Adsorption of chromium(VI) from saline wastewater using spent tea-supported magnetite nanoparticle

Ali Akbar Babaeia,b, Mehdi Ahmadi,a,b, Gholamreza Goudarzi,a,b, Nemat Jaafarzadeh,a,b, Zeynab Babolic,

aEnvironmental Technologies Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, Tel. +98 61 33738269; emails: babaei-a@ajums.ac.ir (A.A. Babaei), ahmadi241@gmail.com (M. Ahmadi), rgoodarzy@gmail.com (G. Goudarzi), n.jaafarzade@yahoo.com (N. Jaafarzadeh)
bDepartment of Environmental Health Engineering, School of Public Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

cBehbahan Faculty of Medical Sciences, Department of Environmental Health Engineering, School of Public Health, Behbahan, Iran, Tel. +98 61 52887201; Fax: +98 61 52887232; email: baboliz87@gmail.com

Received 4 October 2014; Accepted 4 May 2015

ABSTRACT

Spent tea-supported magnetite (ST/Mag) nanoparticles were synthesized as an adsorbent for the removal of hexavalent chromium [Cr(VI)] from saline wastewater. Prepared ST/Mag adsorbent was characterized using X-ray diffraction, scanning electron microscopy, and Fourier transform infrared spectroscopy. Various factors affecting the uptake behavior such as pH, contact time, initial concentration of metal ions, adsorbent dose, coexisting ions, and desorption behavior were studied using batch tests. The results revealed that adsorption of Cr(VI) was highly pH dependent and the kinetics of the adsorption followed by the Avrami fractional-order and pseudo-second-order kinetic models. The results showed that the adsorption isotherms were more accurately represented by Langmuir and Liu isotherm models with a sorption capacity of 30.0 mg g$^{-1}$. Adsorption experiments with co-ions indicated that the adsorptive removal of Cr(VI) ions was slightly decreased. Desorption studies using alkaline eluents showed maximum recovery of ST/Mag and only 10% decrease occurring in maximum adsorption capacity after five cycles. The ST/Mag nanoparticles proved to be a very prospective adsorbent for Cr(VI) uptake from industrial high-TDS effluents.

Keywords: Chromium(VI); Spent tea-supported magnetite nanoparticles; Adsorption; Saline wastewater

*Corresponding author.