{1*}

¹*Center for Technology in Water and Wastewater, School of Civil and Environmental Engineering, University of Technology Sydney, NSW 2007, Australia*

²*School of Environmental Science and Technology, Hanoi University of Science and Technology (HUST), Hanoi, Vietnam*

*Corresponding author's e-mail: daiquyet.truong@student.uts.edu.au; tien.nguyen@uts.edu.au

Abstract

Nowadays, ammonium pollution in groundwater is an emerging problem that is receiving significant attention worldwide. This study investigated the capability of a commercial resin (CG-8) for ammonium removal from groundwater. In the batch adsorption studies, the material exhibited a magnificent ammonium uptake efficiency in the batch sorption test using a 25 mg/L NH_4^+ simulated solution, with a maximum Langmuir sorption capacity of 17.45 mg/g. In addition, the adsorbent demonstrated a sustainable performance over a wide pH solution range (2 - 8) and a rapid kinetics rate. The effect of competing ions in groundwater (i.e., Na, Mg and K) on the ammonium uptake efficacy was also studied in a binary solution of NH_4^+ and each single competitive ion, and the results indicated that the ammonium uptake rate was only reduced by less than 10 % in the presence of interfering ions. In the column study with practical groundwater samples collected from a rural area in Hanoi (Vietnam), CG-8 possessed an NH_4^+ sorption capacity of 5.23 mg/g after 630 BVs. Furthermore, after regenerating with 10% NaCl eluent, the ammonium uptake capacity of the resin was restored by 97% compared to the pristine material. These satisfied outcomes indicate the feasibility of CG-8 adsorbent for the elimination of ammonium in practice.

Biographical note

I am a PhD student at the University of Technology Sydney, Australia. My research focuses on rubidium recovery from seawater and seawater brines.

My research interests include adsorption technology and capacitive deionization process regarding contaminants removal in aqueous solution and precious metals recovery from seawater/seawater brine, and microplastic detection/elimination from high-strength wastewater streams. I am currently continuing to explore these fields and have published several papers.

DOWNSTREAM SEPARATION OF FUNCTIONAL BIOPRODUCTS AND THEIR APPLICATION IN THE COSMETIC INDUSTRY



Mateusz Szczygiel¹, **Daria Szymanowska**², **Ewa Kilian-Pięta**³, **Krystyna Prochaska**¹

¹Poznan University of Technology, Berdychowo 4, 60-965 Poznań, Poland

²Poznan University of Life Science, Wojska Polskiego 48, 60-927 Poznań, Poland

³Symbiosis Sp. z o.o., Rubież 46H, 61-612 Poznań, Poland

Corresponding author's e-mail: mateusz.szczygiel@put.poznan.pl

Abstract

The processes forming the basis of white biotechnology are viewed as an opportunity to gain independence from limited raw materials, reduction of postproduction waste and energy costs. On the other hand, one of the main challenges posed by the modern biotechnological industry is the development of efficient methods of recovery of selected low-molecular metabolites. The multitude of by-products present in fermentation broth, increase the costs of separation and concentration of the main product [1]. Keto acids (e.g. alpha-ketoglutaric acid and pyruvic acid), metabolites of industrial microorganisms, are examples of the so-called green chemicals. Ultimately, keto acids can be used to produce food additives, diet supplements, pharmaceuticals, cosmetics and used in agriculture [2]. In this study we proposed the combination of forward osmosis (FO) and bipolar membrane electrodialysis (EDBM) as a method to isolation of selected keto acids from fermentation broth without the need to use hazardous chemicals. We also assessed the usefulness of the obtained bioproducts in cosmetic industry. It is worth emphasizing, that proposed in our study the combination of biosynthesis of industrially attractive metabolites with the separation process, combined with the evaluation of the functionality of the compounds obtained, opens a completely new chapter connecting industrial biotechnology with chemical technology, cosmetology and medicine.

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The authors wish to acknowledge the financial support from the Ministry of Education and Science, Poland.

Biographical note

Mateusz Szczygiel PhD, since 2022 assistant professor at the faculty of Chemical Technology, Poznan University of Technology. Specialist in membrane technology including bioproduct separation using pressure-, osmotically- and electrically driven membrane processes. His work focuses on developing new membrane bioreactor systems and hybrid processes by the assumptions of the circular economy.

PLASMONIC METASTRUCTURES FOR EMERGING POLLUTANT DETECTION



Lin Chang

Chongqing Institute of Green and Intelligent technology, Chinese Academy of Sciences, 400714, Chongqing, China.

Corresponding author's e-mail: changlin@cigit.ac.cn

Abstract

Metastructures are widely used in photonic devices, energy conversion, and analytical applications. However, to fabricate multiple patterns continuously in single etching protocol with highly tunable photonic properties is challenging. Here, a simple and robust dynamic nanosphere lithography is proposed by inserting a spacer between the nanosphere assembly and the wafer. The nanosphere diameter decrease and uneven penetration of the spacer during etching lead to a dynamic masking process. Coupled anisotropic physical ion sputtering and ricocheting with isotropic chemical radical etching achieve highly tunable structures with various 3D patterns continuously forming through a single etching process. Specifically, the nanosphere diameters define the periodicity, the etched spacer forms the upper parts, and the wafer forms the lower parts. Each part of the structure is highly tunable through changing nanosphere diameter, spacer thickness, and etch conditions. Using this protocol, numerous structures of varying sizes including nanomushrooms, nanocones, nanopencils, and nanoneedles with diverse shapes are realized as proof of concepts. The broadband antireflection ability of the nanostructures and their use in surface-enhanced Raman spectroscopy to detection emerging pollutants are also demonstrated for practical application. This method substantially simplifies the fabrication procedure of various metastructures, paving the way for its application in plasmonic metastructures and emerging pollutant detection.¹

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Biographical note

Assistant professor Lin Chang received his PhD degree in Environmental Science at the University of Chinese Academy of Sciences in 2022 and is now working at Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences. His research interest is in microfluidic systems integrated plasmonic sensors and electrochemical devices for environmental detection. He has published several papers in *Advanced Materials*, *Environmental Science: Nano*, *Analytica Chimica Acta*, and so on.

