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EDITORIAL

Green technologies for sustainable environment: an introduction

Eldon R. Rene[1] · Xuan Thanh Bui[2,3] · Huu Hao Ngo[4] · Long D. Nghiem[4] · Wenshan Guo[4]

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Water pollution has long been a major source of concern for the environment, the biosphere, and human well-being. In order to safeguard the environment, technologies such as wastewater treatment, reuse, recycling, and resource recovery have been tested and implemented at the pilot and industrial scales. In recent years, the research hotspot of environmental protection has gradually shifted from the well-known conventional technologies to eco-friendly, cost-effective, and sustainable technologies, also known as green technologies which could demonstrate outstanding advantages. Several practical treatment processes have been proposed and applied in practice; however, the green technologies are currently the most attractive for pollution control, especially water and wastewater remediation, preventing air pollution, and also the development of sophisticated, yet usable on-site sensors and analytical instruments. In the context of environmental protection, green technologies are a collection of practical methodologies, techniques, technologies, and materials that are based on non-toxic chemical processes, non-toxic end products, renewable energy sources, and environmental monitoring instruments, among other things, to mitigate or correct the negative impact caused by human activities.

Responsible Editor: Philippe Garrigues

✉ Xuan Thanh Bui
bxthanh@hcmut.edu.vn

[1] Department of Water Supply, Sanitation and Environmental Engineering, IHE Delft Institute for Water Education, Westvest 7, PO Box 3015, 2611AX Delft, The Netherlands

[2] Key Laboratory of Advanced Waste Treatment Technology, Vietnam National University Ho Chi Minh (VNU-HCM), Linh Trung Ward, Thu Duc City, Ho Chi Minh City 700000, Viet Nam

[3] Faculty of Environment and Natural Resources, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City 700000, Viet Nam

[4] Centre for Technology in Water and Wastewater, School of Civil and Environmental Engineering, University of Technology Sydney, Sydney, NWS 2007, Australia

Firstly, concerning water quality, an effective arithmetical method for evaluating the quality of surface and ground water has been described as the water quality index (WQI). The determination of water quality indexes often entails the integration of diverse biological, physical, and chemical aspects of a water source to yield a single value that is unitless but serves as an effective indicator of water quality because it is non-destructive. Secondly, the increased consumption of fossil fuels contributes to global warming, depletion of fossil fuel reserves, and future energy insecurity, all of which encourage the globe to look for alternatives that are more environmentally friendly, simple, and inexpensively available. Thirdly, in many water bodies around the globe, toxic cyanobacterial blooms (TCBs) are becoming a rising source of worry and it has depleted the water quality. By using modern analytical and quantitative real-time polymerase chain reaction (qPCR) and high-performance liquid chromatography (HPLC) techniques, the dynamics of poisonous cyanobacteria and microcystin (MC) concentrations in different aquatic ecosystems can be determined. Fourthly, the recovery of energy from plastic wastes has become increasingly popular in recent decades, owing to the increased need for energy in the world. The green principles and concepts such as recycling and reusing are being considered as an alternative, but reprocessing plastics and subjecting them to additional heating cycles will almost certainly result in molecular damage such as cross-linking, chain scission, or the formation of double bonds, which will reduce the product's reliability. Fifthly, when we discuss the global issue of climate change, the levels of carbon dioxide in the earth's atmosphere are increasing on a daily basis as a result of the combustion of fossil fuels for the generation of electricity. This has caused greenhouse gas (GHG) emissions, accounting for 64% of global warming since the industrial revolution. From a techno-economic and green technology viewpoint, researchers have been more interested in novel carbon capture because of its ease of integration with coal-fired power plants, which does not require considerable adjustments (e.g., the use of photobioreactors,

photo-sequencing bioreactors, and algal bioreactors). All these five issues have led to the development of an enormous number of indicators that aims at pollution prevention, resource recovery, and the implementation of cleaner production concepts by a variety of national and international entities/research groups.

