The Adsorption Kinetics and Isotherms of Removing Methylene Blue Dye with Chitosan

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ABSTRACT

In this study, adsorption experiments were carried out in batch process for the removal of methylene blue (MB) using chitosan prepared from fresh river shrimp shell (Macrobrachium rosenbergii). The chitosan was confirmed by FTIR and its degree of deacetylation (DD) was 67.98%. The factors affecting the adsorption process were solution pH, contact time and initial concentration. Experiment results showed that dye uptake was a rapid process and reached equilibrium in about 5 min at pH 10. The equilibrium data were analyzed by Langmuir and Freundlich isotherm models. The better fitting isotherm model was Langmuir. The maximum adsorption capacity of chitosan obtained from the Langmuir model was 76.92 mg/g. The adsorption kinetics corresponded to the pseudo-second order model. The results in this study indicated that chitosan was a good adsorbent for removing methylene blue.

Keywords: Kinetic adsorption, Methylene blue, Chitosan, Shrimp shell

INTRODUCTION

Many industries – including textile, paper, plastics and dyestuffs – are water-intensive and use chemicals and dyes. As result, they generate colored wastewater and pollute the environment. Methylene blue (MB) is a basic dye used in the textile industry. It can cause permanent injury to human eyes and gives rise to respiratory problems, while oral ingestion produces a burning sensation and may cause nausea, vomiting, profuse sweating, mental confusion and methemoglobinemia (Ghosh et al., 2002).

Adsorption is the most commonly used technique for decontaminating dye-containing effluents. Most commercial systems currently use activated carbons as an adsorbent because of their high adsorption capacity, large surface area and microporous structure, but they are expensive (Low et al., 2011) and activated carbons are difficult to generate (Sakkayawong et al., 2005). Considerable research in recent years has focused on finding a low-cost alternative (Bulut and Aidin, 2006; Hameed et al., 2008; Senturk et al., 2010; Santhi and Manonmani, 2011). Adsorption using agricultural waste products offers a new alternative for wastewater treatment (Ibrahim et al., 2006). Natural biodegradable waste materi-