

Abiotic and Biotic Transformation of TCE under Sulfate Reducing Conditions: the Role of Spatial Heterogeneity

John T. Wilson (Wilson.JohnT@epa.gov) (U.S. EPA, NRMRL, Ada, Oklahoma, USA)

Yontian He (NRC Research Associate, Kerr Center, Ada, Oklahoma, USA)

Bruce Henry (Parsons Infrastructure and Technology Group, Inc., Denver, Colorado, USA)

Patrick Evans (CDM, Bellevue, Washington, USA)

At a number of sites in the USA, passive reactive barriers built with shredded plant mulch have been constructed to treat ground water contaminated with TCE. These barriers are called biowalls because anaerobic biodegradation of the plant mulch is expected to provide substrates to support biological reductive dechlorination of the TCE. If there are significant concentrations of sulfate in the water, the biowalls also support sulfate reducing activity. The sulfide produced can react with available iron in the biowall matrix to produce iron sulfide. Iron monosulfide (FeS), occurring as poorly crystalline mackinawite, can chemically reduce TCE. If substantial quantities of FeS accumulate in the biowall matrix, the removal due to abiotic degradation on FeS can be an important fraction of the total removal.

Staff at the Kerr Center in Ada, Oklahoma built a laboratory column that modeled a full scale biowall that was installed by Parsons at the SS-17 site at Altus Air Force Base, Oklahoma. The column study and the biowall at the SS-17 site reproduced the design of a pilot scale biowall that was installed by Parsons at the OU-1 site on Altus AFB.

The degradation of TCE in the laboratory column and in the field scale biowalls followed two substantially different patterns. In the laboratory column, approximately 99% of the TCE was degraded, but *cis*-DCE or vinyl chloride did not accumulate in pore water. During abiotic degradation of TCE by FeS, the major transformation product can be acetylene, not *cis*-DCE. This is a pattern of degradation products that would be expected if abiotic degradation of TCE was the dominant pathway for removal of TCE. In contrast, in the full scale biowalls, approximately 99% of the TCE was degraded, but the TCE was largely converted to *cis*-DCE and vinyl chloride. This is the distribution of transformation products that would be expected if biological reductive dechlorination was the major pathway for removal of TCE.

The laboratory column study and both biowalls produced copious quantities of soluble sulfide, in excess of 50 mg/L. In the laboratory column, the average concentration of FeS in the sediment fraction of the matrix was 1560 mg/kg. In contrast, the average concentration of FeS in the sediment was only 218 mg/kg at the OU-1 biowall and 207 mg/kg at the SS-17 biowall.

The water content of the biowall material was more variable than the water content of the material in the laboratory column study. Casual observation of frozen samples from the biowalls indicated large regions (on the scale of a few centimeters) with no solids. Because of the more heterogeneous distribution of water and solids, there may have been less opportunity for hydrogen sulfide in the pore water to react with iron in the matrix to produce FeS, and less opportunity for TCE in the pore water to interact with FeS.

This is an abstract of a proposed presentation and does not necessarily reflect EPA policy.