Hydrated ferric oxide (HFO)-encapsulated tea waste for enhanced lead(II), cadmium(II), and copper(II) removal from waters

Shunli Wan*, Guobin Liu, Hai He, Nan Qu, Zhaozhao Ma, Yao Xue

College of Life & Environmental Sciences, Huangshan University, Huangshan 245041, P.R. China, Tel. +86 559 2546552; emails: wsl@hsu.edu.cn (S. Wan), 1243296689@qq.com (G. Liu), 835082635@qq.com (H. He), 2200926335@qq.com (N. Qu), 2356825202@qq.com (Z. Ma), 1309596583@qq.com (Y. Xue)

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ABSTRACT

Hydrated ferric oxide (HFO) was impregnated successfully within tea waste by precipitation, and a novel hybrid adsorbent named HFO–TW was prepared. The sorption characteristics of HFO–TW toward Pb(II), Cd(II), and Cu(II) in aqueous solution were investigated. HFO–TW was characterized by X-ray diffraction and Fourier transform infrared analysis. Three heavy metals sorption onto HFO–TW is pH-dependent, and the higher pH value is more helpful for sorption at evaluated pH range. HFO–TW can exhibit strong sorption selectivity toward three metal ions, and the removal efficiencies fall only 21% for Pb(II), 34% for Cd(II), and 10% for Cu(II) in the presence of competing ions Ca(II), Mg(II), and Na(I) at concentration 50 times higher than target metal ions. The maximum sorption capacities calculated by Langmuir equation for Pb(II), Cd(II), and Cu(II) removal onto HFO–TW are 87.84, 26.01, and 22.97 mg/g, respectively. The sorption process of three heavy metals could approach equilibrium within 60 min. Both the sorption capacities and speed of three heavy metals by HFO–TW have improved significantly compared to the host tea waste. The kinetics curves could be fitted well by the pseudo-second model and the related coefficients were all higher than 0.97. In addition, the experiment results of initial concentration influence and column sorption runs further validated that HFO–TW was more appropriate for heavy metals removal of low concentration. All the results indicated that the modification of tea waste by loading HFO was a great promotion for tea waste application toward heavy metals removal.

Keywords: Hydrated ferric oxide; Heavy metal; Tea waste; Adsorption; Application

*Corresponding author.