REVEALING TRADE-OFF BETWEEN CARBON AND FLUE GAS EMISSIONS FROM POWER GENERATION PLANTS



Sultan F.I. Abdillah^{1,2,3}, Te-Wei Yang², Sheng-Jie You^{2,3}, Ya-Fen Wang^{2,4*}

¹Department of Civil Engineering, Chung Yuan Christian University, Zhongli, Taoyuan 32023, Taiwan

²Department of Environmental Engineering, Chung Yuan Christian University, Zhongli, Taoyuan 32023, Taiwan

³Center for Environmental Risk Management, Chung Yuan Christian University, Zhongli, Taoyuan 32023, Taiwan

⁴Sustainable Environmental Education Center, Chung Yuan Christian University, Zhongli, Taoyuan 32023, Taiwan

Corresponding author's e-mail: yfwang@cycu.edu.tw

Abstract

The growing pressure on energy industries to reduce their emissions of flue gases has led to a notable increase in retrofitting efforts within power plants [1]. However, these activities may inadvertently result in higher carbon emissions due to increased electricity consumption by air pollution control devices (APCDs), or changes in fuel and combustion methods, creating a trade-off between carbon and flue gas emissions. This research aims to thoroughly examine this trade-off at major power plants in Taiwan by analyzing shifts in emission factors (EF) between carbon and flue gas. A significant trade-off was observed at the C2 coal-fired power plant (CFPP), where carbon dioxide (CO₂) EF increased by 17.50%, while total suspended particulate (TSP), sulfur dioxide (SO₂), and nitrogen oxides (NO_x) EFs declined by 82.49%, 48.31%, and 54.02%, respectively, from 2016 to 2020. The carbon emissions induced by APCDs at C1 and C2 CFPPs nearly tripled during this period due to intensified retrofitting activities, underscoring the impact of APCD configurations on this trade-off. Analysis revealed that liquefied natural gas (LNG) power plants consistently exhibit lower CO₂ and flue gas EFs compared to CFPPs, thereby minimizing the trade-off tendency. Additionally, sub-critical (SBC) coal combustion reactors emitted more carbon and flue gas compared to ultra-supercritical (USC) reactors. Through TODIM multi-criteria decision-making analysis [2], it was determined that the most optimal APCD configuration, in terms of both annual APCD CO₂ emissions and operational cost, is selective catalytic reduction (SCR) + electrostatic precipitator (ESP) + sea water flue gas desulfurization (SWFGD). This study emphasizes the overlooked trade-off dynamics within power plants, which are crucial for achieving net-zero and sustainable energy sectors in the future.

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[2] Zhao, M., et al., *TODIM method for multiple attribute group decision making based on cumulative prospect theory with 2-tuple linguistic neutrosophic sets*. International Journal of Intelligent Systems, 2021. 36(3): p. 1199-1222 DOI: 10.1002/int.22338.

Biographical note

The presenting author is a Ph.D candidate from Chung Yuan Christian University, Taiwan. His research currently focuses on addressing the issues of air pollution and climate change. Apart from that, he also interested in monitoring and modelling of unregulated air pollutant such as ultrafine particles, black carbon, and others.

RECYCLING PRODUCT MODEL AS THE SOLUTION FOR MODELING RECYCLING: PROPERTIES OF THE PRODUCT



Jacek Diakun

*Poznań University of Technology, 5 Maria Skłodowska-Curie Square, 60-965 Poznań, Poland
Corresponding author's e-mail: jacek.diakun@put.poznan.pl*

Abstract

Handling a product in the last phase of its life cycle has become an important issue over recent years. The method of dealing with the product after its end-of-life should be determined already at the design stage. However, both 3D CAD tools and PLM systems offer functions and tools that enable the assessment of the product's properties from the point of view of its handling after its end-of-life to a very limited extent. This is due, among other things, to the lack of appropriate models that determine the properties of the product in the last phase of its life cycle. This work presents Recycling Product Model (RPM) as a proposal for a product modeling standard for the purposes of its assessment from the recycling point of view. Recycling Product Model consists of the following elements [1, 2]: (1) CAD 3D assembly model (2) extended connection attributes with disassembly attributes (connection constraints) (3) material recycling attributes (4) product category. Except for modeling of recycling properties of the products, Recycling Product Model enables calculation of quantitative assessment measures that describe recycling properties of the product – thus the product design variants can be compared quantitatively. Recycling Product Model can be used both for assessment of product being design and already existing products.

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Biographical note

Jacek Diakun graduated from Poznań University of Technology in computer science. He obtained his Ph.D. with a thesis on computer simulation of production processes. His scientific interests encompass product modeling in terms of the last phase of the life cycle, computer simulation of production processes and applications of machine learning methods in production engineering issues.

AN INTEGRATED EVALUATION STRATEGY FOR ANAEROBIC DIGESTION MONITORING BASED ON ACID-BASE BALANCE AND THERMODYNAMICS OF VOLATILE FATTY ACID DEGRADATION



Di Wu, b. Huiliang Liu, Tao Xing, Fan Xiao, Yuan Liua, Feng Zhenb, Yongming Sun

Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, Chongqing, 400714, China
Corresponding author's e-mail: wudi1@cigit.ac.cn

Abstract

Process monitoring is a top priority for anaerobic digestion (AD) treating organic waste, yet it poses a significant challenge due to its inherent inaccuracies and case-specific nature in diagnosing reactor status. Herein, a long-term instability simulation experiment using lignocellulosic biomass was conducted with varying organic loading rate (OLR) and hydraulic retention time (HRT) levels. The increase in OLR (0.75 to 20 kg VS m⁻³·d⁻¹) and decrease in HRT (20 to 4 d) led to substantial total volatile fatty acids (TVFA) accumulation (> 14 g/L) with a concomitant decrease in methane yield and organics removal. Full processing capacity with considerable conversion efficiency at four steps (hydrolysis: 60.43 ± 2.82%, acidogenesis: 56.13 ± 3.27%, acetogenesis: 56.03 ± 3.31%, methanogenesis: 55.93 ± 3.32%) and optimal methane yield (3.13±0.17 L/(L·d)) was achieved at an OLR of 18 Kg VS·m⁻³·d⁻¹ and HRT of 4 days. An integrated evaluation strategy for AD process stability is proposed based on the acid-base balance and thermodynamics of VFA degradation. Propionate, iso-valerate, TVFA/bicarbonate alkalinity (BA), and BA/total alkalinity (TA) were identified as potential auxiliary indicators for diagnosing AD imbalances, while ΔG for propionate and valerate degradation served as the early warning signs. To enhance the efficacy and universality of early warnings, relative variations for acid-base indicators based on steady-state (~15%) and the absolute threshold value for ΔG_{Propionate} (-40 KJ/mol) and ΔG_{Valerate} (-55 KJ/mol) were adopted. This approach integrates considerations for microbial adaption, thereby enhancing an assessment of whether a given signal reflects irreversible acidification or is merely a temporary fluctuation induced by reversible acidification. The proposed strategy enables a reliable and accurate early warning, holding great promise for practical applications.

Acknowledgements

This work was supported by the National Natural Science Foundation of China (No. 52122007, 51978641, 52300179, 52131003, 52327813, 42307111), Chongqing Natural Science Fund for Distinguished Young Scholars (No. CSTB2022NSCQ-JQX0003), Postdoctoral Natural Science Foundation of Chongqing (No. CSTB2023NSCQBHX0171), the Outstanding Scientist of Chongqing Talent Plan (CQYC20210101288/CQYC202101006), the Postdoctoral Innovation of Chongqing Talents Support Program, and the Key R & D project of Heilongjiang Province (GY2021ZB0253/GA21D009)

Biographical note

My primary research interest is the optimization of anaerobic digestion (AD) process of treating organic waste. My work during my Ph.D. study focused on AD process stability, including substrate pretreatment, biological process optimization, exploring early-warning indicators, kinetic models, thermodynamic calculation, metagenomics, and metaproteomics.

