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RDX degradation using an integrated Fe(0)-microbial treatment approach

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ABSTRACT

RDX is a persistent and highly mobile groundwater contaminant that represents a major remediation challenge at numerous munitions manufacturing and load-assemblage-package facilities. This work presents proof of concept that permeable reactive iron barriers might be a viable approach to intercept and degrade RDX plumes. Specifically, RDX was rapidly reduced in aquifer microcosms amended with Fe(0) powder, and in flow-through columns packed with steel wool. The rate and extent of RDX degradation in microcosms was enhanced by anaerobic bacteria that feed on cathodic hydrogen (i.e., H_2 produced during anaerobic Fe(0) corrosion by water). Apparently, the hydrogenotrophic consortium that exploits Fe(0) corrosion as a metabolic niche participated in the further degradation of heterocyclic intermediates produced by the reaction of RDX with Fe(0). Reductive treatment of RDX with Fe(0) also reduced its toxicity to microorganisms and enhanced its subsequent biodegradability under either anaerobic or anaerobic conditions. Therefore, a combined or sequential Fe(0)-biological treatment approach might improve treatment efficiency.