Rapid removal of aqueous Cr(VI) and the removal mechanism using ZVI/Fe$_3$O$_4$/Fe$^{2+}$ system

Long Zhang, Fenglian Fu*, Zecong Ding, Jiabin Pang

School of Environmental Science and Engineering, Guangdong University of Technology, Guangzhou 510006, China, email: fufenglian2006@163.com (F. Fu)

Received 31 March 2017; Accepted 4 August 2017

**ABSTRACT**

The treatment of chromium wastewater is a global environmental issue. In this paper, the influencing factors such as initial pH and Fe$^{2+}$ concentration on the removal of Cr(VI) by the zero-valent iron (ZVI)/Fe$_3$O$_4$/Fe$^{2+}$ system were studied. The comparison of Cr(VI) removal by hybrid ZVI/Fe$_3$O$_4$/Fe$^{2+}$ system, non-hybrid, and partial-hybrid systems were studied. Fe(II)/Fe, and Fe(III)/Fe, changes, and Cr(III) concentration change were also investigated. X-ray powder diffraction, Fourier transform infrared spectroscopy, and X-ray photoelectron spectroscopy were used to study the reaction mechanism between Cr(VI) and the ZVI/Fe$_3$O$_4$/Fe$^{2+}$ system. The removal of Cr(VI) was accelerated with the increase of Fe$^{2+}$ concentrations and decrease of initial pH. Cr(VI) from synthetic wastewater reduced from initial 20.0 to 0.1 mg/L in 30 min by 2.5 g/L ZVI, 2.5 g/L Fe$_3$O$_4$, and 0.4 mM Fe$^{2+}$ at initial pH 3.0. At initial pH value of 3.0, Fe(II) and Fe(III) generation–consumption–regeneration cycle in the ZVI/Fe$_3$O$_4$/Fe$^{2+}$ system was studied. The characterization of the ZVI/Fe$_3$O$_4$ after the reaction revealed that the removal of Cr(VI) is a complex process including surface adsorption and reduction. This study demonstrates that the ZVI/Fe$_3$O$_4$/Fe$^{2+}$ system has a great potential to be applied in treating wastewater containing Cr(VI).

Keywords: ZVI/Fe$_3$O$_4$/Fe$^{2+}$; Cr(VI); Removal mechanism

* Corresponding author.