LIFE CYCLE AND TECHNOECONOMIC ANALYSIS OF INDUSTRIAL SCALE BIODIESEL PRODUCTION FROM MACROALGAL BIOMASS THROUGH BIOREFINERY APPROACH



Pravin Ravichandran, Baskar Gurunathan

*Department of Biotechnology, St. Joseph's College of Engineering, Chennai-600119, Tamilnadu, India.
Corresponding author's e-mail: basg2004@gmail.com*

Abstract

The present work discusses on the life cycle and technoeconomic assessment of the simulated industrial scale biodiesel production through incorporating biorefinery approach. The lipid extracted from the algal and non-edible seed biomass were mixed and used for the transesterification reaction. The catalyst used to speed up the reaction was synthesized from the residual macroalgal biomass which significantly contributes to waste utilization. The synthesized catalyst was characterized using analytic techniques such as FT-IR, SEM-EDX, XRD, TGA-DSC and BET analysis. The process parameters were optimized using the conventional and statistical methods using response surface methodology. The produced biodiesel was characterized using GC-MS and physiochemical characteristics to assess their quality. Using the laboratory optimized data, the industrial scale production model was simulated using the Superpro Designer software. The economic factors such as the NPV, ROI, IRR and payback period was evaluated. The CO₂ emissions were also studied using the environmental analysis. The minimum selling price was found and sensitivity analysis were also studied to evaluate the sustainability of the biodiesel production. This paves the way for the greener environment and sustainable bioeconomy.

Biographical note

Mr. Pravin Ravichandran is currently designated as Full-time research scholar in the Department of Biotechnology, St. Joseph's College of Engineering, Chennai, India. His research area revolves around the biofuels production, nanomaterials synthesis and characterization, Technoeconomic analysis and life cycle assessment. He has published nearly 12 SCI indexed articles including both review and research studies. He has also attended several international conferences in different states around India. These conferences serve as platforms for scholarly exchange, facilitating networking opportunities, and enabling him to stay updated on the latest advancements and trends in his field.

PRODUCTION OF POLYHYDROXYALKANOATE (PHA) COPOLYMERS FROM METHANE AND VALERATE USING MIXED MICROBIAL CULTURES



Aleksandra Gęsicka, Natalia Gutowska, Sivasankar Palaniappan, Piotr Oleskowicz-Popiel, Mateusz Łęzyk

Faculty of Environmental Engineering and Energy, Poznan University of Technology, Berdychowo 4, 60-695 Poznan, Poland

Corresponding author's e-mail: mateusz.lezyk@put.poznan.pl

Abstract

Polyhydroxyalkanoates (PHA) biopolymers can replace conventional petroleum-derived polymers and are produced by diverse bacteria, most commonly in the form of polyhydroxybutyrate (PHB). While PHB is a low performance bioplastic that is crystalline and brittle with poor elastic properties, PHA copolymers such as poly(3-Hydroxybutyrate-co-3-Hydroxyvalerate) (PHBV) with defined copolymer composition can be produced utilizing mixed microbial cultures [1]. Moreover, PHAs can be produced utilizing methane as a major carbon source allowing for the development of a gas fermentation process that helps to mitigate methane emissions while producing biopolymers.

In our recent work, we have tested a number of environmental inocula [2] and operational strategies for improving PHA production and attempting to control the relative content of hydroxyvalerate fraction incorporated by mixed microbial consortia. All cultures were dominated either by *Methylobacter* or *Methylocystis* genus. Selected enrichment cultures were tested in a continuous process, examining the impact of varying co-substrate addition strategies on PHA production under sequential feast-famine cycles. Moreover, novel strains of *Methylocystis* were isolated and characterized in the course of our studies.

Applying sequential feast:famine cycles facilitated the production of PHBV with a high molecular fraction of hydroxyvalerate monomer in a methane-based mixed culture system. However, adjusting the polymer composition by modifying the carbon supply strategies was not feasible. The mixed methanotrophic culture for PHA production could operate with and without pH control, as deviations from the optimum neutral pH for *Methylocystis* sp. did not negatively impact polymer accumulation.

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ACKNOWLEDGMENT

This research was financed by the National Science Center, Poland under the grant agreement no. 2019/35/D/ST8/03530

Biographical note

Mateusz Łęzyk received his Ph.D. in 2014 and later worked as a postdoc researcher at the Department of Chemical and Biochemical Engineering at Technical University of Denmark, where he worked on mining enzymatic biodiversity for various industrially-relevant processes. In 2018, he joined the Faculty of Civil and Environmental Engineering, at Poznan University of Technology. Currently, he participates and is leading a number of projects comprising: 1) high-throughput omics characterization, optimization and control of microbial consortia, 2) metabolic engineering of selected cell factories – both applied for conversion of organic waste streams (especially C1 compounds) into value-added chemicals and energy.

MICROALGAE-DERIVED BIOLUBRICANTS: CHALLENGES AND OPPORTUNITIES



Duong T. Nguyen, T M Indra Mahlia, A.S. Silitonga, and Long D. Nghiem[#]

Center for Technology in Water and Wastewater, School of Civil and Environmental Engineering, University of Technology Sydney, NSW 2007, Australia

[#]Corresponding author's e-mail: duclong.nghiem@uts.edu.au

Abstract

Lubricants play an indispensable role in modern society, ensuring the reliable, durable, smooth, and energy-efficient operation of tools and equipment. With the advent of the industrial revolution, the demand for lubricants has increased and changed significantly. However, the production, usage, and disposal of conventional lubricants pose a major threat to the environment due to their toxic components [1]. Given these several drawbacks of petroleum-based lubricants, biolubricants have recently emerged as a promising alternative [2]. Biolubricants can be synthesized from plants, animals, and any microorganisms with high lipid or polysaccharide content. While environmentally friendly, biolubricant production can create direct competition for arable land and food security. To address these issues, microalgae have recently emerged as a suitable feedstock. Microalgae possess key characteristics of petroleum-derived feedstocks in biolubricant production, including reliability, consistency, and scalability. The current high cost of microalgal biomass harvesting and lipid/polysaccharide extraction is a major hurdle to further expansion of the microalgae-based biolubricant market [3]. There are also challenges associated with scaling up production or optimizing biomass productivity [4]. This review provides an overall perspective on microalgae-based biolubricants and determines research priorities in this field. Key research priorities were identified and discussed including (1) selection of suitable microalgae strains; (2) large-scale and low-cost microalgae cultivation; (3) efficient lipid/polysaccharide extraction and processing; and (4) tribological performance evaluation and optimization. This work also highlights pathways to synthesize microalgal-based biolubricant from two important components in microalgal cells, i.e. lipid and polysaccharide.

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Biographical note

I am a PhD candidate at the University of Technology Sydney. I am doing my PhD under the supervision of professor Long Nghiem and professor Arridina Susan. My research focuses on biolubricant production from microalgal.

Prior to joining UTS, I received training and experience from the Ho Chi Minh City University of Technology under Professor Xuan Thanh Bui. During this time, I had the opportunity to engage in projects funded by the Vietnam National Foundation (NAFOSTED) and participate in the SAKURA Exchange Program.

