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Editorial

Special Issue "Green Technologies: Bridging Conventional Practices and Industry 4.0"

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1. Introduction

Green technologies have been globally accepted as efficient and sustainable techniques for the utilization of natural resources. Currently, Industry 4.0, which is also called a "smart industry", aims for the integration of cyber and physical systems to minimize waste and maximize productivity. Therefore, green technologies can be identified as key components in Industry 4.0. The scope of this Special Issue is to address how conventional green technologies can be a part of smart industries by minimizing waste, maximizing productivity, optimizing the supply chain, or by additive manufacturing (3D printing). This theme focuses on the scope and challenges of integrating current environmental technologies in future industries.

This Special Issue "Green Technologies: Bridging Conventional Practices and Industry 4.0" invites manuscripts from academicians working on green technology-related processes. Authors are invited to submit original research articles covering topics which include, but are not limited to, the following areas: (1) the development of new disease-specific models to guide therapy; (2) air pollution monitoring and control; (3) carbon emission reduction; (4) computational tools for environmental applications; (5) energy and environmental policy; (6) environmental monitoring, assessment and management; (7) Industry 4.0; (8) process system engineering; (9) renewable energy; (10) solid/biomass waste treatment, management, and recycling; and (11) waste minimization, etc. The manuscripts were regularly submitted, selected and reviewed by the regular system and accepted for publication. This Special Issue, "Green Technologies: Bridging Conventional Practices and Industry 4.0", aims to incorporate and introduce the advances in green technologies to the cyber-based industries.

In this Special Issue on "Green Technologies: Bridging Conventional Practices and Industry 4.0", we have accepted and published 17 high-quality and original articles [1–17]. These research papers cover theoretical, numerical, or experimental approaches on green technology that bridge conventional practices and Industry 4.0. The Special Issue operates a rigorous peer-review process with a single-blind assessment and at least two independent reviewers, hence resulting in our final acceptance of these published high-quality papers.

2. Papers Presented in the Special Issue

Borhan et al. [1] researched about the characterization and modelling studies of activated carbon produced from rubber-seed shells using KOH for the CO_2 adsorption. The study experimentally demonstrated that the Freundlich isotherm and pseudo-second kinetic model provided the best fit to the experimental data, suggesting that the rubber-seed shell activated carbon they prepared is an attractive source for CO_2 adsorption applications. Yunus et al. [2] reported that ionic liquids, which are classified as new solvents, have been identified to be potential solvents in the application of

CO_2 capture. In this work, six ammonium-based protic ionic liquids, containing ethanolammonium (EtOHA), tributylammonium (TBA), bis(2-ethylhexyl) ammonium (BEHA) cations, and acetate (AC) and butyrate (BA) anions, were synthesized and characterized.

Pan et al. [3] successfully synthesized an amorphous mesoporous silicon oxycarbide material (SiOC) via a low-cost facile method by using potassium hydroxide activation, high-temperature carbonization, and acid treatment. The precursors were obtained from floating plants (floating moss, water cabbage, and water caltrops). Ali et al. [4] optimized municipal solid waste (MSW) conversion technologies using a process network synthesis tool, the "process graph" (P-graph). The four highest compositions (i.e., food waste, agriculture waste, paper, and plastics) of the MSW generated in Malaysia were optimized using a P-graph. Two types of conversion technologies were considered, namely biological conversion (anaerobic digestion) and thermal conversion (pyrolysis and incinerator). All these conversion technologies were compared with the standard method used: landfilling. One-hundred feasible structures were generated using a P-graph.

There are few excellent examples of research done in enhancing the sustainability of biofuels. Damanik et al. [5] demonstrated the performance and exhaust emissions of a diesel engine fuelled with calophyllum inophyllum—palm biodiesel. Meanwhile, Wan Nurain et al. [6] discussed the sugarcane bagasse-based adsorbent employed for mitigating eutrophication threats and producing biodiesel simultaneously. Further, Bello et al. [7] reported the thermal analysis of Nigerian oil palm biomass with sachet-water plastic wastes for the sustainable production of biofuel. Besides, Xuefei et al. [8] discussed the fabrication of green superhydrophobic and superoleophilic wood flour for an efficient oil separation from water. Wong et al. [9] conducted an in situ fermentation process for improving protein and lipid contents in the larval biomass of the black soldier fly, which can be subsequently converted into nutrients and biofuels. All these collections are important in contributing to the sustainability of biofuel production in Industry 4.0.

