



## Removal of reactive dyes by a solid waste product from food processing: crayfish carapace

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### ABSTRACT

Crayfish carapace micropowder (CM), an economical and environmentally benign material, was used as adsorbents to remove reactive black 5(RB-5) and reactive yellow K-4G (RY-K4G) textile dye from aqueous effluents. The batch adsorption system was evaluated in relation to pH, ionic strength, contact time, initial dye concentration and temperature. Combined alkaline and acidic condition, the absorption capacity was enhanced. Ninety percent of the dyes could be removed by CM when the adsorption experiment was carried out under pH 10 for 2 h and then pH 2 for 30 min. The exothermic adsorption of both dyes onto CM was better fit by the pseudo-second-order kinetic. The adsorption isotherms of RB5 followed the Langmuir model, while that of RY-K4G fitted the Freundlich model, with their maximal adsorption capacity of 285 and 1299 mg g<sup>-1</sup> at pH 2 and 303 K. The possible mechanism was proposed that nucleophilic addition or substitution occurred between CM and reactive dyes under alkaline condition and then electrostatic adsorption appeared between CM and reactive dyes in the acid condition. The adsorption capacity of this low-cost adsorbent is much larger than other adsorbents. Meanwhile, the used adsorbents were successfully applied to adsorb a cationic dye directly at a particular condition in the secondary adsorption. CM can be an economical and promising adsorbent in the wastewater treatment.

*Keywords:* Crayfish carapace; Reactive dyes; Nucleophilic substitution or addition;  
Electrostatic adsorption; Secondary adsorption; Chitin

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