My research interests include microalgal technology, membrane process, and anaerobic digestion. I am currently continuing to explore these fields and have published several papers.

PLANT-DERIVED SURFACTANTS AS A NOVEL APPROACH TO ENHANCING ANTIBIOTICS EFFICIENCY



Amanda Pacholak, Wojciech Smulek, Ewa Kaczorek

Institute of Chemical Technology and Engineering, Poznan University of Technology, Poznan, Poland
Corresponding author's e-mail: amanda.pacholak@put.poznan.pl

Abstract

Antibiotics are chemical substances of natural or synthetic origin used to treat or prevent bacterial infections. They work by killing bacteria or inhibiting their growth. Recently, a significant increase in antibiotic consumption has been observed. Due to their overuse, bacteria can develop defense mechanisms against antibiotics, contributing to the global rise in antibiotic resistance. Antimicrobial-resistant strains can share resistance genes with other bacteria, making the infections they cause more difficult or impossible to treat. Consequently, research focused on improving the antimicrobial effectiveness of antibiotics is necessary. A new and not yet fully understood approach involves using natural, environmentally friendly surfactants in combination with antimicrobials. The presence of surface-active agents may alter the mechanisms of drug delivery systems within the organism. The overall purpose of this study was to explore the mechanisms of interaction between plant-derived surfactants containing saponins, antibiotics, and model bacterial strains, such as *Escherichia coli*. The study utilized surfactants found in several plants, including *Aesculus hippocastanum* (horse chestnut), *Glycyrrhiza glabra* (liquorice) or *Sapindus mukorossi* (soapnut). The experiments performed included, among other things, the assessment of microbial growth rate, metabolic activity, and modifications of the surface properties of cells exposed to saponins and antibiotics. The results obtained may enhance our understanding of the interaction between antibiotics, saponins and bacterial strains that are common human pathogens. These findings could help develop new antibiotic dosing strategies, potentially reducing the rate of increasing antibiotic resistance and protecting the natural environment.

This work was supported by National Science Centre, Poland, grant number 2020/39/B/NZ9/03196.

Biographical note

Amanda Pacholak received a master's degree in chemical technology from Poznan University of Technology, Poland and a master's degree in laboratory medicine from Poznan University of Medical Sciences, Poland. Recently, she received her PhD in chemical technology from Poznan University of Technology. Her current field placement is with the Institute of Chemical Technology and Engineering at Poznan University of Technology. Her main area of interest is the study of interactions of bioactive substances with the bacterial cells as well as the role of biological methods in elimination of deleterious compounds from the environment.

OPEN (MIXED) CULTURE FERMENTATION - A PLATFORM FOR BIOCHEMICALS PRODUCTION FROM WASTE



E. Brodowski^a, H. Prusak^a, R. Zagrodnik^b, M. Szczygielda^c, N. Gutowska^a, A. Duber^a, S.B. Rohipour^a, N.Y. Wint^a, A. Zagórna^a, T. Rozmanowski^c M. Lezyk^a, P. Oleskowicz-Popiel^{a,*}

^aWater Supply and Bioeconomy Division, Faculty of Environmental Engineering and Energy, Poznan University of Technology, Berdychowo 4, 60-965 Poznan, Poland

^bFaculty of Chemistry, Adam Mickiewicz University, Uniwersytetu Poznańskiego 8, 61-614 Poznan, Poland

^cFaculty of Chemical Tehnology, Poznan University of Technology, Berdychowo 4, 60-965 Poznan, Poland

*Corresponding author's e-mail: piotr.oleskowicz-popiel@put.poznan.pl

Abstract

The application of naturally occurring open (mixed) cultures in fermentation processes has numerous advantages, such as the division of labour among the microbes and lowering the costs of a bioprocess due to the elimination of the necessity of sterility. Such a distinctive feature is particularly appealing while conducting the process of valorisation of wastes to platform chemicals [1]. A lot of various compounds with diverse applications, such as short-chain carboxylic acids, dicarboxylic acids, medium-chain carboxylic acids, and short-chain alcohols, may be produced in those systems [2]. Especially interesting is the control of the microbial consortium for the production of different groups of chemicals according to the conditions applied.

Chain elongation (CE) is an emerging biotechnological process for production of medium chain carboxylic acids (MCCAs) from low-value heterogenous substrates such as organic waste and wastewater [3]. The CE has its roots in anaerobic digestion: short-chain carboxylates accumulated during acidogenesis and acetogenesis are elongated into MCCA instead of forthgoing through methanogenesis to methane [4]. MCCAs can be seen as platform chemicals and be used, among others, as food additives or precursors of plasticizers, lubricants and Sustainable Aviation Fuels. The most common MCC is caproate which can be widely used in the chemical, pharmaceutical and food industry as well as a precursor for the liquid fuels production in a subsequent chemical conversion processes. The basic metabolic requirement to carry out the CE is a presence of electron donors (providing acetyl-CoA to the reverse β -oxidation cycle) and electron acceptors in the feedstock [4]. Various chemical compounds such as ethanol or methanol can play the role of electron donors in the CE [5].

The aim of the study was to perform long-term caproic acid production from variety of organic waste streams (organic fraction of municipal solid waste, acid whey), investigate operational process parameters on production performance, characterize and in-depth analyze microbial community, develop effective downstream processing for product recovery and finally perform techno-economic analysis to indicate future process implementation along with the initial studies on Kolbe electrolysis for products upgrading.

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Presented study was funded by National Science Centre (Poland) contract no. 2017/26/E/ST8/00007; 2021/43/B/ST8/00393 as well as Norway Grants 2014-2021 via the National Centre for Research and Development (Poland) under the project no. NOR/POLNOR/ WasteValue/0002/2019.

Biographical note

Prof. Piotr Oleskowicz-Popiel research is focused on a bioeconomy aspects in environmental engineering. He is developing new bio-technologies for resource recovery from organic waste and wastewater. He is leading the BioRefinery Research Group. He started his studies in 2000 at the Poznan University of Technology, majoring in Chemical Technology, but graduated from Aalborg University in 2005, major in Industrial Biotechnology. In 2010, he obtained PhD from the Technical University of Denmark, and then completed a post-doc at the Berkeley Laboratory (US). He has been working at the Poznan University of Technology since 2012 and in 2021 he received Full Professor position.

