Modification of activated carbons by HNO₃ and H₂O₂ for removal of methylene blue dye from aqueous solutions

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ABSTRACT

A commercial granular activated carbon (GAC-C) was used as raw adsorbent, and modified by nitric acid and hydrogen peroxide. The modified samples were named as GAC-N (nitric acid) and GAC-H (hydrogen peroxide). The optimum conditions of different modifiers were determined by single factor and orthogonal experiments, while the adsorption amount of methylene blue (MB) was used as the evaluation index. The modification could significantly improve the mesopore volumes of adsorbents, and introduce oxygen-containing functional groups on its surface, which played an important role in MB adsorption process. The optimum conditions for the two modifiers are consistent, that is, modification temperature = 90°C, modifier concentration = 2 mol/L, contact time = 4 h, and adsorbent dose = 0.2 g/mL. The MB adsorption capacities of GAC-C, GAC-N, and GAC-H were 22.44, 28.33, and 25.12 mg/g, respectively. The MB adsorption was a heterogeneous and monolayer process in which chemisorption was dominant. Moreover, the MB adsorption process followed the pseudo-second-order model. The intraparticle diffusion was the rate-controlling step.

Keywords: Oxidation modification; Activated carbons; Process optimization; Methylene blue dye; Adsorption

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