REMOVAL AND INACTIVATION OF WATERBORNE VIRUSES USING ZEROVALENT IRON

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ABSTRACT

Waterborne viruses are of great concern regarding drinking water safety because they are not always effectively removed by water treatment processes such as filtration and chlorination. Iron (oxyhydr)oxides are known to remove viruses from water, which suggests the potential of using zerovalent iron (ZVI) as a precursor of iron oxides to remove waterborne viruses. In this study, the mechanisms for virus removal and inactivation by ZVI and effect of dissolved organic matter (DOM) on the removal of viruses by ZVI were investigated through batch and column experiments using two bacteriophages, ϕX174 and MS2, as model viruses. Batch experimental results indicated that removal of viruses from water by ZVI under anaerobic conditions was achieved through interactions of viruses with iron corrosion products, including aqueous Fe(II) and magnetite. Aqueous Fe(II) inactivated ϕX174 but had no effect on MS2. Magnetite removed both viruses, where the removal of MS2 was mainly via reversible sorption, and for ϕX174 the removal was due to both inactivation (or irreversible sorption) and reversible sorption. Column experimental results showed that DOM decreased virus removal by ZVI and that this effect was much more significant at 2.41 ppm dissolved organic carbon (DOC) compared to 0.34 ppm DOC. Competitive adsorption of DOM for the same adsorbing sites of iron corrosion products and DOM-facilitated virus transport are likely mechanisms responsible for the decreased virus removal observed in this study. Results from this study suggest that removal and inactivation of viruses by ZVI occur through multiple mechanisms involving different iron species, such as Fe(II) and magnetite. Different viruses may

interact with iron species differently and hence are susceptible to inactivation to different extents. When ZVI is applied as a medium to treat viruses in water, pretreatment of DOM needs to be conducted to minimize its adverse effect on virus removal efficiency of ZVI.