On December 1–4, 2019, the 2nd Green Technologies for Sustainable Water Conference (GTSW 2019) was successfully held in Ho Chi Minh City, Viet Nam. The aim of GTSW 2019 was to provide a special forum for exchanging experiences, knowledge, and innovative ideas on all aspects of green technologies, with seven main themes: (1) water and wastewater treatment by green technologies, (2) wastewater treatment and reuse, (3) membrane processes, (4) resources recovery from wastewater, (5) nanotechnology for biological waste treatment, (6) bioprocesses and bio-products, and (7) disruptive technologies and the application for water resource treatment and management. A wide range of present and future development difficulties in the fields of green technologies for waste to energy conversion, the resource recovery in the form of energy, fuel, valuable products and chemicals, and resilient environmental technologies were addressed by the keynote speakers, all of whom were speaking in a worldwide context.

The outcomes of GTSW 2019 were an opportunity to discuss and assess the latest approaches, innovative technologies, policies, and new directions in infrastructure development, pollution prevention, and eco-friendly processes to promote cooperation and networking amongst practitioners and researchers involved in addressing Green Technologies for Sustainable Water. The papers published in this special edition will provide significant networking opportunities for professionals and will provide the groundwork for future collaboration among these individuals. We are grateful to Prof. Philippe Garrigues, the Editor-in-Chief of Environmental Science and Pollution Research (ESPR), for providing us with the chance to publish a selection of peer-reviewed papers that were presented at GTSW 2019, and we appreciate him for his support. We would like to express our gratitude to Ms. Fanny Creusot and Ms. Florence Delavaud, Editorial Assistants of ESPR, as well as the entire Springer production team, for their invaluable assistance in bringing this issue to a successful conclusion. The guest editors are confident that the papers in this special issue will be useful reading materials for your study group, and we wish you the best of luck in your endeavors.

Dr. Eldon R. Rene is currently working as a Senior Lecturer at IHE Delft Institute for Water Education, The Netherlands. He obtained his University Teaching Qualification (UTQ) diploma from IHE Delft and a PhD in Chemical Engineering from the Indian Institute of Technology Madras (India). Eldon's research focuses on topics related to the development of resilient biological treatment processes for waste-gas and wastewater treatment, development of waste-to-energy conversion technologies, and the use of artificial intelligence tools for environmental monitoring and environmental process control. He has contributed to several EU-funded projects (the ABWET and ETeCoS^3), PADUCO projects with Palestine partners, DUPC-funded projects, and consultancy roles for companies in Poland, India, and Brazil. He has mentored 21 PhD students and more than 70 MSc students. He has published 280 research/review articles in scientific journals, ~25 book chapters, ~100 conference papers, and 7 monographs.

Assoc./Prof. Dr. Xuan Thanh Bui obtained his bachelor's degree in Chemical Engineering from Ho Chi Minh City University of Technology (HCMUT), Vietnam National University Ho Chi Minh (VNU-HCM), Viet Nam, and received his M. Eng and Ph.D. degrees in Environmental Engineering from the Asian Institute of Technology (AIT), Thailand. Currently, he is an associate professor at the Faculty of Environment and Natural Resources, HCMUT, VNU-HCM. He serves as the chairman of Dept. of Water Science & Technology and head of VNU-HCM Key Laboratory of Advanced Waste Treatment Technology. His research focuses on membrane separation processes, water, and wastewater treatment technologies, biological treatment processes, algae processes, and green technologies. He has published more than 150 SCIE journal papers, 30 books/book chapters, and 1 US patent. Additionally, he has played the role of project investigator for more than 60 international/national research projects in the field and organized three international conferences. Since 2017, he became a member of the scientific

committee in the field of earth sciences and environment of National Foundation for Science and Technology Development (NAFOSTED), Ministry of Science and Technology, Viet Nam.

