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Editorial

Special Issue: "Advances in Waste Treatment and Resource Utilization"

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Waste, in its various forms, is a big issue worldwide but one that can be tackled. Instead of seeing waste as a burden to be discarded, it is now viewed as a valuable resource waiting to be tapped into. Most types of waste can be specifically treated to minimize environmental impacts, from being reused to minimize the hyper-production of new waste to being used for resource utilization and nutrient recovery.

One of the primary benefits of waste resource utilization is the reduction in environmental harm. Recycling paper, glass, plastics, and metals helps conserve natural resources and reduces the energy and emissions associated with producing new materials. It lessens the strain on landfills and prevents the release of harmful substances into the environment. Waste-to-energy processes like incineration and anaerobic digestion show us that organic waste can be converted into biogas or electricity, contributing to cleaner and more sustainable energy sources. By reusing and repurposing waste materials, we can maximize the utility of the resources initially used to obtain those products. Such an approach reduces the demand for raw materials and lessens the strain on ecosystems.

This Special Issue contains nine papers dealing with waste treatment and resource utilization; the papers in the form of reviews are presented first, followed by the presentation of the research papers and reports that comprise this Special Issue.

In their article, Bist and Chai [1] introduce the pertinent issue of particulate matter (PM) within the sphere of poultry farming. The article meticulously examines the origin of PM within poultry housing, shedding light on its varying sizes, chemical compositions, and the multitude of factors that contribute to its generation. Furthermore, the authors conscientiously enumerate the potential impacts of PM on the health and welfare of both poultry and farm workers. They subsequently engage in a comprehensive discussion regarding mitigation strategies aimed at suppressing PM production, all while considering their economic feasibility.

The review by Julapong et al. [2] offers a profound analysis of one of the techniques employed for the recovery of Rare Earth Elements (REEs), namely, flotation. This method hinges on the principle of separating materials based on differences in surface wettability, and the authors meticulously guide us through a decade's worth of novel research. The article commences with an expansive overview of REEs and the minerals from which these invaluable elements are derived. The authors subsequently illuminate the spectrum of mining techniques employed in the quest for REEs. However, the true highlight of this paper lies in its discussion of flotation—an innovative method that takes center stage in the review. Julapong and their team meticulously delve into its application in primary sources of REEs before unveiling its great potential in secondary sources such as solid waste (e.g., phosphors) and liquid waste (e.g., industrial wastewater).

Another review article [3] in this Special Issue provides an in-depth exploration into the utilization of fly ash derived from municipal solid waste incineration and it potential use within the realm of agriculture, aligning it with the principles of the circular economy. The article introduces readers to the sheer volume of municipal waste that is generated and

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the principal methods employed for its processing, specifically highlighting incineration as a pivotal technique. The authors of this article, Rusanescu and Rusanescu, meticulously delineate the technological workflow of municipal solid waste incineration, elucidating the typical physico-chemical properties of the resultant fly ash. Furthermore, the article contains a detailed discussion regarding the viability of employing such ash as a fertilizer. Insights into plant development, water retention capabilities, and other pertinent soil attributes are also thoughtfully shared. Rusanescu and Rusanescu assert that the incorporation of fly ash into soil can substantially enhance the soil's physico-chemical and biological soil properties, especially so in the case of acidic soils. This augmentation, in turn, may lead to increased crop yields, including crops such as rye, barley, rice, and sunflowers, when applied to select soil types.

Transitioning to research articles, Attard et al. [4] undertook a study based on the waste generated by the olive cultivation industry in the Maltese Islands. Olive mill wastewater and pomace were subjected to hydrolysis and evaluated for their antioxidant properties. Notably, the authors discerned that the cultivar and maturity of olives were the primary factors influencing phenolic activity in the samples. Moreover, they established correlations between the total phenolic, flavonoid, and ortho-diphenolic contents and the metal ion-reducing activity and radical scavenging activity across various phenolic classes.

Intriguingly, olives are also an integral part of another study in this Special Issue, as Ivankovic et al. [5] investigated the use of waste olive cake and pruned biomass as substrates for biogas production. The authors sought to enhance yield through the introduction of targeted bacteria optimized for the biodegradation of these specific olive waste materials. The results indicate that the bioaugmentation of anaerobic reactors, particularly when utilizing biocarriers, can significantly amplify biogas production. However, this effect was observed predominantly when olive cake, not pruned biomass, was used as the substrate.

As previously mentioned in this Editorial, fly ash remains an interesting theme of research, as evidenced by Kaczmarski et al. [6], who harnessed ash from a heat and power plant in Poland as a precursor for the production of geopolymers. Geopolymer materials derived from post-processing waste such as fly ash or blast furnace slag offer an eco-friendly alternative to conventional concrete in the construction industry. This study assesses the application of air guns with variable nozzles for the precise deposition of foamed geopolymers onto existing structures and vertical surfaces. Various mechanical properties and configurations were explored, with optimal results achieved at a nozzle diameter of 6 mm and a moderate working pressure (0.51–0.65 MPa). Nonetheless, it is worth noting that the geopolymer material exhibited prolonged setting times in open air, leading to some streaking when applied. These promising results suggest that the modification of mixtures with hydraulic additives or stabilizers may offer potential solutions to enhance the foaming processes and reduce setting times of geopolymer materials in ambient conditions.

Also in Poland, a nation wherein vegetable production occupies a significant place in the agricultural sector, Czekala et al. [7] undertook an investigation involving various agrifood waste materials, such as cabbage leaves, onion husks, and tomato dry leaves, either individually or in combination, as potential substrates for composting. The authors of the study achieved successful composting, as evidenced by temperature increases, with discussions encompassing variations in O_2, CO_2, NH_3, and H_2S emissions during the composting process. The authors foresee the development of the compost market, driven by regulatory measures and escalating mineral fertilizer costs, positioning agrifood waste as a promising substrate for compost production.

In the report by Kang et al. [8], an analysis of the operational conditions pertaining to an air separator designed for the secondary utilization of farmland residual mulch film is presented. After harvest, used plastic mulch, predominantly polyethylene, often remains in the soil. To address this issue, mechanized recycling methods have been employed, resulting in the development of various recovery machinery types. Through simulations and analysis, this study evaluates the efficiency of a tumbler screen-type separator, focusing on its feed inlet dimensions and optimal feeding rates. The findings reveal that the most effective disaggregation occurs with a square feed inlet and a feeding rate of 202 kg/h. Subsequently, a prototype was constructed based on these parameters and verified through testing. The results demonstrated a significant reduction in impurity content within the residual film, which was consistently maintained during the continuous operation of the film–impurity wind separator.

Finally, Peng et al. [9] introduce a differential separation trommel screener designed to address the issue of the high insect impurity rates encountered during the separation of black soldier fly (BSF) sand mixtures. The BSF sand mixture is a product of livestock waste bioconversion, wherein high-protein black soldier fly larvae serve as protein feed for aquatic animals. The optimal operational parameters include a trommel rotation speed of 47.37 r/min, a spike teeth rotation speed of 24.16 r/min, and a trommel inclination angle of 5°. These parameters resulted in an insect impurity content of 6.0%, along with an impressive reduction in insect impurity rates to 1.2%.

We hope that this Special Issue shows that waste is not just something to be disposed of in a landfill and that, instead, it can help to facilitate a circular economy where products are designed with recycling and reuse in mind. This shift away from a linear "take, make, and dispose" model promotes sustainability and reduces the environmental footprint of consumer goods. By changing our perception of waste through viewing it as an opportunity rather than a problem, we can unlock waste's potential to facilitate conservation, innovation, and economic growth.

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

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