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Preparation of chitosan-loaded zero-valent iron-coated quartz sand and study of its ability to remove Cr(VI) in groundwater

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ABSTRACT

Hexavalent chromium [Cr(VI)] pollution has attracted intense interest in research on heavy metal pollution removal. Here, quartz sand chitosan zero-valent iron (QS-CTS@ZVI) was prepared as a permeable reactive barrier (PRB) medium material by using PRB permeable reaction wall technology and modified CTS-loaded ZVI-coated quartz sand. Characterization analyses were performed with scanning electron microscope, X-ray diffraction, Fourier-transform infrared spectroscopy and thermogravimetry-differential scanning calorimetry. The effects of the reaction time, reaction temperature, initial solution pH, initial Cr(VI) concentration, adsorbent dosage, interfering ions and adsorption cycle on the adsorption of Cr(VI) and total Cr on QS-CTS@ZVI were examined. Then, the adsorption of Cr(VI) by QS-CTS@ZVI was investigated. The results showed that for a ZVI:CTS ratio of 1:1 (m:m), a QS:ZVI ratio of 1:2 (m:m), a pH of 3, t = 5 h, an initial Cr(VI) concentration of 200 mg/L, a QS-CTS@ZVI dosage of 3.5 g/L, and T = 25°C, the efficiencies of Cr(VI) and total Cr removal by QS-CTS@ZVI were 91.6% and 90.9%, respectively. The adsorption efficiency of QS-CTS@ZVI for Cr(VI) was approximately 80% after three reuses. The coexistence of SO_4^{2-} in water can significantly inhibit the Cr(VI) adsorption and removal process. The process of adsorption of Cr(VI) by QS-CTS@ZVI conformed to the pseudo-second-order kinetic equation and the Langmuir adsorption isotherm model.

Keywords: QS-CTS@ZVI composite; Hexavalent chromium; Total Cr; Groundwater

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