Prof. Huu Hao NGO (Ngo) is currently a Professor of Environmental Engineering and serves as the Deputy Director of Centre for Technology in Water and Wastewater and Co-Director of Joint Research Centre for Protective Infrastructure Technology and Environmental Green Bioprocess, University of Technology Sydney. He has not only been duly elected as Fellow of International Water Association (FIWA) and Fellow of the International Bioprocessing Association (FIBA) but also as the Chairman of the International Bioprocessing Association. Ngo's main areas of expertise include advanced biological waste treatment processes, membrane separation technologies; alternative resources, management and impacts assessment, and solid waste management. Ngo also focuses on developing green technologies for sustainable development for resource recovery, water-waste-bioenergy nexus, and greenhouse gas emission control. Ngo has received several important national and international awards/honors such as Clarivate Analytics, Web of Science Highly Cited Researcher 2020 in the category of Biology and Biochemistry; Clarivate Analytics, Web of Science Highly Cited Researcher 2019 in Cross Field Category; Mendeley Data top Cited Researchers in the world, 2020; Top #1 in Australia and Top #3 in the world in the field of Environmental Engineering (2015–2020)-SciVal (Elsevier 5-year ranking); Top #1 in Australia and Top #5 in the world in Bioengineering (2015–2020)-SciVal (Elsevier 5-year ranking); Top #1 in Australia and Top #11 in the world in Renewable Energy, Sustainability and the Environment (2015–2020)-SciVal (Elsevier 5-year ranking); Leader in Environmental Science 2020 (THE AUSTRALIAN- RESEARCH yearly ranking); and Leader in Biotechnology in Australia, 2019 (THE AUSTRALIAN-RESEARCH yearly ranking).

Ngo has more than 600 publications including 12 books and 35 book chapters, 5 patents with a *h*-index of 83, and citation of > 29,500 (Google Scholar, September 2021). He has been invited for giving numerous plenary/keynotes and invited talks, seminars, and lecturers in the international conferences as well as the universities/research institutions. He has also been the Honorary Distinguished Professor, International Guest/ Chair professor, Visiting Research Fellow in France, China, India, Korea, Japan, Taiwan, Thailand, and Vietnam, etc. while being Conference Chair, Section Chair, and as advisory, organizing, or scientific committee member in a number of conferences

Ngo has been appointed as the Editor of Bioresource Technology, Elsevier; Associate Editor of Science of the Total Environment, Elsevier; Associate Editor of Journal of Water Process Engineering and Associate Editor of Heliyon Journal, Elsevier. He is also an editorial board member/guest editor of numerous international journals such as Bioresource Technology Reports, Bioresource Technology, Elsevier; Environmental Nanotechnology, Monitoring, and Management, Elsevier; Editor of Science of the Total Environment, Elsevier; Journal of Water Process Engineering, Elsevier; Journal of Energy and Environmental Sustainability, IJSEES; Environmental Science and Ecotechnology, EHIT; and Bioengineered, Taylor & Francis.

Prof. Long D. Nghiem is an environmental engineer and a membrane technologist. His research expertise covers a range of membrane separation processes (including pressure-driven membrane filtration, forward osmosis, membrane distillation, facilitated transport membrane, membrane electrolysis, and membrane bioreactor), anaerobic digestion, molecular biology, and urban water management. His current research work focuses on the development of a membrane separation platform for the recovery of clean water, energy, and nutrients from wastewater. He is currently the Director of the Centre for Technology in Water and Wastewater and a Professor in Environmental Engineering at the School of Civil and Environmental Engineering, UTS, Australia.

Prof. Wenshan GUO is currently working as a Professor at University of Technology Sydney UTS, Australia. She is also a core member in Centre for Technology in Water and Wastewater (CTWW) at UTS and her research focuses on innovative water and wastewater treatment and reuse technologies. Her expertise and practical experience cover the areas of water and wastewater engineering such as membrane technologies, advanced biological wastewater treatment technologies, physico-chemical separation technologies, solid waste management, environmental assessment, and desalination. Her current research focuses on green technologies for resource and energy recovery, waste-to-energy, water-waste-energy nexus, and climate change mitigation. She has published 3 books, 31 book chapters, and more than 370 peer-reviewed journal papers. She has been recognized as Highly Cited Researcher 2019 and 2020 in Cross Field Category by Clarivate Analytics, Web of Science Group, and the Mendeley Data Top Cited Researcher. She has also been named as one of the Top 40 Research Superstars in Australia (Environmental Science in Life Sciences & Earth Sciences major discipline area). She is currently serving as the Editor of Bioresource Technology Reports (Elsevier), Associate Editor, Journal of Water Process Engineering (Elsevier), Associate Editor of Journal of Hazardous, Toxic & Radioactive Waste (ASCE), and Academic Editor of Journal of Chemistry (Hindawi Publishing Corporation, USA).