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Enhanced reductive dechlorination of 1,1,1-trichloroethane by FeS with trace metals and sulfide

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Experiments were conducted to evaluate the effect of trace metals and sulfide on the reductive dechlorination by FeS using a batch reactor system in this study. FeS is one of meta-stable phase iron sulfides with the chemical formula of $Fe_{1+x}S$, where $0 < x < 0.07$. It is one of abundant minerals found in reduced soil and sediment environments and have been believed to play an important role in reducing chlorinated organic compounds. 1,1,1-trichloroethane (1,1,1-TCA) was used as an target compound because of its frequent appearance in the National Priority List sites of the United States. The addition of trace metals (Ni(II) and Co(II)) in the range of 1 to 10 mM was effectively improved the reactivity of FeS in reductive dechlorination of 1,1,1-TCA in this study. Although 1 mM of Ni(II) and Co(II) was not significantly increased the reaction rate, it was observed that the reaction rates were linearly increased with increasing trace metal concentrations. The removal efficiency of 10 mM Ni(II) addition into 33 g/L FeS suspension was shown to be three times higher compared to that of no Ni(II) addition, while the addition of 10 mM Co(II) increased the reaction rate by a factor of 4.6. This indicates that the addition of Co(II) was more reactive than the addition of Ni(II). The effect of hydrosulfide (HS^-) addition to FeS on the reductive dechlorination was also investigated in the range from 5 to 20 mM. As the concentration of hydrosulfide increased (5 – 20 mM), the removal efficiency of 1,1,1-TCA increased from 66 to 93% in 9 d. However, no linearity between the reaction rate and hydrosulfide concentration was observed. The reaction rate at 20 mM hydrosulfide was observed to be 10 times faster compared to that without hydrosulfide. The research shows that the addition of trace metals and hydrosulfide was effectively improved the reactivity of FeS and the results of this study will provide good understanding of reductive dechlorination by

FeS in the presence of trace metals and sulfide in soil and groundwater environments.