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Aloe vera biomass containing cellulosic moieties used as sustainable adsorbents for the removal of crystal violet dye from aqueous solution

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ABSTRACT

A chemically treated *Aloe vera* adsorbent was prepared for the removal of hazardous crystal violet (CV) dye from an aqueous system. The chemically modified adsorbent and the adsorbent after uptake of CV dye were characterized by Fourier-transform infrared spectroscopy and scanning electron microscopy. Various physico-chemical parameters such as pH (2–10), contact time (15–180 min), adsorbent dosage (0.05–0.5 g), initial dye concentration (50–400 mg L^{-1}), and temperature (30°C–60°C) were investigated. These parameters were found to have a significant influence on the adsorption process. The maximum adsorption capacity of CV was found at pH 9. Adsorption isotherms (Langmuir, Freundlich and Temkin) and kinetic parameters (pseudo-first-order, pseudo-second-order and intraparticle diffusion) have been applied to the experimental data. The adsorption of CV onto treated *Aloe vera* was best represented by the Langmuir isotherm and followed the pseudo-second-order kinetic model. Thermodynamic calculations of free energy, enthalpy and entropy were carried out. These calculations showed that the adsorption process is spontaneous, endothermic and results in increased randomness in the adsorbent/adsorbate interface. *Aloe vera* waste has been applied as potential low-cost adsorbent for the removal of dyes from water and wastewater.

Keywords: *Aloe vera* waste; Cellulosic moieties; Crystal violet; Adsorption isotherm; Kinetic parameter; FTIR

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