Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2020.25430

188 (2020) 247–256
June

Preparation of tobermorite onto flux-calcinated diatomite surface and the adsorption properties and mechanism of methylene blue

Mingyang Li[a], Zijie Ren[a,b], Huimin Gao[a,b,*], Anling Zhang[a], Zhiming Sun[c]

[a]*School of Resources and Environmental Engineering, Wuhan University of Technology, Wuhan 430070, China, Tel. +86-027-13971465349; email: gaohuimin1958@126.com (H. Gao), Tel. +86-0391-15716529132; email: 2330843886@qq.com (M. Li), Tel. +86-027-15071403704; email: renzijie@whut.edu.cn (Z. Ren), Tel. +86-027-18369956020; email: zhanganling@whut.com (A. Zhang)*
[b]*Hubei Key Laboratory of Mineral Resources Processing and Environment, Wuhan 430070, China*
[c]*School of Chemical and Environmental Engineering, China University of Mining and Technology, Beijing 100083, China, Tel. +86-010-13466774499; email: zhimingsun@cumtb.edu.cn (Z. Sun)*

Received 22 July 2019; Accepted 29 December 2019

ABSTRACT

A diatomite-based composite adsorbent with multifunctional structures was prepared using calcinated diatomite as the raw material and CaO as the agent, where conventional hydrothermal alkaline activation was employed. The procedure resulted in a highly functionalized, porous adsorbent, whose the structure and morphology, as well as its adsorption properties on methylene blue (MB) were characterized with Fourier-transform infrared spectra, scanning electron microscope, X-ray diffraction, Brunauer–Emmett–Teller measurements. Various adsorption conditions, including adsorbent dosage, contact time, contact temperature, initial MB concentration, and pH was considered. The adsorption kinetic and thermodynamic models, and static adsorption isotherms were investigated. The tests illustrated that the highest MB absorption capacity was under higher temperature and strong alkaline conditions, which accorded with the Langmuir adsorption isotherm model and the pseudo-second-order kinetic model. The whole adsorption process was governed by physical adsorption with an endothermic spontaneous nature. The adsorption of MB molecules may be attributed to electrostatic interaction and hydrogen bonding attraction. The results indicate that the modified diatomite has great potential as an alternative low-cost material in much wider industrial application.

Keywords: Calcinated diatomite; Adsorbent; Methylene blue; Hydrothermal alkaline activation

* Corresponding author.