Available online at www.sciencedirect.com

ScienceDirect

Current Opinion in Environmental Science & Health

Editorial overview: Green technologies for environmental remediation

Huu Hao Ngo, Wenshan Guo and Raj Boopathy

Current Opinion in Environmental Science & Health 2019, **12:**A1–A3

This review comes from a themed issue on **Environmental Impact Assessment: Green technologies for environmental remediation**

Edited by **Huu Hao Ngo, Wenshan Guo** and **Raj Boopathy**

https://doi.org/10.1016/j.coesh.2019.11.003

Huu Hao Ngo
School of Civil and Environmental Engineering, University of Technology Sydney, USA

Dr. Huu Hao Ngo is a Professor of Environmental Engineering, Deputy Director of Centre for Technology in Water and Wastewater, and Co-Director of Joint Research Centre for Environmental Green Bioprocess, SCEE, FEIT, University of Technology Sydney. Currently, his research is more focused on developing specific green bioprocessing technologies for resource recovery, water-waste-bioenergy nexus and greenhouse gas emission control. He has been selected as Lead Researcher in the field of Biotechnology in Australia while being in the list of Elsevier - World Top 3 ranking researcher in Environmental Engineering in 2019; and Web of Science - 2019 Highly Cited Researcher.

Wenshan Guo
School of Civil and Environmental Engineering, University of Technology Sydney, USA

Dr Guo is a Professor of Environmental Engineering at University of Technology Sydney (UTS). Her current research is in the areas of innovative water and wastewater treatment and reuse technologies, green technologies for resource and energy recovery, waste-to-energy, water-waste-energy nexus and climate change mitigation. She has been listed as one of the top five researchers with research output in Environmental Engineering 2015-1018 by Elsevier and 2019 Highly Cited Researcher by Web of Science.

Rapid and uncontrolled increase in the urbanization and industrial activities along with human population growth especially in the developing countries is a serious threat to the environment and human health. As a result, environmental degradation is a common issue addressed by engineers, scientists, government regulators and policy makers in many countries. In addition, public awareness of the environmental issues such as pollution and global warming is significantly visible in social media. The advances made in the area of Environmental Engineering and Research on a global scale have made significant impact not only on cleaning up of a diverse range of pollutants and contaminated sites, but also on developing advanced wastewater treatment processes and environmental remediation technologies for pollution prevention and resource conservation.

In this special issue on Green Technologies for Environmental Remediation, there are nine mini review papers that deal with various aspects environmental research highlighting recent emerging issues and developments in the field. This special issue aims to show sustainable biotechnological methods for water and soil treatment and emphasize their practical applications.

The topics and remarks highlighted in this special issue are as follows:

- Currently, most of biological sewage treatment processes are operated based on the bio-oxidation principle with substantial amount of energy input for oxidizing COD and ammonia. This concept has been greatly challenged by its environmental sustainability due to high energy demand, excessive sludge production and large footprint. Zhang et al. [1] proposed an A-B process which is built on wastewater chemical energy (i.e. COD) capture for direct energy production without bio-oxidation to sludge. This sewage treatment philosophy can significantly improve energy recovery potential, and substantially reduce energy consumption and waste sludge generation, offering a feasible engineering solution for realizing energy self-sufficient sewage reclamation.
- Industrial discharge of dye containing wastewater poses a potential health hazard to human health because of toxic and carcinogenic

Raj Boopathy
Department of Biological Sciences, Nicholls State University, USA

Dr. Raj Boopathy is an Alcee Fortier Distinguished Service Professor of biological sciences at the Nicholls State University, USA. He received the Jerry Ledet Foundation Endowed Professorship in Environmental Biology in 2002 and John Brady Endowed Professorship in 2012. In 2008, Dr. Raj Boopathy received the Nicholls State University's Presidential Award for Teaching Excellence. He has more than 30 years of research experience in the area of bioremediation and bio-processing. His research involves bioremediation of hazardous chemicals including oil spills and explosives, biological treatment of wastewater, antibiotic resistance genes in the environment, and bio-ethanol production.

