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Regeneration of anthraquinone dye-loaded waste activated carbon by microwave heating and its reuse to adsorb dye-containing wastewater

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ABSTRACT

This study investigated the regeneration of waste activated carbon (AC) that contains anthraquinone dye, by microwave irradiation. The adsorption isotherm and adsorption kinetics were analyzed by batch adsorption experiments in which Methylene blue (MB) dye and Malachite green (MG) dye were chosen as the adsorbates. The effects of microwave heating power, heating temperature and holding time on the adsorption capacity of regenerated AC were investigated. The Brunauer–Emmett–Teller equation, scanning electron microscopy, X-ray photoelectron spectroscopy and Raman spectra were used to characterize spent waste AC and regenerated AC. The results showed that microwave heating efficiently preserved the porous structure of the regenerated AC to restore the original activation sites and adsorption capacity. The specific surface area of regenerated AC was 634.73 m^2/g, the maximum adsorption capacities of MB and MG were 265.65 and 366.89 mg/g, respectively, and the C–O functional groups on the surface of AC increased significantly. The adsorption isotherm was confirmed by the Langmuir isotherm, and the adsorption process could be accurately described by the pseudo-second-order kinetic model. In addition, the power consumption of microwave regeneration was significantly lower than that of traditional regeneration methods, which represented a significant improvement in adsorption chemistry.

Keywords: Waste activated carbon; Microwave heating; Anthraquinone dye; Regeneration; Adsorption

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