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Kinetics of selenite reduction by zero-valent iron

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ABSTRACT

Zero-valent iron (ZVI) is an inexpensive agent that can remove many common environmental contaminants. The effects of dissolved oxygen (DO), pH, initial selenite concentration (Se(IV)), ZVI dosage and particle size as well as reaction temperature on Se(IV) removal by ZVI were systematically investigated in this study. Se(IV) removal by ZVI was more favored under oxic conditions with higher reaction rate than under anoxic conditions, ascribing to the promoted ZVI corrosion rate in the presence of DO. Moreover, Se(IV) removal by ZVI was enhanced with increasing ZVI dosage and reaction temperature but decreased with increasing pH and ZVI particle size. The removal rate of Se(IV) by ZVI experienced an increase and then a decrease with initial Se(IV) concentration ranging from 9.9 to 78.6 mg L^{-1}. To further describe the reaction rate, a pseudo-first-order kinetics was employed, and the calculated activation energy, by fitting the rate constants at different temperatures, was determined to be 32.86 kJ mol^{-1}. When fixing other conditions, good linear correlation could be observed between pseudo-first-order reaction rate constants (k_{obs}) and ZVI dosage. Compared with other methods for Se(IV) removal reported in literatures, reduction by ZVI was considered a promising technique, which could rapidly and effectively eliminate Se(IV) from waters.

Keywords: Selenite; Zero-valent iron; Kinetics; Activation energy; Reduction

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