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Editorial

Challenges in environmental science/engineering and innovations in pollution prevention and resource recovery for a sustainable future

Sustainable future of the earth and humanity are going to depend completely on how well we are going to utilize our natural resources such as water, agricultural lands, mineral reserves, fossil fuels and others. Population growth and urbanization demand large amount of natural resources to be made available for various activities at a rapid rate, while leaving behind waste in huge quantities which are rich in secondary resources. A practice of making use of those wastes is essential in order to have a sustainable future. The theme of this special issue is "Innovations in Pollution Prevention and Resource Recovery for a Sustainable Future" and it contains 39 articles disseminating research outcomes relevant to the theme. The articles are based on the presentations delivered at the 12th International Conference on the Challenges in Environmental Science and Engineering, CESE-2019. The conference was held from the 3rd to the November 7, 2019 in Kaohsiung, Taiwan. This special issue covers the following areas: 17 articles on pollution prevention, 2 articles on the fate and transport of pollutants, 10 articles on resource recovery and waste to energy (WtE), 3 articles on the preparation of membranes and their treatment efficiencies, 3 articles on the detection of chemical species of environmental concern and 4 articles on the health impacts of pollutants.

1. Pollution prevention

Three articles discuss the oxidation process. A critical review on advanced oxidation processes for the removal of trace organic contaminants highlights that the organic and inorganic ions present are either converted to high redox potential radicals upon collision with other reactive species and increase the reaction rates, or may act as radical scavengers and decrease the process efficiency in removing trace organic contaminants during advanced oxidation (Tufail et al., 2020). A study on the degradation of trichloroethylene (TCE) by photoelectrochemically activated persulfate proposes the degradation mechanism of TCE (Peng et al., 2020) and finds that the degradation rate of TCE in the anodic chamber is more effective than that in the cathodic chamber because of the synergistic effect of hydroxyl and sulfate radicals. A study on solar oxidation of toluene (TOL) over Co doped TiO_2 nano-catalyst finds that adding Co to TiO_2 significantly changes crystal size and surface morphology, reduces the bandgap energy of TiO_2 and improves the solar photo-oxidation of TOL significantly (Almomani et al., 2020).

Three articles are related to arsenic (As). In one study, mesoporous activated carbons have been prepared by an innovative iron/calcium in-situ-impregnation and multistage depth-activation to adsorb arsenic in the presence of humic acids (Gong et al., 2020). The study finds that physisorption and chemisorption mechanisms are dominant in arsenic adsorption on the activated carbon in the presence of humic acid, forming inner-sphere complexation with metallic oxide, functional groups on carbon surface and humic acid structure, or ternary surface complexation via cationic metal ions as a cation bridge. A study on the comparative valuation of groundwater quality parameters in Bhojpur, Bihar for arsenic risk assessment evaluates the levels of geogenic arsenic and other heavy metals affecting the release of As in the aquifers within the drinking water sources (Maity et al., 2020). In another study, charged covalent organic framework [ethidium bromide (EB)-COF:Br] is applied for the first time as adsorbent for phosphorus (V) or arsenic (V) removal from nearly neutral waters (Yang et al., 2020). The synthesized COF shown to be structurally stable in highly acidic and basic media. The phosphate adsorption onto the EB-COF:Br is shown to be an endothermic process and the corresponding arsenate adsorption process being an exothermic process.

Four articles are dealing with nitrogen and phosphorus. A study shows that using dolomite to provide calcium and magnesium decreases the crystallization process cost and recovers phosphorus from livestock wastewater (Yin et al., 2020). Positive impact of titanium (III) nitrilotriacetate [Ti(III)-NTA] as a reducing agent on autotrophic nitrogen removal process and the nexus of nitrous oxide emission in an anaerobic downflow hanging sponge reactor is discussed in another article (Thao Tran et al., 2020). One study evaluates the aerobic degradation of tetramethylammonium hydroxide (TMAH) that is often used as developer in the high-tech industries (Wu et al., 2020). The study finds that after the aerobic degradation of TMAH and ammonia release, the lag time for the onset of nitrification was highly correlated with initial TMAH fed for the sequencing batch reactor (SBR). One study by Cheng et al. (2020) evaluates the effects of copper on *N*-methylformamide (NMF) - and methyl diglycol (MDG)-containing wastewater treatment using batch experiments and a lab-scale anoxic-oxic (A/O) sequencing batch reactor (SBR). The long-term A/O SBR operation reveals that daily dosage of 0.5 mg/L copper is not detrimental to NMF/MDG degradations due to regular sludge wasting. The system can be recovered from the spike of copper concentration by regularly wasting sludge and maintaining the sludge retention time at 20 days.

