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Equilibrium and kinetic modeling for the removal of Turquoise Blue PG dye from aqueous solution by a low-cost agro waste

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ABSTRACT

The present study deals with the evaluation of cost-effective and abundantly available biomass of sugarcane bagasse for the removal of Turquoise Blue PG dye from aqueous solutions. The biosorbent was utilized in its native, modified, and immobilized forms. For the modification of biomass, it was treated with different acids, alkali, chelating agents, surfactants, and organic solvents. The experiments were conducted to assess the effects of process variables such as medium pH (5–9), biosorbent dose (0.05–0.30 g), contact time (0–180 min), initial dye concentration (10–200 mg/L), and temperature (30–60 °C). H_2SO_4-treated biomass was selected as potential-modified biosorbent for the removal of Turquoise Blue PG dye as it showed maximum biosorption capacity (69.73 mg/g). Biosorption process was favorable at pH 5 using low biosorbent dosage. Equilibrium was achieved in 120 min. The kinetic analysis showed that the pseudo-second-order model had the best fit to the experimental data. The Langmuir model provided the best fit for the experimental data of the equilibrium biosorption of Turquoise Blue PG onto sugarcane bagasse. Biosorption process was found to be endothermic in nature. The thermodynamic evaluation of Turquoise Blue PG biosorption on sugarcane bagasse revealed that the biosorption phenomenon under the selected conditions was a spontaneous physical process. Fourier transform infrared analyses demonstrated the involvement of different functional groups, mainly hydroxyl, carboxyl, and amine groups. Consequently, sugarcane bagasse was proved to be a very proficient, low-cost biosorbent, and a promising alternative for eliminating dyes from industrial effluents.

Keywords: Biosorption; Turquoise Blue PG; Sugarcane bagasse; Kinetic studies; Thermodynamics

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