SYNERGISTIC EFFECT OF STRESS WITH PHYTOHORMONES FOR ENHANCED PUFA PRODUCTION IN THRAUSTOCHYTRIDS



Ajeet Singh Chauhan^{1,3†}, Anil Kumar Patel^{1,2†}, Chiu-Wen Chen^{1,3,5}, Cheng-Di Dong^{1,3*}, Reeta Rani Singhania^{2,3}

¹*Institute of Aquatic Science and Technology, College of Hydrosphere, National Kaohsiung University of Science and Technology, Kaohsiung City, 81157, Taiwan*

²*Centre for Energy and Environmental Sustainability, Lucknow-226 029, Uttar Pradesh, India*

³*Department of Marine Environmental Engineering, National Kaohsiung University of Science and Technology, Kaohsiung City, Taiwan*

⁴*Department of Chemical and Materials Engineering, Tunghai University, Taiwan*

⁵*Research Center for Smart Sustainable Circular Economy, Tunghai University, Taiwan*

[†]Equal contribution

Corresponding author's e-mail: cddong@nkust.edu.tw (C.-D. Dong)

Abstract

In the last decades, thraustochytrids have been considered to be a potential and sustainable microbial source for producing essential polyunsaturated fatty acids (PUFA), showcasing significant scalability to meet the global demand for PUFA. Nowadays, several strategies are adopted to enhance PUFA content through microbial bioprocess development. This present study investigated the effect of four different inducers (phytohormones) and cold stress on the biomass growth, lipid accumulation, and PUFA biosynthetic capacity of *Thraustochytrium* sp. Absciscic acid (ABA) and Indole acetic acid (IAA) emerged as potential inducers for PUFA enhancement. In contrast, 2-Naphthoxyacetic acid (BNOA) and Salicylic acid (SA) moderately enhanced biomass and lipid. Meanwhile, IAA significantly enhanced the EPA by 1.21-fold, while DHA and DPA enhanced by 19%. Interestingly, ABA and SA improved omega-6 fraction (ARA) by 2-fold and 3.33-fold, respectively, and also improved EPA and DPA fractions by 21 and 35%. However, BNOA enhanced biomass and EPA by 21%. DHA fraction has also improved with SA, ABA, and BNOA treatment but less than 15%. The analysis of the impact of cold stress and inducers on results, along with examining their effects on crucial enzymes in fatty acid biosynthesis, revealed the potential mechanism that enhances growth and improves the production of DHA. In conclusion, this study developed a feasible method to screen *Thraustochytrium* sp. with high DHA yield by combining inducers and cold stress.



Poster presentations

THE DESIGN OF NOVEL CARBON-TiO₂/KRAFT LIGNIN HYBRID SYSTEMS AS FUNCTIONAL ADMIXTURES FOR CEMENT MORTARS WITH PHOTOCATALYTIC AND ANTIMICROBIAL PROPERTIES



Patryk Jędrzejczak^{1,2}, Łukasz Kłapiszewski²

¹Poznan University of Technology, Faculty of Civil and Transport Engineering, Institute of Building Engineering, Piotrowo 5, 60-965 Poznań, Poland

²Poznan University of Technology, Faculty of Chemical Technology, Institute of Chemical Technology and Engineering, Berdychowo 4, 60-965 Poznań, Poland

Corresponding author's e-mail: patryk.jedrzejczak@put.poznan.pl

Abstract

The advancement of nanotechnology and nanomaterials has led to the creation of more durable buildings with extended lifetimes. Among these materials, titanium dioxide (TiO₂) has been extensively studied for its ability to impart antimicrobial and self-cleaning properties and to remove air pollutants such as NO_x and volatile organic compounds when used as an admixture in cement mortar. However, TiO₂ nanoparticles tend to aggregate and exhibit optimal photocatalytic activity mainly under UV radiation [1,2].

In this context, the present study aimed to synthesize hybrid systems incorporating a visible-light active photocatalyst, specifically carbon-modified TiO₂, with kraft lignin as the organic precursor. A low-waste, solvent-free mechanical method was employed to prepare the hybrid materials. Incorporation of the synthesized C-TiO₂/lignin hybrid systems at 1.0 wt.% relative to the cement mass into the cementitious composite resulted in mortars with improved workability, mechanical strength, and frost resistance. In particular, the resulting mortars exhibited photocatalytic activity under both ultraviolet and visible light, as well as antimicrobial properties. The degradation efficiency of a model organic pollutant exceeded 40%.

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Acknowledgements: This work was supported by National Science Center Poland under research project no. 2019/35/B/ST8/02353 and by the Polish National Agency for Academic Exchange (NAWA) under the STER programme, Towards Internationalization of Poznan University of Technology Doctoral School (2022-2024).

Biographical note

Patryk Jędrzejczak is a doctoral student at the Doctoral School of Poznan University of Technology, since 2020. He is pursuing his doctorate in the field of chemical sciences. The topic of his dissertation, supervised by Prof. PUT Łukasz Kłapiszewski, PhD, DSc, Eng, is: Design of functional nano- and micromaterials with photocatalytic and antimicrobial properties. Since 2023 he is employed as a research assistant at Poznan University of Technology. His research interests include sustainable development, water and air pollution removal, hybrid materials, titanium(IV) oxide modifications, lignin valorization, functional admixtures, sustainable and environmentally friendly building materials.

EXPLORING THE FUNCTIONALITY OF AN ACTIVE ZrF-LACCASE BIOCATALYST TOWARDS TARTRAZINE DECOLORIZATION



Agnieszka Kołodziejczak-Radzimska, Joanna Zembruska, Filip Ciesielczyk, Teofil Jesionowski

^aPoznan University of Technology, Faculty of Chemical Technology, Institute of Chemical Technology and Engineering, Berdychowo 4, PL-60965 Poznan, Poland

^bPoznan University of Technology, Faculty of Chemical Technology, Institute of Chemistry and Technical Electrochemistry, Berdychowo 4, PL-60965 Poznan, Poland

Corresponding author's e-mail: agnieszka.kolodziejczak-radzimska@put.poznan.pl

Abstract

Presented research demonstrates unique properties and high potential of a novel biocatalytic system of laccase immobilized onto hybrid zirconium oxide/fucoidan carrier in decolorization of azo dyes. An active hybrid carrier, based on zirconia and fucoidan, was fabricated using modified sol-gel method, efficiency of which was proved by the physicochemical evaluation performed, including FTIR, NMR, TG/DTG, BET, elemental and electrokinetic analysis. The presence of functional groups in the ZrF hybrid (O–H, S–O), its good thermal stability, high surface area and pore volume qualify it as a good carrier for enzyme loading. The immobilization of laccase onto ZrF hybrid material was really efficient, as confirmed by changes in the structural parameters of the carrier (reduction of the surface area and pore volume) and electrokinetic parameters (decrease in the value of the isoelectric point) as well as the appearance of functional groups characteristic for enzyme (see FTIR spectra), which additionally suggest that electrostatic interactions, van der Waals forces and weak hydrogen bonds take part in enzyme binding with the surface of ZrF support. The designed ZrF-laccase biocatalytic system showed excellent enzymatic activity even after 10 cycles of repeated reuse, making it a potential biocatalyst for industrial applications. The key element of the research included verification tests of produced biocatalyst in tartrazine degradation. More than 95% decolorization yield of tartrazine was achieved within 60 min. Irrespectively of the process conditions (pH and temperature), which were affected by the dye concentration, the high tartrazine decolorization (under 80%) was achieved. A possible degradation pathway of the azo dye (tartrazine) was proposed together and degradation by-products were defined. Finally, it can be stated that the produced ZrF-laccase system is a promising biocatalyst because it exhibits enzymatic and kinetic parameters that predispose it for application in the removal of emerging pollutants from wastewaters.

