Effects of Peroxydisulfate Oxidation on Biodegradation of Perchlorethene

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Current remediation approaches to clean sites contaminated by chlorinated solvents rely to a certain extent on biodegradation, which is a sensitive natural process depending mainly on the innate microbial capacity to process the pollutants. It may be irretrievably damaged when an abiotic oxidizing agent, such as peoxydisulfate, is applied incorrectly. Insufficient understanding of interactions between the oxidizing agent and subsurface ecosystems, already damaged by chlorinated solvents, is the basic knowledge gap limiting remediation performance. Thus, through this current work the impact of an oxidant on microbial inoculum isolated from a site contaminated by chlorinated ethenes was investigated.

The batch experiments were carried out in the dark at 13°C for 14 to 22 days. Sodium peroxydisulfate was used as a strong oxidant, without an activation and then activated using Fe(II) chelated by citric acid and alkaline activation using YXPER. Perchlorethene was used as a model contaminant. Different molar ratios of peroxydisulfate/perchlorethene/activator were used. While testing the impact of the oxidant on the inoculum, also the ability of the inoculum to degrade perchlorethene was studied. The removal efficiency of the contaminants was measured using static headspace GC-FID. Capillary electrophoresis was employed to measure the changes in peroxydisulfate and sulfate ions concentrations. The tested inoculum was characterized by quantitative polymerase chain reaction.

Results have shown the high removal efficiency of perchlorethene in the systems with peroxydisulfate activated with Fe(II) chelated by citric acid. The removal efficiency in systems with non-activated and YXPER activated peroxydisulfate was low. The expected negative effect of peroxydisulfate on microbial inoculum was detected in the systems with high peroxydisulfate concentration ($\geq$ 500 $mg.L^{-1}$), inversely in the systems with peroxydisulfate concentration < 500 $mg.L^{-1}$ inoculum recovery was observed. Moreover, the microbial inoculum had affected the peroxydisulfate activation and the efficiency of perchlorethene removal. The tested inoculum exhibited poor PCE removal efficiency.