Few of the papers published in this Special Issue also investigated the concept of automation and investigations were done on the underlying principles and technologies for implementation in an automated industry. Tran Van et al. [10] studied the hygro-thermo-mechanical responses of balsa wood core to observe the permeability and fire resistance of the composites. Experimental, analytical and numerical methods were applied to understand the moisture impervious barrier significance of the structure. De-la-torre et al. [11] performed a study on a multivariate analysis and machine learning algorithm for the ripeness classification of Cape gooseberry fruits. The work applied sophisticated algorithms to analyze the feature selection and extraction, and combined them to find the best combination for a particular application. The optimization work may be developed to use for measuring the level of ripeness of the Cape gooseberry or any different type of fruit. Moreover, the work by Mohd Aris et al. [12] shows a Gaussian process (GP) methodology for a multi-frequency marine controlled-source electromagnetic profile estimation in an isotropic medium. The Gaussian process proposed can reduce the high computational cost and complexity of the mathematical equations involved, where a 2D forward GP model was developed and the model was validated. Good agreement between the output and estimation was achieved. These works are important as a stepping stone for the creation of an automated industry.

Apart from that, this Special Issue also attracted three quality review papers. The first review article is written by Khoo et al. [13], and this review paper covers the latest developments in bioseparation technology using a liquid biphasic system (LBS). The review article begins with an in-depth discussion on the fundamental principle of LBS and this is followed by the discussion on the further developments of the various phase-forming components in LBS. Additionally, the implementation of various advance technologies to the LBS that is beneficial towards the efficiency of LBS for the extraction, separation, and purification of biomolecules was discussed. The key parameters affecting the LBS were presented and evaluated. Moreover, future prospects and challenges were highlighted to be a useful guide for the future development of LBS. The efforts presented in this review will provide an insight for future research in liquid–liquid separation techniques. In the Special Issue, there are works by Tham et

al. [14,15], where the article critically discussed the recovery of protein from dairy milk waste products using an alcohol–salt liquid biphasic flotation, which is one of the latest technologies in LBS that can be potentially applied in Industry 4.0.

On the other hand, the second review paper was written by Chow et al. [16] and is about the potential co-substrates and operating factors for an improved methane yield from the perspective of anaerobic co-digestion of wastewater sludge. This review summarizes the results from numerous laboratory, pilot, and full-scale anaerobic co-digestion (ACD) studies of wastewater sludge with the co-substrates of organic fractions of municipal solid waste, food waste, crude glycerol, agricultural waste, and fat, oil and grease. The critical factors that influence the ACD operation are also discussed. The ultimate aim of this review is to identify the best potential co-substrate for wastewater sludge anaerobic co-digestion and to provide a recommendation for future reference. By adding co-substrates, a gain ranging from 13% to 176% in the methane yield was accomplished compared with mono-digestion.

In the third review paper contributed by Yong et al. [17], a comprehensive review of the appraisal of the environmental, financial, and public issues related to the energy recovery from municipal solid waste in the view of sustainable waste-to-energy (WTE) development in Malaysia is offered. This review article mainly discusses the various WTE technologies in Malaysia by considering the energy potentials from all the existing incineration plants and landfill sites as an effective MSW management in Malaysia. Furthermore, to promote local innovation and technology development and to ensure the successful long-term sustainable economic viability, social inclusiveness, and environmental sustainability in Malaysia, the four faculties of sustainable development, namely technical, economic, environmental, and social issues affiliated with MSW-to-energy technologies, were compared and evaluated.

3. Conclusions

It is hope that the novel green technologies presented in this issue are useful in assisting the global community in working towards fulfilling the Sustainable Development Goals of United Nation. The guest editors thank the authors for their contribution to the new knowledge and the reviewers for their valuable time and efforts in the review process. Besides, we would like to thank the editorial office and Dr Unai Vicario for their help and support in completing this Special Issue, especially during the pandemic of COVID-19.

Conflicts of Interest: The authors declare no conflict of interest.

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