This research was funded by the Ministry of Education and Science

Biographical note

Agnieszka Kołodziejczak-Radzimska works at Poznan University of Technology, Institute of Chemical Technology and Engineering, as an assistant professor. She finished her PhD study in 2011 in chemistry at Poznan University of Technology. Research conducted by Agnieszka Kołodziejczak-Radzimska concerns the synthesis of inorganic materials and the immobilization of enzymes on various types of materials, determining their enzymatic activity on the example of selected model reactions and their application in the removal of organic pollutants from aqueous solutions.

BIOSAFETY AND MICROBIOME DIVERSITY OF DIGESTATE DERIVED FROM AGRICULTURAL BIOGAS PLANTS



Korzeniewska Ewa, Wolak Izabela, Harnisz Monika, Męcik Magdalena, Czatzkowska Małgorzata

Department of Water Protection Engineering and Environmental Microbiology, Faculty of Geoengineering, University of Warmia and Mazury, Prawocheńskiego 1 Str., 9, 10-719 Olsztyn, Poland
Corresponding author's e-mail: ewa.korzeniewska@uwm.edu.pl; ewakmkr@uwm.edu.pl

Abstract

The composition of microbial communities, including Bacteria and Archaea, is the key to effective anaerobic digestion (AD) [1,2]. Digestate is generally regarded as a waste product, but it has considerable potential for use in soil fertilization and bioremediation, which is why the biological safety of digestate and the composition of its microbial community should be evaluated [3,4].

In the present study, digestates from three full-scale agricultural biogas plants were analyzed to determine the impact of substrate composition on the structure of their microbial communities. The prevalence of *ail*, *ystA*, *ystB*, and *invA* genes characteristic of potentially pathogenic microorganisms such as *Yersinia enterocolitica* and *Salmonella spp.* was determined, and the presence of parasites of the genera *Ascaris*, *Trichuris*, and *Toxocara* was analyzed to determine the biological safety of digestate samples and their applicability for fertilization and bioremediation. The microbial biodiversity of AD samples were analyzed using 16S rRNA gene sequencing methods.

The metagenomic analysis of 16S rRNA amplicon revealed that *Firmicutes* and *Bacteroidota* were the dominant bacterial phyla (>28% and 21%, respectively) in digestates regardless of the composition of the processed substrates. All tested digestates were free of analysed potentially pathogenic microorganisms, as well as parasites. Regardless of substrate composition and sampling season, Archaea were represented mainly by microorganisms of the order *Halobacterota*.

The results of this study indicate that digestate is a rich source of agronomically important microorganisms and is free of pathogenic bacteria and parasites. Therefore, it can be used as an organic fertilizer in agriculture.

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This study was supported by grant No. 2020/37/N/NZ9/00431.

Biographical note

The research conducted by Ewa Korzeniewska focuses on the fate and risk of pollutants such as antibiotic resistant microorganisms and their genes responsible for antibiotic resistance in the environment. The research has 3 main avenues: biomonitoring of air, water, wastewater and soil pollution in relation to transmission of ARB and ARGs; to determine influence of wastewater treatment technology on ARGs abundance in surface water environment; to study antibiotic resistance in relationship to “One Health Approach”. Moreover, she also participates in research on intensification of production of high-energy biogas from organic waste. H-index=29, ~3,000 citations (Scopus, 2024).

CONTROLLABLE SYNTHESIS OF MESOPOROUS IRON OXIDE NANOPARTICLES FOR ADSORPTIVE REMOVAL OF LEVOFLOXACIN FROM AQUEOUS SOLUTIONS: KINETICS, ISOTHERMS, THERMODYNAMICS AND MECHANISM



Siyasanga Mpelane^{a,b,d}, Nomvano Mketof, Ndzonelelo Bingwa^{a,e}, Philiswa N. Nomngongo
a,c,d

^a Department of Chemical Sciences, University of Johannesburg, South Africa.

^b Analytical Facility, University of Johannesburg, P.O. Box: 524, Auckland Park 2006, South Africa.

^d DST/NRF SARCHI Chair: Nanotechnology for Water, University of Johannesburg, Doornfontein 2028, South Africa

^c DST/Mintek Nanotechnology Innovation Centre, University of Johannesburg, Doornfontein 2028, South Africa

^e Centre for Synthesis and Catalysis, University of Johannesburg, P.O. Box: 524, Auckland Park 2006, South Africa.

^f Department of Chemistry, College of Science and Engineering and Technology, Florida Science Campus, University of South Africa, Johannesburg, South Africa.

Corresponding author's e-mail: pnnomngongo@uj.ac.za

Abstract

This study describes the synthesis, characterization and the application of mesoporous Fe₂O₃ as an adsorbent for Lev removal from aqueous solutions. The effect of calcination temperature on specific surface area, particle size, morphology, crystallite size, and adsorption activity of Fe₂O₃ were investigated. The characterization results indicated that at calcination temperatures between 250 and 350 °C, the annealed Fe₂O₃ showed highest surface area values of 73.6 and 90.6 m² g⁻¹ and lowest particle sizes ranging from 87.8 to 48.4 nm, respectively. Furthermore, adsorption experiments revealed that calcination temperatures had a noticeable effect on the adsorption affinity of Fe₂O₃, and the 350 °C calcined sample exhibited higher adsorption activity (33.1 mg g⁻¹), which was the maximum adsorption capacity (q_{max}) for the removal of Lev. Under optimum adsorption conditions (pH: 9.5, contact time: 10 min, temperature: 25 °C, Lev concentration: 10 mg L⁻¹ and Fe₂O₃ dose: 0.02g), the proposed system favored *pseudo*-second-order model, confirming chemisorption. Moreover, the intraparticle diffusion model demonstrated that the mechanism of Lev adsorption was driven by both the surface adsorption and the intraparticle diffusion. It is worthy to indicate that, Lev adsorption equilibrium data was in alignment with Langmuir isotherm model (R² = 0.9851) and these findings were further supported by Redlich-Peterson model, signifying monolayer adsorption process. The adsorptive removal of Lev from aqueous solutions was exothermic and spontaneous, as revealed by the thermodynamics parameters. The reusability experiments indicated that Fe₂O₃ adsorbent could maintain 70-50% adsorption capacity for Lev after five recycles. Therefore, the proposed adsorption system possessed clear advantages such as low-cost, high adsorption performance and easy reusability via external magnetic field for large-scale applications.

Keywords: Fluoroquinolone antibiotics; calcination temperature; levofloxacin; mesoporous iron oxide; thermodynamics

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Acknowledgements

This study received financial support from the Department of Science and Innovation/National Research Foundation South African Research Chairs Initiative (DSI/NRF SARCHI) grant no. 91230. The authors wish to thank Faculty of Science, Department of Chemical Sciences and Analytical Facility at University of Johannesburg for providing laboratory facilities as well as characterization techniques.

