Cr(VI) removal from aqueous solution using nano-ZVI-materials

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The removal of Cr(VI) from aqueous solutions was tested using zeolite, vermiculite, bentonite and attapulgite supported nanoscale zero-valent iron (nZVI) synthesized by the sodium borohydride reduction method. The XRD method was used for the characterization of nZVI-materials. XRD results indicated the difference between swelling and non-swelling minerals and the presence of Fe(0) and iron (hydro)oxide precipitation on the mineral surface. The proposed mechanism includes Cr(VI) to Cr(III) reduction and Cr(III) and Fe(III) (hydro)oxide (co)precipitation. The determinant factor of Cr(VI) reduction was found to be the pH, with the optimum value of 3. Bentonite exhibited the highest Cr(VI) removal efficiency due to the decreasing of Fe(0) nanoparticles aggregation. Thus, an amount of 10 g L^{-1} of nZVI-bentonite achieved 100% Cr(VI) removal of an initial concentration 50 mg L^{-1}, while an amount of 50 g L^{-1} of the three remaining materials was required for roughly the same performance. Kinetics studies showed that the process is better described by Lagergren pseudo first-order model (R^2=0.9913). Consequently, the results of this study demonstrate the excellence and suitability of nZVI-bentonite mineral for Cr(VI) removal from aqueous solutions.