Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2022.28261

252 (2022) 276–286
March

2,4-Dichlorophenol removal from water by walnut shells-based biochar

Xuan Zhou[a], Xinyuan Li[a], Li Guo[a], Xiuying Liu[b,*], Yangshuo Liu[c,d,e,*]

[a]*School of Chemistry and Environmental Engineering, Wuhan Institute of Technology, 430205, China, emails: hbzhoux@sina.com (X. Zhou), ynlxy06@163.com (X. Li), liguo@whu.edu.cn (L. Guo)*
[b]*School of Chemistry and Chemical Engineering, Wuhan Textile University, Wuhan 430073, China, email: liuxiuying@wtu.edu.cn*
[c]*Key Laboratory of Advanced Textile Materials and Manufacturing Technology, Ministry of Education (Zhejiang Sci-Tech University), Hangzhou 310018, China, email: liuyangshuo8858@163.com*
[d]*Zhejiang Provincial Key Laboratory of Fiber Materials and Manufacturing Technology (Zhejiang Sci-Tech University), Hangzhou 310018, China*
[e]*State Key Laboratory of New Textile Materials and Advanced Processing Technologies, Wuhan Textile University, Wuhan 430073, China*

Received 2 August 2021; Accepted 21 January 2022

ABSTRACT

Walnut shell, as a biomass waste, was used as material to prepare walnut shell biochar (WSB), nitrogen-doped biochar (NB), Hummers-modified biochar (HB), and alkali-activated biochar (AB). The biochars were used as adsorbents for the removal of the hazardous and poorly degradable 2,4-dichlorophenol (2,4-DCP) in water. The structures and morphologies of the biochars were analyzed by Raman spectra, Fourier transform infrared spectroscopy, and scanning electron microscopy. The pore structures of AB and WSB were compared using Brunauer–Emmett–Teller analysis and AB had shown a mesopore structure with a smaller pore size and larger specific surface area. The adsorption behaviors of 2,4-DCP on WSB, NB, HB, and AB were studied. The adsorption followed the pseudo-second-order kinetic model and Langmuir isotherm model indicating chemical and monolayer adsorption process. The adsorption mechanism was discussed. AB exhibited the highest removal rate for 2,4-DCP (96.5%) and adsorption capacity (240.4 mg/g), due to its larger specific surface area and the aromatic compounds formed during pyrolysis. The removal rate was 4.2 times that of the commercial activated carbon. In brief, AB had the potential to be applied as a low-cost and effective adsorbent for 2,4-DCP removal from water. This present work will provide a foundation for the treatment of chlorophenol pollutants in wastewater and for the resource utilization of walnut shells.

Keywords: Walnut shell; Biochar; Adsorption; 2,4-Dichlorophenol; Modification

* Corresponding authors.