Removal of Cr(VI) from wastewater by supported nanoscale zero-valent iron on granular activated carbon

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ABSTRACT
Granular activated carbon supported nanoscale zero-valent iron (GAC–nZVI) was synthesized using liquid-phase reduction and adopted to remove Cr(VI) from wastewater. Batch experiments were used to evaluate the factors impacting Cr(VI) removal and showed that nZVI–GAC mass ratio, GAC–nZVI dosage, initial Cr(VI) concentration and pH value were all important factors. The nZVI–GAC mass ratio was optimized at 1:10 and GAC–nZVI dose was 6.0 g/L. Lower pH and initial Cr(VI) concentration could increase the Cr(VI) removal efficiency. After treatment, the residual total chromium concentration determined by flame atomic absorbance spectrometer equals to the Cr(VI) concentration determined by 1,5-diphenylcarbazide method using UV–vis spectrophotometer. This study demonstrates that the GAC–nZVI has the potential to become an effective agent for the removal of Cr(VI) from wastewater.

Keywords: Hexavalent chromium; Nanoscale zero-valent iron; Granular activated carbon; Supported

1. Introduction
Chromium is widely applied in industrial processes, such as leather tanning, electroplating, metal processing, film and mining of chrome ore. Chromium exists in mainly as Cr(VI) and Cr(III) oxidation states in the natural environment. Hexavalent chromium (Cr(VI)) is one of the most toxic and carcinogenic contaminants. In China, it is considered as one of priority controlled pollutants in water. However, Cr(III) is much less toxic and immobile and could be a nutrient for human at low concentrations. Due to toxicity, Cr(VI) must be removed from wastewaters prior to discharge into aquatic environments.

A number of treatment processes on the removal of Cr(VI) have been developed including chemical reduction [1–3], physicochemical adsorption [4,5], bioremediation [6–8], ion exchange [9,10], electrocoagulation [11], etc. Among these technologies, the use of zero-valent iron (ZVI) for chemical reduction of Cr(VI) has attracted increasing attention due to its effectiveness, rapid removal and applicability under different conditions, operational simplicity and low-cost [12–14]. It is appreciable evidence that nanoscale zero-valent iron (nZVI) particles, due to extremely high surface area, are more reactive than microscale powders and can enhance the reduction rates remarkably.