Co-influence of the pore size of adsorbents and the structure of adsorbates on adsorption of dyes

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**ABSTRACT**

To investigate the co-influence of the pore size of adsorbents and the structure of adsorbates on adsorption capacity and rate, the adsorption of basic dyes, methylene blue (MB), and crystal violet (CV) onto a granular adsorbent based on fly ash (GAF) and a granular activated carbon (GAC) were conducted. MB and CV were selected as the target adsorbates due to their similar molecular weights (MB: 319.85 g/mol and CV: 407.98 g/mol) but different molecular structures (MB is line-shaped and CV is fork-shaped). Two different kinds of adsorbents, GAF and GAC, were used here: GAF, a mesoporous adsorbent (average pore diameter $\approx 4.28$ nm) with small surface area (21.94 m$^2$/g), and GAC, a microporous adsorbent (average pore diameter $\approx 0.45$ nm) with high surface area (1,306 m$^2$/g). Although the surface area of GAC was almost 60 times of GAF, the results of adsorption showed the adsorption capacity of GAC for MB was only 1.5 times of GAF (354.59 mg/g of GAC and 262.58 mg/g of GAF), whereas the adsorption capacity of GAC for CV was even less than that of GAC (327.77 mg/g of GAC and 430.73 mg/g of GAF). Moreover, the $k_p$ values obtained from intra-particle diffusion theory showed that the adsorption rate of both MB and CV in GAF were far bigger than in GAC. Thus, when choosing an adsorbent, surface area is not only the parameter should be considered, the pore size of adsorbents and the structure of adsorbates should also be considered.

**Keywords:** Pore size; Adsorbate structure; Adsorption capacity; Methylene blue; Crystal violet

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