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Removal of Rhodamine B and Methyl Violet Dyes by Jack Sawdust Activated Carbon-Simultaneous Analysis by the First-Order Derivative Spectra Method

Dilhari, M.A.R., Jayaweera, C.D.*

Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**dangolle@sjp.ac.lk*

Abstract

Rhodamine B and methyl violet are common targets in developing new methods for dye removal from contaminated water sources, due to their widespread use and potential environmental and health hazards. This study investigated the potential use of activated carbon derived from Jack sawdust (*Artocarpus heterophyllus*) to remove rhodamine B and methyl violet in a two-dye system as a sustainable and low-cost method for waste utilization. The activated carbon was prepared using Jack sawdust according to the selected best production conditions, considering particle size, carbonization temperature, and carbonization time. The prepared activated carbon was characterized using proximate analysis, FTIR, SEM, and BET analysis. The optimum conditions for the adsorption onto Jack sawdust-activated carbon (JSAC) were studied using batch adsorption experiments. The first-order derivative method was used for the simultaneous analysis of the residual concentration of each dye by overcoming the spectral overlapping. The best-activated carbon production conditions selected according to the iodine number were thirty minutes of carbonization at 400º C with 106 µm particle size. The BET surface area of JSAC was determined to be 1119.78 m^2 g^{-1}. The dye adsorption capacity of JSAC was evaluated for 0.50 g/L of adsorbent dose in 100.00 mL of 200 ppm dye solution at 30º C for 2 hours contact time, after its adsorption capacity reached equilibrium. For a single dye system, 87.24±1.02% removal of rhodamine B and 97.06±0.39% removal of methyl violet were observed whereas for the two-dye system containing both rhodamine B and methyl violet, 66.96% removal of rhodamine B and 37.22±4.8% removal of methyl violet were observed due to the competitive adsorption effect in the multi-component system. The observed results indicate that JSAC exhibits selective adsorption behavior, with a greater affinity for rhodamine B in mixed dye systems compared to methyl violet. The First-order derivative spectra method is a good method to evaluate the remaining concentration of each dye after adsorption without previous separation. The significant removal of rhodamine B and methyl violet indicates the potential of JSAC as a low-cost and efficient adsorbent for dye removal applications.

Keywords: *first order derivative spectra method, Jack sawdust, methyl violet, rhodamine B, simultaneous analysis*