Two more articles deal with pollutants in marine sediments and soils. Hung et al. (2020a) investigate the performance of biochar derived from red algae (RAB) for efficient remediation of 4-nonylphenol (4-NP) from marine sediments. It has been found that the calcium in RAB efficiently activates sodium percarbonate (SPC) to generate reactive radicals for the catalytic degradation of 4-NP at pH 9.0. A study by Senevirathna et al. (2021) reveal that

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more than 98% of Perfluorooctanesulfonate (PFOS) removal could be attained by flushing with five bed volumes of 50% ethanol. In addition, the study investigated thirteen commercially available filter materials to identify a suitable one to eliminate PFOS with competitive PFOS adsorption characteristics.

Another two articles discuss about the pollutants in potential potable water. One article discusses the mechanism and potential application of the flocculation of Microcystis unicells induced by pH regulation (Tan et al., 2021). Results show that when pH is adjusted in the range of 2.5 to 2 by HCl (1.2 M), Microcystis unicells aggregate to form flocs as large as 28 μm, which are easily removed by filtration or sedimentation. Study by Shen et al. (2020) emphasise that understanding the transformation pattern of nitrogen (N) pollutants and its pathways in the pre-chlorinated raw water distribution system (PRWDS) is vital for controlling the stability and safety of raw water quality. The study investigates the N transformation, N functional genes and their correlations to find the N transformation pathways along the PRWDS.

Three more articles are dedicated to air pollution and treatment. Prikyai et al. (2020) study the performance of a laboratory-scale hollow fiber air membrane bioreactor to purify waste gas stream containing methanol (MeOH) under steady and transient state conditions. Another study by Ichiura et al. (2020) investigate acetaldehyde gas removal by a nylon film-TiO_2 composite sheet prepared on a paper surface using interfacial polymerization and electrostatic interactions. The nylon film-TiO_2 composite sheet effectively removed acetaldehyde gas by photocatalysis and adsorption and could be applied to remove volatile organic compounds in indoor air. Amira et al. (2020) investigate indoor generated PM2.5 compositions and volatile organic compounds with respect to potential sources and health risk implications. A principal component analysis (PCA) shows that the main sources of benzene, toluene, ethylbenzene, and isomeric xylenes (BTEX) are originated from vehicle emissions and exacerbated because of temperature variations.

2. Fate and transport of pollutants

Pallabi et al. (2020) assess the mobility and environmental risks associated with copper, manganese and zinc in soils of a dumping site around a Ramsar site in Guwahati, India. Sequential extraction has revealed that the binding strength of Cu, Mn and Zn had a uniform trend. Chen et al. (2020) study microplastics and their affiliated polycyclic aromatic hydrocarbons (PAHs) in the sea surface connected to the southwest coast of Taiwan. The diagnostic ratios and the results of principal component analysis (PCA) and multiple linear regression of the absolute principal component scores (MLR-APCS) indicated that the PAHs were mainly contributed from sources related to petrogenic (71.4%) and vehicles (28.6%).

3. Resource recovery and waste to energy

There are six articles on resource recovery. Anggoro et al. (2020) discuss the production of glycerol monostearate from glycerol using dealuminated Zeolite Y catalysts. Converting them to glycerol monostearate will find market as an emulsifier in the food, pharmaceutical, and cosmetics industries. Stefaniak et al. (2020) discuss selective recovery of Co(II) from sulfate electrolytes obtained from the leaching of steel scraps of aircraft engines. The selectivity value of Co(II) extraction over Ni(II) depends on pH. Producing an electrolyte of Co(II) for electrowinning will be a possible alternative route for resource recovery. Kayathi et al. (2020) discuss the benefits of the selective extraction of polar lipids of mango kernel thrown as waste using Supercritical Carbon dioxide ($SC-CO_2$) extraction. The economic evaluation estimates the return on investment of a plant processing 3000 tons of mango kernel per year will have a payback period under 4 years. Huang et al. (2020) propose a system which involves the conversion of CO_2 into high purity, low moisture, compact and large $CaCO_3$ solids through homogeneous granulation in a fluidized-bed reactor (FBR). Overall, the transformation of industrial CO_2 emissions into a valuable solid product can be a significant move towards the mitigation of climate change from anthropogenic emissions. Tawalbeh et al. (2021) investigate Carbon dioxide (CO_2) capture using zeolite membranes. A model based on Maxwell–Stefan equations and Extended Langmuir isotherm is developed to investigate the transport of binary mixtures of CO_2 and N_2 through membranes. Pramanik et al. (2020) investigate a novel integrated approach to recover lithium from salt-lake brines by combining nanofiltration (NF), membrane distillation (MD) and precipitation processes.

