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Editorial

Editorial for the Special Issue "Wastewater and Waste Treatment: Overview, Challenges and Current Trends"

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1. Introduction

Today's environmental challenges, marked by escalating pollution levels, climate change and diminishing natural resources, urgently require innovative solutions, particularly in waste and wastewater management. The existing conventional treatment methods are in need of improved efficiency, reduced energy demands and the ability to effectively tackle complex environmental problems. These shortcomings have been highlighted in the literature, indicating the serious need for more sustainable and environmentally friendly approaches [1,2]. In response to this pressing aim, recent environmental research has turned towards discovering and developing more effective, sustainable and innovative strategies for handling waste and wastewater. This includes leveraging cutting-edge technologies and exploring new ways to improve the efficiency of pollutant removal whilst also reducing the environmental impact of these processes.

This Special Issue has compiled relevant research addressing the aforementioned issues. An overview of the papers published in this Special Issue will follow, highlighting some emerging trends in the research carried out in the field and the interesting solutions that have been proposed to target more specific environmental concerns.

2. Overview of Contributions

The range of topics covered in this Special Issue reflects the dynamic nature of the wastewater and waste treatment research field, offering a broad overview characterized by a diverse array of research into waste streams and treatment processes. The focus on waste streams is notably varied, with urban waste leading in the number of publications, comprising 41% of the total papers in this Special Issue, reflecting the urgent need to address pollution in densely populated areas. Industrial and agro-industrial wastes also received significant attention, constituting 21% and 15%, respectively, highlighting the environmental impact of these sectors. On the treatment front, physicochemical methods are predominant, representing 35% of the studies, indicative of their widespread applicability and effectiveness. Biological treatment methods, integral for their sustainability and eco-friendliness [3,4], account for 32%, while advanced oxidation processes, crucial for recalcitrant contaminants [5], make up 12%. The composition of the Special Issue, with 24% of the works being review papers, provides a solid foundation of knowledge and context, while the 76% original research papers drive the field forward with new insights and innovations, collectively painting a comprehensive picture of the current state of the field and future directions in wastewater and waste treatment research. Figure 1 summarizes the distribution of papers published in this Special Issue.

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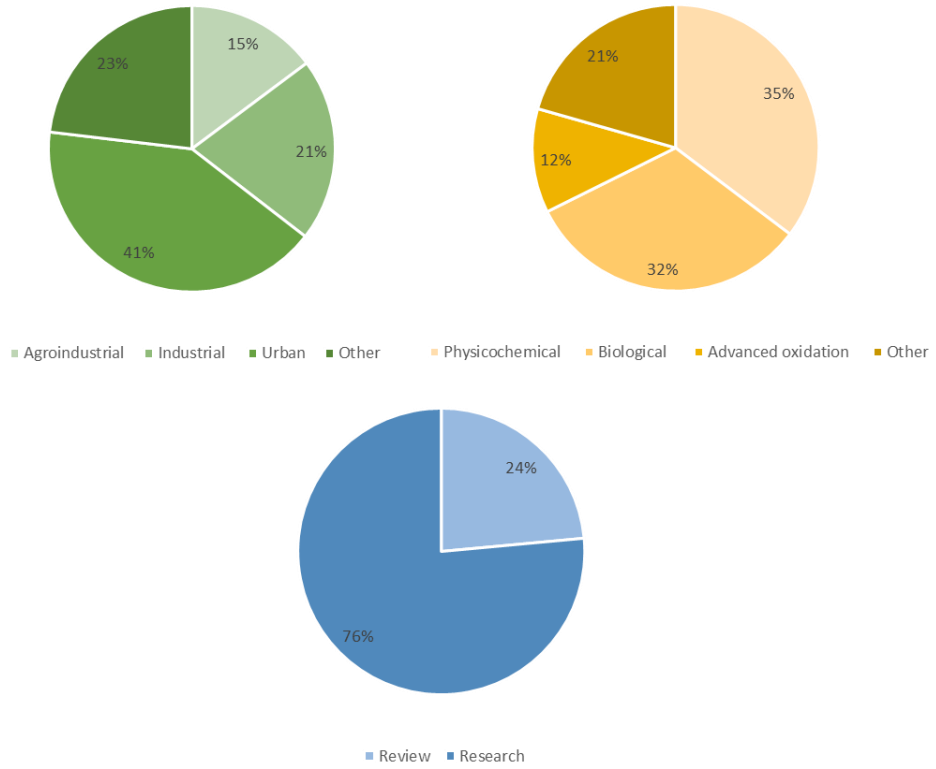

Figure 1. Distribution of topics and nature of the published papers in this Special Issue.

