The world’s growing environmental concerns have sparked a need for effective techniques to remediate water and wastewater, with adsorption emerging as a popular technique of choice. Researchers are devoting significant attention to this technique, with a particular focus on developing activated carbon from cheap, renewable sources to replace commercial activated carbon, which is both costly and environmentally unfriendly. Activated carbon is highly effective at adsorption due to its highly developed internal surface area, porosity and large adsorption capacity. Moreover, activated carbon is simple in design and easy to operate. In the search for cheap and renewable sources of activated carbon, waste biomass from the agriculture sector, forestry, industries, and municipal sewage treatment facilities is being considered. Such wastes are abundant and can be obtained cheaply, with only logistical transportation costs being incurred in some cases. These attributes not only make the production of activated carbon from waste biomass economically viable but also help address the disposal challenge of waste biomass.

Theoretically, any low-cost material with high carbon content and low inorganics can be employed as an activated carbon precursor. However, waste biomass with inherently poor properties can also be used as activated carbon precursors, provided they are sufficiently pretreated to enhance their adsorptive properties. By implementing pretreatment processes, the range of waste biomass types that can be used as activated carbon precursors is widened. Besides biomass pretreatment, ongoing research efforts also focus on optimizing process conditions, synthesizing activated carbon-based composites, and customizing the surface chemistry of activated carbon to remove specific contaminants from water and wastewater. Such contaminants include heavy metals, dyes and contaminants of emerging concern (CECs). Additionally, researchers are exploring the recyclability and regenerability of activated carbon to ensure that the production and use of activated carbon is not only cost-effective, but also environmentally-friendly in water and wastewater treatment. This special issue delves into these areas and provides useful insights on expanding the use of waste biomass-derived activated carbon in water and wastewater treatment. It also covers advances in using biochar, hydrochar, and agro-residues as adsorbents in water and wastewater treatment. Special emphasis is given to the removal of CECs that usually face low removal efficiencies by conventional water treatment processes.

The special issue comprises nineteen articles, of which four are review papers (Ahmad et al., 2022; Ighalo et al., 2022; Sivaranjanee et al., 2022; Menya et al., 2023). The first review paper (Menya et al., 2023) delves into utilizing waste biomass-derived granular activated carbons (B-GACs) for removing CECs in point-of-use (POU) water purification. The article provides an overview of the sources, pathways, and impacts of CECs on human health. It also discusses the progress made in preparing and employing various B-GACs for POU water purification, addresses the factors influencing filter performance, and examines the performance challenges associated with POU water filters. Additionally, the paper explores how these challenges are being addressed through the modification of GAC.

The second review paper (Ahmad et al., 2022) examines the use of biochar-based advanced technologies and the underlying mechanisms involved in remediating persistent organic pollutants (POPs) from wastewater. The review paper provides an overview of the sources, fate, and risks of POPs in the environment. It also describes the synthesis of biochar-based catalysts, their reusability, and the bottlenecks faced in real-life applications. Finally, the review paper explores the commercialization potential of biochar-based catalysts in advanced technologies.

The third review paper (Ighalo et al., 2022) centers on the hydrothermal processing of waste biomass and the unique properties of the resulting hydrochar. The paper examines how these properties affect the hydrochar’s adsorptive performance towards different pollutants in wastewater, such as pharmaceutically active compounds, endocrine disruption chemicals, dyes, and heavy metals.

The fourth review paper (Sivaranjanee et al., 2022) surveyed the recent advances in using different agro-based materials as adsorbents for removing heavy metals from wastewater. The paper also explains how adsorbents can be pretreated using various techniques to expand their sorption limit and efficiency. Furthermore, the paper reviews the sources of heavy metals in wastewater, their impact on human health, and the sorption models that govern the adsorption process.
Out of the remaining fifteen articles, nine of them are dedicated to the synthesis of biochar, its composites, and surface modification to enhance performance of biochar towards specific water contaminants (Benis et al., 2022; Elvir-Padilla et al., 2022; Jacob et al., 2022; Nguyen et al., 2022; Sanchez-Silva et al., 2022; Yusuff et al., 2022; Mineai et al., 2023; Rubangakene et al., 2023; Yue et al., 2023). Additionally, some of these studies focus on process optimization using response surface methodology for maximum adsorption performance of biochar (Benis et al., 2022; Sanchez-Silva et al., 2022; Yusuff et al., 2022; Mineai et al., 2023). In all these studies, it was demonstrated that biochar can be an effective adsorbent for removal of contaminants from wastewater, provided its synthesis is optimized and/or biochar surface modified. The last six articles focus on the synthesis and application of activated carbon from waste biomass in wastewater treatment (Lazarotto et al., 2022; Maneewong et al., 2022; Merodio-Morales et al., 2022; Paixão et al., 2022; Valdés-Rodríguez et al., 2022; Li et al., 2023). These studies also highlight the importance of modifying the surface of activated carbon to enhance its functionality and ultimately its adsorption performance. Some of the modifications include doping with nitrogen, phosphorous, functionalization with lanthanum, and magnetization of the carbon.

Overall, the articles presented in this special issue showcase the potential of waste biomass as a sustainable precursor material for producing activated carbon and biochar. These articles further highlight that when the waste biomass-based activated carbon is optimally activated and/or modified for surface properties, its scope of application in water and wastewater treatment can be widened. We hope that the findings of these articles will inspire further research in this field and encourage the use of waste biomass as an eco-friendly solution for producing activated carbon to address the growing challenges of water and wastewater treatment.

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References


