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Removal of methylene blue using acid and heat treatment of clinoptilolite

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ABSTRACT

The adsorption of methylene blue from aqueous solution onto clinoptilolite has been studied under various experimental conditions. Heat treatment and acid treatment have also been applied to modify the clinoptilolite. It is found that heat treatment and acid treatment can significantly change the adsorption capacity. The treatment of clinoplites has the higher adsorption capacity than untreated ones. The adsorption data have been analyzed using Langmuir and Frendlich isotherms. The results indicate that the Langmuir model provides the better correlation of the experimental data. Isotherms have also been used to obtain the thermodynamic parameters such as free energy, enthalpy and entropy of adsorption. For heat treatment of clinoptilolite, adsorption of methylene blue is endothermic reaction with ΔH_{ads} at 50.67 kJ/mol.

Keywords: Clinoptilolite; Methylene blue; Adsorption; Modify

1 Introduction

Dye, a constituent that is widely used in textile, paper, plastic, food and cosmetic industries is an easily recognized pollutant. It is not only aesthetically displeasing, but also impedes light penetration in the treatment processes within the treatment plant. It also increases the BOD, and cause lack of dissolved oxygen to sustain aquatic life. In addition, many dyes are toxic to some microorganisms, and may cause direct destruction or inhibition of their catalytic capabilities [1]. Its presence, even in very low concentration, is highly visible and will affect aquatic life as well as food web. Many dyes are difficult to degrade, as they are resistant to aerobic digestion [2]. Hence, contaminations due to dyes pose not only a severe public health concern, but also many serious environmental problems because of their persistence in nature and non-biodegradable characteristics.

The conventional methods of color removal from industrial effluents include ion exchange, activated carbon adsorption, membrane technology and coagulation [3]. Adsorption has been used extensively in industrial processes for many purposes of separation and purification. The removal of colored and colorless organic pollutants from industrial wastewater is considered as an important application of adsorption processes using suitable adsorbent [4–6].

At present, there is growing interest in using low cost, commercially available materials for the adsorption of dyes. A wide variety of materials such as fly ash [7], peat, phenolic resin, wood, maise cob, natural clays, activated sludge, wood chips, jift, palm-fruit bunch particles, nanosize modified silica, sugar beet pulp, activated carbon from fertilizer waste, olive mill products and diatomaceous silica, are being used as low cost materials for the adsorption of dyes [8]. Gupta et al. have made major contribution in this aspect [9–11]. They have studied the adsorption of dyes by a wide variety of materials such as bottom ash [12–15],

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