

Food Waste-Derived Biosorbents for Dye Removal from Wastewater: Recent Advances, Adsorption Mechanisms, and Future Perspectives

Shraddha Tiwari and Dr. Sushrita Patnayak

Research Scholar, School of Science

Professor, School of Science

ISBM University, Nawapara (Kosmi), Chhattisgarh

lshraddhatiware081@gmail.com

Abstract: Industrial effluents with synthetic dyes have become a major environmental problem in the world. The dyes from textile, paper, leather, pharmaceutical and dye industries are persistent, toxic and poorly biodegradable, and this has caused great ecological and health problems. The traditional sewage treatment methods like coagulation, membrane filtration, oxidation and activated carbon adsorption are facing the issue of high operational cost and secondary pollution. Therefore, a greater interest has been aroused in the search of an alternative method for the removal of dyes, which is sustainable and economical. Biosorbents prepared from food waste have appeared to be a promising material, due to their renewability, biodegradability, low cost, and high content in lignocellulosic components. Banana peels, orange peels, watermelon rind, mango peels, spent coffee grounds and other agricultural wastes have shown excellent adsorption properties for removal of dyes from dye solutions. In this review, the critical evaluation of the recent studies related to the application of food waste biosorbents for wastewater treatment is discussed along with the adsorption mechanism, adsorption performance, factors affecting adsorption, adsorption equilibrium and kinetic models, and thermodynamic behavior. The adsorption processes are discussed in detail based upon role of functional groups, surface chemistry and biomass composition. In addition, issues of regenerator of biosorber, industrial applications and large scale implementation of biosorbent are critically reviewed. Last but not the least, future research directions and emerging opportunities for the implementation of the food waste valorization and sustainable wastewater treatment technologies are highlighted. The results prove food waste-based biosorbents to be a promising approach for the implementation of the circular economy and for environmentally friendly water purification systems.

Keywords: Biosorption, Food Waste, Dye Removal, Wastewater Treatment, Adsorption Mechanisms, Circular Economy, Sustainable Adsorbents