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USING POTATO AND GRAPEFRUIT PEELS AS ORGANIC ADSORBENTS TO MINIMIZE THE HAZARDOUS INFLUENCE OF TEXTILE DYE EFFLUENTS

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Abstract

The increasing contamination of water bodies by textile dyes poses significant environmental and health concerns, necessitating the development of sustainable and cost-effective treatment solutions. This study explores the potential of organic waste materials: grapefruit peels (GFP) and potato peels (PP), as natural adsorbents for the removal of Synozol reactive dyes (red, yellow, blue, and black) from textile effluents. The batch adsorption process was systematically investigated by varying key parameters, including adsorbent dosage, contact time, temperature, and pH, to determine optimal conditions for maximum dye removal.

Experimental results demonstrated that a combined dosage of 2 g of GFP and PP achieved maximum dye removal efficiencies of 90.3% (red), 91.6% (yellow), 87.4% (blue), and 86.0% (black) under optimized conditions. Desorption studies revealed that 57.5%–64.5% of the adsorbed dyes could be recovered in the first regeneration cycle, highlighting the potential reusability of the adsorbents. Furthermore, post-treatment analysis of the effluent indicated significant improvements in water quality, with turbidity reduced to 25–35 NTU, total dissolved solids (TDS) lowered to 998–1335 ppm, and pH levels adjusted to 7.13–7.8, approaching the permissible discharge limits for industrial wastewater.

These findings underscore the effectiveness of fruit and vegetable waste-derived adsorbents as low-cost, renewable, and environmentally friendly materials for textile dye removal. The study not only contributes to the advancement of sustainable wastewater treatment technologies but also promotes waste valorization, aligning with circular economy principles.

Key words: dye effluents, organic adsorbents, physio-adsorption, water contamination

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