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The influence of nitrate on the reduction of hexavalent chromium by zero-valent iron nanoparticles in polluted wastewater

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ABSTRACT

Hexavalent chromium, Cr(VI), still represents in several areas in Europe one of the groundwater pollutants of major concern, mainly due to its high toxicity, even enhanced by the synergic effect in the presence of other groundwater contaminants, such as nitrate. In this work, experimental tests of hexavalent chromium reduction in polluted groundwater in the presence of nitrate by nanoscale zero-valent iron (nZVI) particles are presented and discussed. The effect of nitrate on process mechanism was investigated and a kinetic model was proposed. nZVI produced by iron sulfate heptahydrate reduction with sodium borohydride was stabilized by carboxymethyl cellulose, and added to synthetic solutions at different nitrate contents. Results show that nitrate exerts an adverse effect on Cr(VI) reduction, depending on nZVI/Cr(VI) and Cr(VI)/NO_3^- ratio. Though hexavalent chromium reduction resulted slightly enhanced at low nitrate concentration (up to 1.5 nZVI/Cr(VI) molar ratio), as a consequence of the increase of the ionic strength of the solution, a significant decrease was observed at high nitrate level (up to a 25% at Cr(VI)/NO_3^- molar ratio equal to 1.2 with an nZVI/[Cr(VI) + NO_3^-] molar ratio equal to 1), due to the competitive effect in the reaction with nZVI. In both cases, experimental data were successfully fitted by a pseudo-first-order kinetic until iron surface passivation determined nanoparticles deactivation.

Keywords: Water treatment; Hexavalent chromium; Nitrate; Nanotechnologies; Zero-valent iron

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