Methylene Blue Adsorption onto Water Hyacinth: Batch and Column Study

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ABSTRACT

The adsorption of methylene blue cationic dye by water hyacinth root was studied in a batch system. The experimental data isotherms were analyzed using the Langmuir and Freundlich equations. The monolayer adsorption capacity for methylene blue dye was found as 0.187 kg kg^{-1}. Three kinetic models (the pseudo-first order, the pseudo-second order, and the unified approach) were used to calculate the adsorption rate constants. The kinetic data along with equilibrium constants (maximum monolayer capacity and Langmuir constant) fitted well with unified approach model for different initial concentrations, and the rate constants were determined. Laboratory column experiments were conducted to evaluate the performance of water hyacinth root for methylene blue sorption under dynamic flow conditions. Breakthrough curves were plotted for the methylene blue adsorption on the adsorbent using continuous flow column operation by varying the bed height (0.06–0.12 m) and the feed concentrations (0.1–0.2 kg m^{-3}). Different column design parameters, such as depth of exchange zone, adsorption rate, and adsorption capacity, were calculated. At the end, an attempt has also been made to model the data generated from column studies using the empirical relationship based on Bohart–Adams model.

KEYWORDS: Water hyacinth; Adsorption; Equilibrium; Kinetics; Adsorption column; Breakthrough curve

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