Sulfur-modified Nanoscale Zero-valent Iron (S-nZVI) for Reductive Dechlorination of Perchloroethene (PCE) and Dichloroethenes (DCEs)

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Chlorinated solvents are among the most commonly detected and persistent contaminants in the underground environment. Nanosized or bulk-scale zero-valent iron (ZVI) was widely researched and applied in the field for groundwater remediation, and recent studies show that amending nZVI with sulfur enhances the efficiency in trichloroethene (TCE) degradation. In this study, we investigate the degradation rates of other common chlorinated solvents such as perchloroethene (PCE) and dichloroethenes (DCEs) using sulfur-amended nano-ZVI (S-nZVI). Experiments were conducted in batch reactors and the reaction intermediates and products were analyzed with gas chromatography. The experimental results indicate that the rates of PCE, cis-DCE, trans-DCE, and 1,1-DCE degradation were accelerated by 2 to 10 folds when S-nZVI was used in place of the unmodified nZVI, suggesting the enhancement effect varies with different chlorinated contaminants. Increasing the sulfur dosage (i.e., the S/Fe ratio increasing from 0.0013 to 0.5) has a moderate effect on the reaction rates. Overall, sulfur-modification of nZVI results in improved abiotic dechlorination efficiency of all Chloroethenes, but the positive effects on PCE and DCEs are less significant than that on TCE.

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