pollutants in dye effluents. Conventional treatment methods used for treating harmful contaminants cannot completely elimination harmful pollutants. In this study, Bharathiraja et al. [2] used itaconic acid as cost-efficient sorbent to remove organic pollutants in dye industrial effluents. The preparation, performance and mechanism of itaconic acid hydrogels for removal of metal ions and dyes from wastewater have been introduced and discussed. The results indicated that itaconic acid–based hydrogels high adsorptive nature and can be a promising solution in industrial dye effluents treatment for eco-friendly environmental applications.

- The immobilized systems have been proved to be more efficient than suspended biomass systems, in which live or dead microbes are attached or encapsulated on support materials or within a matrix to remove targeted pollutants in aqueous and soil matrices. Girijan and Kumar [3] reviewed the current advances in immobilization techniques, materials used for immobilization of biomass, and factors affecting the performance of the immobilized and encapsulated biomass systems for emerging contaminants removal, as well as discussed the key challenges faced in promoting immobilization of biomass for field-scale application. In addition, immobilization of enzymes, as an attractive alternative, can also represent a fast and efficient way to degrade emerging contaminants and other persistent pollutants.
- Biogas technology has been considered as a renewable and environmentally sustainable technology for overcoming pollution and energy challenges. However, compared to developed countries, biogas technology implementation in developing countries is still far behind due to lack of adequate infrastructures, sufficient capital, and appropriate policy. Patinvoh and Taherzadeh [4] elucidated current problems and key factors (e.g. policy, funding, technical services, sustainability, awareness, and education) associated with the achievement of implementing biogas technology in developing countries. They also pointed out that the government plays the key role in enforcement of policy and promoting sustainable waste management and incentives. Additionally, proper advertisement of biogas programs is recommended for enhanced biogas implementation.
- Shallow-bed constructed wetlands (SCWs) have been widely used as a secondary wastewater treatment technology due to the advantages of low cost, less maintaining and operational requirements, and environmental friendliness. Currently, green roof has been utilized as an effective and eco-friendly solution to save energy, enhance green space, provide landscape aesthetics, prevent flooding problem caused by stormwater runoff, and purify air pollutants. Therefore, research has been focused on the development of wetland roof (WR), a combination of SCWs and green roof to provide low-cost and effective domestic wastewater treatment [5]. In this review, an insight understanding of the WR system and its potential applications of SCW on the roof, as well as the factors affecting performance, benefits, and challenges of SCW were discussed.
- Pulp and paper industry is one of the rapidly growing industries in the world, which consumes large amounts of energy, generates various pollutants and emits large quantity of greenhouse gases. The environmental and health risks associated with harmful pollutants from paper and pulp mill industries are highlighted in the review [6]. Some recent techniques such as microbial fuel cells, anaerobic digestion, bleaching technologies, aerobic granulation and electrocoagulation are summarized and discussed. This review provides better understanding the risks of pollutants released from the industry and useful information to help in tackling these pollutants for a sustainable environment development.

- Following the previous review article, aerobic granular sludge (AGS) technology was reported by Nancharaiah and Sarvajith [7], because AGS process represents effective, compact, cost-effective and energy-efficient biological treatment alternative to conventional activated sludge process for domestic and industrial wastewater treatment. Although AGS technology can overcome sludge–water separation issues in conventional biological treatment processes, long start-up periods for AGS formation and disintegration of AGS hinder the widespread implementation of AGS technology. Thus, some identified key operational parameters and strategies (e.g. anaerobic feeding and sludge removal) for improved start-up of granulation have been extensive discussed.
- Plastic residuals have been reported as one of the major pollutants in the environment due to its non-biodegradable nature and toxicological impact. Microplastic debris not only poses a threat to human health, but also leads to soil corrosion and landslides though disposal of plastic debris in the soil. Rajmohan et al. [8] illustrated the impacts of these pollutants and associated hazards. They also discussed the existing technologies for resource recovery from plastic wastes and plastic pollution management.
- Ultrasonic is an emerging technology that can be applied for the remediation of contaminated soil through two main mechanisms occurring in the ultrasonic process (desorption and chemical degradation). Although the research related to ultrasonic remediation is limited, ultrasonic could be used as a pre-treatment process or integrated with other remediation technology to improve the removal efficiency for organic and inorganic contaminants, especially heavy metals or petroleum hydrocarbon contaminated soil as shown by some studies [9].

