Reduction and Immobilization of Radionuclides and Toxic Metal Ions Using Combined Zero Valent Iron and Anaerobic Bacteria

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Research Objectives

Large groundwater plumes contaminated with toxic metal ions, including radionuclides, exist at several DOE facilities. Previous research indicated that both zero valent iron and sulfate reducing bacteria can yield significant decreases in concentrations of redox sensitive metals and radionuclides due to abiotic and biotic reduction, respectively. The major hypothesis of this research is that a combined abiotic-biological system can synergistically combine both processes to maximize metal ion reduction in an engineered permeable reactive barrier. The second major hypothesis is that design of either in situ or ex situ metal ion reduction processed based on biotic, abiotic or combined abiotic/biotic reduction scheme requires a more thorough understanding of the rates of the reaction and quantification of the parameters which impact the rates of reduction. A natural corollary to this hypothesis is that this increased understanding must also include quantification of parameters or parameter levels which inhibit either the biotic or abiotic process. The overall goal of this project is to design a combined abiotic/biotic, reactive, permeable, in situ barrier with sufficient reductive potential to prevent downgradient migration of toxic metal ions.

Research Progress

Successful completion of this goal required evaluating (1) the kinetics of abiotic metal ion reduction under a range of environmental conditions and (2) the kinetics of biotic processes under a range of environmental conditions.