DISTRIBUTION AND CONCENTRATION OF PER- AND -POLYFLUOROALKYL SUBSTANCES IN WATER SOURCES IN THAILAND, ASSOCIATED WITH AQUEOUS FILM-FORMING FOAM AND INDUSTRIAL POLLUTION



Pitchaya Piyaviriyakul¹, Suratsawadee Sukeesan², Kawinthip Wichatham¹, Jedsada Chuiprasert¹, Narin Boontanon³, Chettiappan Visvanathan¹, Suwanna Kitpati Boontanon^{1,4}

¹Graduate Program in Environmental and Water Resources Engineering, Department of Civil and Environmental Engineering, Faculty of Engineering, Mahidol University, 999 Phutthamonthon 4 Rd. Salaya, Phutthamonthon, Nakhon Pathom, 73170, Thailand;

²Department of Marine Science, Faculty of Fisheries, Kasetsart University, 50 Ngamwongwan Rd, Chatuchak, Bangkok, 10900, Thailand;

³Faculty of Environment and Resource Studies, Mahidol University, 999 Phutthamonthon 4 Rd. Salaya, Phutthamonthon, Nakhon Pathom, 73170, Thailand;

⁴Graduate School of Global Environmental Studies, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto, 606-8501, Japan

Corresponding author's e-mail: Suwanna Kitpati Boontanon, suwanna.boo@mahidol.ac.th

Abstract

Per- and polyfluoroalkyl substances (PFAS) are widely used in various industries and serve as key chemicals in firefighting foams, enhancing fire suppression efficiency. The components of industrial and aqueous film forming foam (AFFF) wastewater, which contain PFAS, may pose a toxic threat to aquatic life and potentially impact human health. Nowadays, information about PFAS releases from industrial and AFFF storage sites close to water sources is limited. So, this study aims to determine the levels of PFAS content in water sources located near industrial estates, oil refineries, airports, and ports, as well as AFFF storage and firefighting training facilities in Thailand. The samples were prepared and spiked with labeled internal standards ($^{13}\text{C}_8$ -PFOS and $^{13}\text{C}_8$ -PFOA) before being loaded into an Oasis wax cartridge for solid-phase extraction. Tandem mass spectrometry and high-performance liquid chromatography were used to determine the amounts of PFAS. The water sample from the firefighting training center exhibited the most significant accumulation of several PFAS, including perfluoropentanoic acid (PFPeA), perfluorohexanoic acid (PFHxA), perfluoroheptanoic acid (PFHpA), and perfluorononanoic acid (PFNA), with concentrations detected at 210.8, 77.6, 75.1, and 3.3 ng/L, respectively, indicating a significant influence from the use of AFFF. Perfluorobutanoic acid (PFBA) was the most prevalent compound detected in all freshwater and wastewater samples obtained from fire training facilities, industrial wastewater treatment plants (WWTP), and airports. The concentration of PFBA in these samples ranged from 8.4 to 12.6 ng/L. The fraction of PFAS around the ports, oil refineries, and industrial estates exhibits distinct PFAS composition patterns compared to airports and firefighting training centers, suggesting the presence of diverse PFAS sources. The results of this study clearly indicate the presence of PFAS contamination in the water sources in Thailand. This highlights the urgent need for additional laws to govern the importation and use of PFAS or products containing PFAS.

Biographical note

Pitchaya Piyaviriyakul is a research assistant and doctoral student at Mahidol University. She holds a Master's Degree in Environmental and Water Resources Engineering from Mahidol University. Pitchaya has published in the Journal of Environmental Science and Health, Part A, the Journal of Water, Sanitation, and Hygiene for Development, and other journals. Her research interests focus on the monitoring and development of techniques for removing emerging contaminants in water, such as per- and poly-fluoroalkyl substances (PFAS), pharmaceuticals and personal care products (PPCPs), and other emerging contaminants, as well as biological treatment for the removal of pollutants in water.

LACCASE AND METAL-ORGANIC FRAMEWORKS: A NEW APPROACH TO REMOVING MICROPOLLUTANTS



Agnieszka Rybarczyk¹, Jakub Zdarta¹, Teofil Jesionowski¹

¹Institute of Chemical Technology and Engineering, Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, PL-60965 Poznan, Poland

Corresponding author's e-mail: agnieszka.rybarczyk@doctorate.put.poznan.pl

Abstract

The presence of pharmaceuticals in surface waters has emerged as a significant environmental issue [1]. To address this, effective methods for removing such pollutants have been developed, including the use of enzymes immobilized on solid supports [2]. Metal-organic frameworks (MOFs) have gained attention as promising matrices due to their three-dimensional structure and porosity [3]. Incorporating enzymes into MOF systems can enhance thermal and chemical stability, improve catalytic efficiency, and provide better access to active sites. Laccase, known for its potential in pollutant degradation, was immobilized on CuBDC in this study [4].

Optimal parameters for enzyme immobilization were determined through systematic analysis. The amount of immobilized enzyme, immobilization efficiency, retained activity, and kinetic parameters were thoroughly evaluated. Additionally, the potential for reuse of the biocatalytic system was assessed, as well as the impact of temperature and pH on the catalytic properties of the immobilized laccase. The catalytic system was then tested for its effectiveness in degrading 17 β -estradiol, a key focus of this research.

Immobilization performed at room temperature for 24 hours, using an initial laccase concentration of 5 mg/mL at pH 5, achieved an immobilization efficiency of 81.4%, corresponding to approximately 162.5 mg of enzyme per gram of Cu-BDC. The system retained 88% of its catalytic activity, demonstrating its efficacy. In estrogen degradation, the system achieved over 90% degradation of 17 β -estradiol within 12 hours.

The study demonstrates the advantages of immobilizing laccase on an MOF support. The results confirm the high immobilization efficiency, minimal impact on enzyme activity, and the effective degradation of estrogens from aqueous solutions, highlighting the potential of MOF-based biocatalytic systems for environmental applications.

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The research was funded under National Science Center research project No. 2021/43/B/ST8/01854.

Biographical note

Agnieszka Rybarczyk is a PhD student at the Faculty of Chemical Technology at Poznan University of Technology. She is a graduate of the interdisciplinary course Pharmaceutical Engineering, and her main interests are related to pharmaceuticals and the dangers of their release into the environment. She is particularly interested in creating biocatalytic systems for the degradation of pollutants from wastewater, and she is furthering her activities in this area by pursuing her PhD project. She participates in many scientific conferences and is actively involved in 3 scientific research projects, resulting in the co-authorship of 6 scientific publications.

MICROALGAE/BACTERIA GRANULATION TREATING WASTEWATER AT DIFFERENT COD/N RATIOS



Mai-Duy-Thong Pham^{1,2}, Thi-Lan-Trinh Nguyen^{1,2}, Minh-Ngoc Hoang^{1,2},
Nguyen-Quynh-Nhu Ho^{1,2}, Ky-Phuong-Ha Huynh^{1,2}, Thi-Kim-Quyen Vo^{1,3}, Chitsan
Lin⁴, Phuoc-Dan Nguyen^{1,2}, Xuan-Thanh Bui^{1,2,*}

¹Key laboratory of Advanced Waste Treatment Technology, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet street, district 10, Ho Chi Minh City, Vietnam.

²Vietnam National University Ho Chi Minh, Ho Chi Minh City, Vietnam.