Each of the above-mentioned mini reviews provide up to date published work on specific subject with a critical analysis of the technology. Therefore, the special issue will serve as one stop shop for environmental engineers and scientists to get useful information on the recent developments relevant to wastewater and bioremediation fields.

We would like to express our deepest appreciation to the authors and reviewers who have made valuable contributions to this special issue by sharing their knowledge and expertise. We also wish to show our sincere gratitude to Editor-in-Chief of COESH Prof. Damià Barceló (the Editor-in-Chief), Ms. Alison Langestraat (the Editorial Manager), Ms. Priya Alagesan (the Journal Manager), and Ms. Carly Middendorp (the SI Content Manager) for their great support in publishing the special issue.

References

1. Zhang X, Zhang M, Liu H, Gu J, Liu Y: **Environmental sustainability: a pressing challenge to biological sewage treatment processes**. *Curr Opin Environ Sci Health* 2019, **12**:1–5, https://doi.org/10.1016/j.coesh.2019.05.006.

2. Bharathiraja B, Ebenezer Aberna, Selvakumari I, Iyyappan J, Varjani S: **Itaconic acid: an effective sorbent for removal of pollutants from dye industry effluents**. *Curr Opin Environ Sci Health* 2019, **12**:6–17, https://doi.org/10.1016/j.coesh.2019.07.004.

3. Girijan S, Kumar M: **Immobilized biomass systems: an approach for trace organics removal from wastewater and environmental remediation**. *Curr Opin Environ Sci Health* 2019, **12**:18–29, https://doi.org/10.1016/j.coesh.2019.08.005.

4. Patinvoh RJ, Taherzadeh MJ: **Challenges of biogas implementation in developing countries**. *Curr Opin Environ Sci Health* 2019, **12**:30–37, https://doi.org/10.1016/j.coesh.2019.09.006.

5. Vo TDH, Bui XT, Lin C, Nguyen VT, Hoang TKD, Nguyen H, Nguyen PD, Ngo HH, Guo W: **A mini-review on shallow-bed constructed wetlands: a promising innovative green roof**. *Curr Opin Environ Sci Health* 2019, **12**:38–47, https://doi.org/10.1016/j.coesh.2019.09.004.

6. Mandeep Gupta GK, Liu H, Shukla P: **Pulp and paper industry–based pollutants, their health hazards and environmental risks**. *Curr Opin Environ Sci Health* 2019, **12**:48–56, https://doi.org/10.1016/j.coesh.2019.09.010.

7. Nancharaiah YV, Sarvajith M: **Aerobic granular sludge process: a fast growing biological treatment for sustainable wastewater treatment**. *Curr Opin Environ Sci Health* 2019, **12**:57–65, https://doi.org/10.1016/j.coesh.2019.09.011.

8. Rajmohan KS, Ramya C, Varjani S: **Plastic pollutants: waste management for pollution control and abatement**. *Curr Opin Environ Sci Health* 2019, **12**:72–84, https://doi.org/10.1016/j.coesh.2019.08.006.

9. Effendi AJ, Wulandari M, Setiadi T: **Ultrasonic application in contaminated soil remediation**. *Curr Opin Environ Sci Health* 2019, **12**:66–71, https://doi.org/10.1016/j.coesh.2019.09.009.