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Treatment of Malachite green wastewater using walnut shell

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ABSTRACT

In this study, walnut shell (WS) was used to remove Malachite green (MG) from aqueous solutions through adsorption. Static experiments were performed to investigate the effects of different parameters including initial pH value, adsorbent dosage, contact time, and temperature on MG adsorption onto WS. It was found that both Langmuir and Freundlich isotherms could describe the equilibrium of MG onto WS. The maximum Langmuir adsorption capacity at 313 K was up to 1,477.33 mg g^{-1} WS. The removal efficiency was as high as 94.6% for 300 mg L^{-1} of MG concentration, pH = 6.0, a temperature of 303 K, and 6 g L^{-1} of WS dosage. Pseudo-second-order kinetics provided a better fit for the kinetic data of MG on WS. Intraparticle diffusion is an important rate-controlling step in the kinetic process, but it was not the only one. A method derived from the Langmuir equilibrium constant K_L was developed to determine the thermodynamic parameters, which proposes an endothermic spontaneous physisorption process. These findings imply that WS is a cost-effective, efficient, and very promising adsorbent for the treatment of MG wastewater.

Keywords: Walnut shell; Malachite green; Adsorption; Isotherm; Kinetics; Thermodynamics

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