³Ho Chi Minh City University of Industry and Trade, Vietnam

⁴National Kaohsiung University of Science and Technology, Taiwan.

Corresponding author's e-mail: bxthanh@hcmut.edu.vn

Abstract

Microalgae-bacteria granule (MBG) process has been a concern recently because of their outstanding wastewater treatment capabilities, high biomass recovery efficiency, environmental friendliness, and reduced operating costs. The COD/N ratio is an important operating parameter in biological wastewater treatment systems. This study evaluated the pollutant removal capacity and characteristics of MBG at different COD/N ratios. Four Sequencing batch photobioreactors (SPBRs) were operated simultaneously with synthetic wastewater in which COD was fixed at 400 mg/L and $\text{NH}_4^+\text{-N}$ were changed to reach COD/N ratios of 5, 10, 15, and 20. The MBG seed source had an average size of 0.5 mm and was cultured under LED light conditions of 3800 - 4000 klux, light:dark cycle of 12h:12h, and a stirrer was used for mass transfer improvement. After 100 cultivation days, the COD/N of 15 showed a better removal rate of COD, $\text{NH}_4^+\text{-N}$, and TP than other ratios with values of $86.65 \pm 8.14\%$; $84.03 \pm 13.53\%$; $80.33 \pm 21.76\%$, respectively. Meanwhile, COD, $\text{NH}_4^+\text{-N}$, and TP removal showed no significant difference between COD/N ratios. The COD/N of 15 also showed a stable biomass growth ability with an average biomass concentration of 1215 ± 431 mg/L. The particle size distribution does not change significantly and MBG possessed excellent settling ability which can be much efficient in biomass harvesting in real practice.

Keywords: COD to N ratio; Domestic synthetic wastewater; Microalgae-bacteria granule; pollutant removal rate.

Biographical note

Dr. Quyen obtained Bachelor and Master degrees in the field of Environmental engineering at Ho Chi Minh City University of Technology (Vietnam). Then, she got Ph.D. degree in the field of Environmental engineering and Energy at Myongji University (Republic of Korea). At the present, she is a lecturer. Her research focuses on the fields of biological wastewater treatment (sulfur-based autotrophic denitrification, algae-based treatment process, bioplastic production). She has 21 publications (including 12 ISI, 7 international non-ISI, 2 national papers). Additionally, she has played the role of project investigator/key member for 5 projects funded by international/national organizations.

ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES CONTAMINATION IN WATER TREATMENT PLANTS IN THAILAND



**Kawinthip Wichatham¹, Pitchaya Piyaviriyakul¹, Jedsada Chuiprasert¹,
Nattharika Phongmanee¹, Narin Boontanon², Chettiyappan Visvanathan¹, Suwanna
Kitpati Boontanon^{1,3*}**

¹Graduate Program in Environmental and Water Resources Engineering, Department of Civil and Environmental Engineering, Faculty of Engineering, Mahidol University, 999 Phutthamonthon 4 Rd. Salaya, Phutthamonthon, Nakhon Pathom, 73170, Thailand;

²Faculty of Environment and Resource Studies, Mahidol University, 999 Phutthamonthon 4 Rd. Salaya, Phutthamonthon, Nakhon Pathom, 731 70, Thailand;

³Graduate School of Global Environmental Studies, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto, 606-8501, Japan

Corresponding author's e-mail: Suwanna Kitpati Boontanon, suwanna.boo@mahidol.ac.th

Abstract

Water treatment plants (WTPs) are essential for providing clean and safe water, but recent concerns have emerged regarding contamination by per- and polyfluoroalkyl substances (PFAS). PFAS are a group of synthetic chemicals known for their persistence, bioaccumulation potential, and adverse health effects. They can lead to long-term health issues when present in drinking water. However, there are few studies on PFAS contamination in WTPs in Thailand. This study investigates the presence of PFAS in WTPs in Thailand, focusing on two major facilities: the Bang Khen (BK-WTP), representing urban areas and Photharam (P-WTP) water treatment plants, representing rural areas. Samples were collected from critical points from water source to different points of water treatment units. The sample was pretreated and spiked with labeled internal standards (¹³C₈-PFOS and ¹³C₈-PFOA) before being loaded onto a cartridge and concentrated using solid-phase extraction. The concentrations were determined using high-performance liquid chromatography-tandem mass spectrometry. The analysis revealed that PFAS are not fully removed during the water treatment process. Specifically, the effluent from BK-WTP showed a total PFAS concentration of 9.81 ng/L, while the effluent from P-WTP exhibited a concentration of 9.57 ng/L. Among the various PFAS compounds detected, perfluorobutanoic acid (PFBA) and perfluoropentanoic acid (PFPeA) were the most prevalent. These results indicate that the current treatment technologies employed at these WTPs are insufficient in completely eliminating PFAS, leading to their persistence in the treated water supplied to consumers. Although these concentrations are below the European Commission's recommended limit for the sum of PFAS in drinking water, PFAS can still pose risks to human health and the environment due to their persistence and bioaccumulative nature. The study underscores the urgent need for the development and implementation of advanced treatment technologies that can effectively remove PFAS from water.

Biographical note

Kawinthip Wichatham received her M.Eng. degree from Mahidol University. Currently, she is a full-time doctoral student in the Department of Civil and Environmental Engineering at the Faculty of Engineering, Mahidol University, Thailand. Her research interests focus on the monitoring and development of techniques for removing emerging contaminants from water, such as per- and polyfluoroalkyl substances (PFAS) and microplastics (MPs). She is also dedicated to studying the biodegradation processes of these pollutants.

DESIGN OF BIOCATALYTIC MEMBRANES FOR ENVIRONMENTAL MICROPLASTIC SAMPLES PURIFICATION



Olga Bursztyn, Aleksandra Rybak, Oliwia Górczyńska, Agata Zdarta

Institute of Chemical Technology and Engineering, Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, 60965 Poznan, Poland

Corresponding author's e-mail: agata.zdarta@put.poznan.pl

Abstract

Nowadays, the development of sophisticated methods for microplastic analysis in samples is progressing well, engaging microscopic and spectroscopic techniques, supported by gas chromatography and mass spectrometry. Therefore, the limiting factor becomes the sample preparation procedure. Among many chemical treatments, that enable the degradation of co-contaminants in complex matrices, other methods using milder reaction conditions are highly desired to limit polymer degradation. Within the presented study, an attempt will be made to design novel, biocatalytic membrane-based solutions, that offer simultaneous sample filtration and co-contaminant degradation to shorter procedure time and eliminate impurities, to enable more accurate analyses using various analytical methods.

The research was supported by the National Science Center, Poland (Grant No. 2022/47/D/ST8/02677).

Biographical note

Agata Zdarta finished her PhD study in 2020 in chemistry at Poznan University of Technology. Currently, she is leading the project entitled *Bioactive membranes as tools in microplastic pollution count in the process of environmental samples analysis* at Poznan University of Technology.



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EuChemS aisbl Rue du Trône 621050 - Brussels Belgium

Phone: +32 2289 25 67 | +32 2289 26 90

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