IN SITU TREATABILITY TESTING OF REDUCTIVE DECHLORINATION IN WETLAND SEDIMENTS

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In situ treatability testing was conducted in the discharge wetlands along West Branch Canal Creek at Aberdeen Proving Ground, Maryland. This study was conducted in cooperation with the U.S. Army to evaluate the potential for stimulating reductive dechlorination of 1,1,2,2-tetrachloroethane, tetrachloroethene, trichloroethene, and carbon tetrachloride in areas of preferential discharge or seeps. Biostimulation with electron donor addition and bioaugmentation with WBC-2, a mixed anaerobic consortium developed by the U.S. Geological Survey that degrades chlorinated ethanes and ethenes, was tested using MICRO-Trac™ devices developed by GeoSyntec Consultants and SiREM Laboratory. Four sets of MICRO-Trac™ devices were placed at seep areas 3-4W (rapid discharge) and 3-1E (less rapid discharge): an untreated control (C), a biostimulated treatment using a chitin-lactate mixture as the electron donor (BS), a WBC-2 bioaugmented treatment (BA), and a combined WBC-2 bioaugmented and biostimulated treatment (BSBA). A polyurethane support matrix was used in the MICRO-Trac™ devices both for the capture of naturally occurring microbes in the controls and for growing a WBC-2 biofilm for the bioaugmented treatments. Two diffusion samplers were included to evaluate geochemical parameters, chlorinated hydrocarbons, and dissolved gases.

At seep 3-4W, results of the C and BA MICRO-Trac™ treatments showed essentially no biodegradation of chlorinated solvents occurring under natural and bioaugmented conditions. Results of geochemical samples at this site indicated predominantly iron- and sulfate-reducing conditions consistent with the rapid discharge rates previously measured. The BS treatment showed stimulation of methanogenic conditions and partial degradation of the parent chlorinated volatile organic compounds to intermediate chlorinated compounds. The BSBA treatment showed the highest production of methane, the highest removal of parent compounds and intermediate daughter products, and the highest production of the non-chlorinated end product ethene. These results indicate that naturally occurring microbes in the seep are able to dechlorinate the solvents; however, bioaugmentation with WBC-2 improved the dechlorination rate, minimized the accumulation of chlorinated daughter compounds, and assisted in generating highly reducing conditions in the initially non-methanogenic wetland sediment. Of the total bacterial DNA extracted from the devices at seep 3-4W, the BSBA and BS treatments had similarly elevated *Dehalococcoides* DNA (0.4 to 0.5 percent) compared to the C treatment (0.02 percent). Thus, measurement of *Dehalococcoides* DNA did not reflect the difference in dechlorination activity in the BSBA and BS treatments.

At seep 3-1E, which had relatively less rapid ground-water discharge and naturally methanogenic conditions, the BA treatment showed the greatest removal of parent compounds and the highest production of the non-chlorinated end product ethane. The BS and BSBA treatments showed relatively low removal of parent compounds and production of ethane, indicating that addition of electron donor in these methanogenic sediments inhibited degradation.

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