



A batch study of adsorption equilibrium and kinetic for methylene blue onto synthesized zeolite

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Received 26 Apr 2016,

Revised 24 Nov 2016,

Accepted 08 Dec 2016

Keywords

- ✓ Synthesized zeolite (ZS),
- ✓ Methylene blue (MB),
- ✓ Linear,
- ✓ Non-linear regression,
- ✓ Kinetic adsorption,
- ✓ Error estimation,
- ✓ Regression coefficient (R^2)

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Abstract

Synthesized zeolite (SZ) was characterized by nitrogen adsorption-desorption experiments (specific surface area measurements by the BET method), by XRD, and used for the methylene blue (MB) adsorption in synthesized water. The BET surface area (S_{BET}) was 509.9637 m²/g. The XRD indicated the formation of zeolite Y. Kinetic adsorption of methylene blue (MB) onto synthesized zeolite (SZ) was studied in a batch system. The effects of pH and contact time were examined. The maximum adsorption occurred at pH 7. The plateau of the equilibrium state was obtained after 60 min. In order to determine the best-fit-kinetic adsorption, the experimental data were analyzed using pseudo-first-order, pseudo-second-order, pseudo-third-order, esquivel, and elovich models. Linear regressive and non-linear regressive methods were used to obtain the relative parameters. The error analysis was calculated to find which method was better to fit the experimental data. The non-linear pseudo-second order model was best to fit the equilibrium data. The value of free energy (ΔG) was also determined. The present work showed that SZ can be used as a low cost adsorbent for the MB removal from water.

1. Introduction

The textile industry is one of industrial waste water source. This contaminated water is very toxic for the human and animals [1]. Methylene blue (MB) is used in coloring paper, dyeing cottons, wools, silk, leather and coating for paper stock. Although methylene blue is not strongly hazardous, it can cause some harmful effects, such as heartbeat increase, vomiting, shock, cyanosis, jaundice, quadriplegia, and tissue necrosis in humans [2]. The test, application and development of many treatment methods were the essential subjects of many articles such as: physical, chemical, biological [3]. Chemical coagulation-flocculation [4] different type of oxidation processes [5] biological process [6], membrane-based separation processes [7] and adsorption [8] were the treatments used in the purification of waters.

The best efficient method used for the quickly removal of dyes from the aqueous solution is the physical adsorption [9]. In this case, activated carbon has been proven to be widely used adsorbent for lowering the concentration of dyes in waste water, but it presents some disadvantages such as: flammability [10], less regenerability at low temperature [11-12], weak hydrophobicity [13] ...

Actually, the best alternative to carbon adsorbent is zeolite [10]. Recently, commercial zeolites have been used to remove the dissolved pollutants in water and/or wastewater [14]. However, there are relatively limited studies done on the cationic dyes adsorption by synthesized zeolites [15]. In this work, we are interesting to the potential of SZ for the MB dye removal from simulated waste water using batch method. To optimize experimental variables (such as: pH and contact time), the adsorption kinetic efficiency of MB was studied. Linear and non-