Another four articles are related to waste to energy. Mahidin et al. (2020) perform simulations to analyze the maximum power from the burning of oil palm biomass for the electricity generation. The simulations confirm that the power generated can be applied in rural/remote areas. Almomani and Bhosale (2020) propose a strategy for optimizing the anaerobic co-digestion of agricultural solid wastes (ASWs) and cow dung (CD). They identify the key factors governing the co-digestion performance and evaluate the effect of $NaHCO_3$ alkalinity treatment on improving the economy and performance of anaerobic digestion (AD). Lee and Park (2020) find that the hydrothermal pre-treatment (HTP) temperature is closely related to the formation of lignocellulosic biomass-degrading by-products, which potentially hinder the methanogenesis step in an anaerobic digestion (AD); severe HTP conditions may have the opposite effect on the AD performance of lignocellulosic biomass. The study uses sunflower as a model lignocellulosic biomass. Munfarida et al. (2020) study the development of sustainable catalyst from geothermal waste by hydrothermal process for enhanced biohydrogen production. The effects of Si/Al ratio and pH neutralization on the catalyst are also investigated to provide further insight into the hydrogen production capability.

4. Synthesis of membranes

Three articles are dedicated to the synthesis of membranes for pollutant removal. Yan et al. (2020) discuss the fabrication of a layered graphene oxide (GO) membrane through layer-by-layer (LBL) self-assembly to treat dye wastewater. They use borate to crosslink with graphene oxide (GO) on a polyethyleneimine (PEI)-coated hydrolyzed polyacrylonitrile (hPAN) support. Ma et al. (2020) study the hydrophilicity, permeability, and antifouling performance of graphene oxide-polyethylene glycol (P-GO) incorporated PVDF nanocomposite ultrafiltration membrane. Sakarkar et al. (2020) evaluate the effects of polyvinyl alcohol (PVA) loading in the PVA/titanium dioxide (TiO_2) thin film coating on polyvinylidene fluoride (PVDF) membrane for the removal of textile dyes. The results indicate that the PVA/TiO_2 coated PVDF membrane have lower irreversible fouling factors compared to plain PVDF membrane.

5. Detection and chemistry of chemical species of concern

Four articles are in this area. Shinfuku et al. (2020) explore odorous aldehydes and ketones originating from *U. americana* with a view to discovering a possible candidate substance of causative compounds and find its formula to be $C_{13}H_{20}O_3$ on the basis of its accurate mass and natural isotopic pattern. Hung et al. (2020b) study the electrochemical analysis of naproxen (NPX) in water using poly (L-serine)-modified glassy carbon electrode (PLS/GCE). Chen et al. (2020) show the allelopathic interaction between *Microcystis aeruginosa* and its antagonist by imaging mass spectrometry

of interspecies metabolic exchange.

6. Health impacts of pollutants

Four articles are dedicated to this section. Nanayakkara et al. (2020) study the influence of fluoride on chronic kidney disease of uncertain aetiology (CKDu) in Sri Lanka. The study recommends close monitoring of serum fluoride levels in CKDu patients and establishing health-based target guidelines for fluoride in drinking water for the CKDu patients. Ju et al. (2020) evaluate the biometry-dependent metal bioaccumulation in aquaculture shellfishes in southwest Taiwan and the risks in consuming them. This study assesses the distribution of metals, including Cd, Cr, Cu, Pb, Ni, Zn, and Hg, in soft tissues of hard clam (Meretrix lusoria), surrounding water body, and sediment in the southwest coast of Taiwan. Knowing the environmental toxicity of tetracycline antibiotics to aquatic organisms is very important and Wang et al. (2020), for the first time, study the toxicity of two tetracycline antibiotics on *Stentor coeruleus* and *Stylonychia lemnae* as the potential use as toxicity indicator. Yadav et al. (2021) review on a persisting global issue - threat and sustainable technological solution for antineoplastic drugs (used in chemotherapy, in large quantities worldwide) pollution. The study reviews the role of antineoplastic agents as emerging water contaminants, their transfer through the food chain, eco-toxicological properties and effects, technological solutions and management aspects.

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