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Preparation of the activated carbon from India shrub wood and their application for methylene blue removal: modeling and optimization

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ABSTRACT

In this article, we investigated the use of activated carbon (AC) obtained from India shrub wood for the removal of methylene blue (MB) from aqueous solutions. The properties of this adsorbent, such as BET surface area, pore volume and pores diameter, were characterized from N_2 adsorption isotherms. It was found that the prepared AC is essentially mesoporous, and that the BET surface area was 1,024 m^2/g. The experimental design was conducted based on a central composite design and the data were analyzed using response surface methodology. The biosorption process was investigated as a function of three independent factors viz. contact time, initial solution pH (2–10), and adsorbent dosage (0.2–1 g/L). Equilibrium isotherms were analyzed with Langmuir, Freundlich, and Dubinin–Radushkevich isotherm equations using correlation coefficients. Adsorption data were well described by the Langmuir model, although they could be modeled by the Freundlich as well. The maximum MB adsorption capacity of prepared AC was 257.73 mg/g. In order to test the experimental data, different kinetic models were applied. It was concluded that the pseudo-second-order kinetic model provided better correlation of the experimental data than other models. Thermodynamic parameters (ΔH°, ΔG°, and ΔS°) were determined and the adsorption process was found to be at the state between physical and chemical sorption, spontaneous, and an endothermic one.

Keywords: Adsorption; Isotherm; Activated carbon; Dye removal; Chemical kinetic; India shrub wood

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