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Removal of crystal violet from aqueous solution using iron based metal organic framework

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ABSTRACT

Iron-benzene dicarboxylic acid (BDC) metal-organic framework (MOF) has been synthesized by solvothermal method at room temperature and tested for the adsorptive removal of the organic dye crystal violet from aqueous solution. Dye removal efficiency and adsorption characteristics were determined to investigate factors such as the effect of dye concentration, contact time, temperature, dose, and pH. Maximum dye removal efficiency was recorded to be 100% with an initial dye concentration of 5 mg/L. Langmuir, Freundlich, and Temkin adsorption isotherm models were used to investigate the adsorption process. The adsorption isotherm of crystal violet onto Fe-BDC-MOF can be described by Freundlich isotherm model and Langmuir isotherm model. Pseudo-second-order kinetic model with rate constant 1.22×10^{-2} g/mg.min is found to be the best fit for the adsorption. Thermodynamic parameters viz. free energy; enthalpy, and entropy have been calculated with the help of adsorption isotherm data. The values of enthalpy and entropy have been obtained as 0.0947 kJ/mol and 0.325 kJ/mol/K, respectively, indicating an endothermic process with an increase in randomness at the solid-solution interface during adsorption. Negative value of ΔG illustrates the process to be spontaneous. Column adsorption capacity of Fe-BDC-MOF has been recorded 26.65 mg/g.

Keywords: MOF; Crystal violet; Adsorption; Kinetics; Thermodynamics

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