It would be impossible to discuss all of the high-quality contributions in the Editorial of this Special Issue, but a brief discussion will follow to highlight some of them.

As previously mentioned, most of the contributions present innovative research work describing treatment technologies. In the work entitled "Characterization of Sludge Resulting from Chemical Coagulation and Electrocoagulation of Pumping Water from Fishmeal Factories", the authors present a physicochemical treatment method for the management of an industrial waste stream (namely from a fishmeal factory). Through the use of chemical coagulation and electrocoagulation, the authors managed to recover some of the valuable constituents of the waste stream. In the work entitled "Preparation and Phosphorus Removal Performance of Zr–La–Fe Ternary Composite Adsorbent Embedded with Sodium Alginate", the authors discuss the preparation of a novel composite material that can be used as an adsorbent for phosphorous removal. The material was tested on both synthetic and real urban wastewater, achieving a removal of phosphorous of more than 99%. Papers such as the one entitled "Development of a Continuous Hydrothermal Treatment Process for Efficient Dewatering of Industrial Wastewater Sludge" showcase novel treatment technologies that promise enhanced efficiency. This study demonstrates the benefits of hydrothermal carbonization for the dewatering of biological paper sludge without the use of dewatering aids such as fiber sludge or polyelectrolytes.

In addition to the works that present novel treatment methods, several of the contributions examine ways to optimize existing treatment processes; for example, "Optimization of the Biotreatment of GTL Process Water Using Pseudomonas aeruginosa Immobilized in PVA Hydrogel" and "Improving the Treatment Efficiency and Lowering the Operating Costs of Electrochemical Advanced Oxidation Processes" examine the optimization of a biological and an advanced oxidation process, respectively. In the work entitled "Increase by Substitution of Galvanized Steel for Aluminum Mirrors in the UV Solar Radiation in Canal with Fins and Side Panels That Disinfect Wastewater", the authors examine the addition of mirrors in water disinfection canals, intensifying solar radiation by 8%.

Emerging contaminants are an ever-growing environmental problem, posing unique challenges to existing waste and wastewater treatment systems [6]. The authors of the work

entitled "Occurrence of Selected Emerging Contaminants in Southern Europe WWTPs: Comparison of Simulations and Real Data" examine the occurrence of six targeted emerging contaminants in the outflow of an urban wastewater treatment plant over nine months. In the review work entitled "Emerging Pollutants in Wastewater, Advanced Oxidation Processes as an Alternative Treatment and Perspectives", the authors provide an overview of the most significant groups of emerging contaminants that could potentially be found in wastewater and the environment.

Papers such as "Fermentation Wastes from *Chrypthecodinium cohnii* Lipid Production for Energy Recovery by Anaerobic Digestion", "Circular Economy Indicators for the Assessment of Waste and By-Products from the Palm Oil Sector" and "Recovery of Phosphorus in Wastewater in the Form of Polyphosphates: A Review" examine the recovery of valuable materials and energy from waste streams, a concept that promotes the incorporation of circular economy principles and sustainable practices in waste treatment. Such methodologies not only address waste treatment but also underscore the importance of resource conservation and recovery in achieving environmental sustainability.

3. Challenges and Future Directions

Despite the significant advances in the field of waste and wastewater treatment, the field faces persistent challenges due to the ever-growing complexity of industrial effluents and the scalability of novel treatment methods. In most cases, new processes, and in this case wastewater treatment processes, need to have a positive fiscal impact on the waste producer in order to be adopted or imposed by authorities. More work is needed to improve the economic sustainability of novel treatment methods, at least to minimize the treatment cost, and the authorities that have oversight regarding environmental issues need to be updated on recently developed solutions to existing environmental concerns. These solutions should exhibit their positive impact on the environment through environmental assessment studies, as this will facilitate their adoption. Future research must continue to foster interdisciplinary collaborations, integrating insights from engineering, microbiology, chemistry and environmental science to develop holistic and adaptable solutions.

The varied collection of research presented in this Special Issue not only advances our understanding of wastewater and waste treatment but also catalyzes action towards more sustainable practices, offering both a reflection of our current standing and an aim of a cleaner, more sustainable future.

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

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