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Modification of activated carbon by the alkaline treatment to remove the dyes from wastewater: mechanism, isotherm and kinetic

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ABSTRACT

The present paper investigates the surface modification of activated carbon (AC) by alkaline (NaOH) and dye removal ability of the surface modified activated carbon (SMAC). Acid Red 14 (AR14) and Acid Blue 92 (AB92) were used as the dye models. The surface characteristics of SMAC were investigated using the Fourier transform infrared (FTIR), scanning electron microscopy (SEM), and surface area. The possible mechanism of the adsorption process and dye interaction with SMAC surface was analyzed. The effects of adsorbent dosage, initial dye concentration, and pH on the dye removal were investigated. The isotherm and kinetic of dye adsorption were studied. The adsorption isotherm of the dyes onto AC and SMAC followed Langmuir and Freundlich isotherms, respectively. The kinetic of dyes onto both AC and SMAC followed pseudo-second-order kinetic model. The results indicated that the alkaline (NaOH) treatment of AC was an efficient method to modify the AC. The maximum adsorption capacity (Q_{max}) of AR14 and AB92 was 2.50 and 0.69 mg/g onto AC and 9.17 and 11.77 mg/g onto SMAC, respectively. Dye desorption tests (SMAC regeneration) showed that the maximum dye release of 85% for AR14 and 83% for AB92 was achieved in an aqueous solution at pH 12. In addition, the SMAC could be used as an eco-friendly adsorbent to remove the dyes from colored wastewater.

Keywords: Surface modification; Activated carbon; Alkaline treatment; Dye removal; Isotherm and kinetic

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