Abstract G-78, in: Bruce M. Sass (Conference Chair), *Remediation of Chlorinated and Recalcitrant Compounds—2006.* Proceedings of the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2006). ISBN 1-57477-157-4, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

Effect of Ethanol on the Natural Fermentation of Benzene in Groundwater

Cherri Adair (adair.cherri@epa.gov) and John T. Wilson (wilson.johnt@epa.gov)
(U.S. EPA, R.S. Kerr Center, Ada, Oklahoma, USA)

Ethanol is commonly used as a fuel oxygenate in California and in the mid continent area around the Great Lakes. The presence of ethanol in a gasoline spill has raised concerns about the effects of the additive on the natural biodegradation of fuel hydrocarbons, including benzene. Ethanol in water provides microorganisms with an easily metabolized food source. A spill of gasoline containing ethanol would result in the partitioning of ethanol into the ground water. Electron acceptors would then be consumed in the degradation of ethanol and be unavailable for metabolism of benzene and fuel hydrocarbons. The process of natural anaerobic fermentation of benzene and other BTEX compounds could be inhibited by ethanol. Other studies have been conducted on the effects of ethanol on the supply of electron acceptors in fresh spills. At many older gasoline spill sites, the soluble electron acceptors have been consumed and are not available for metabolism of benzene. Benzene in these older spills is metabolized through a fermentation reaction. This work is unique in that it addresses the effects of ethanol on benzene fermentation in aquifer sediments contaminated with gasoline.

Microcosms were prepared from soil collected from five locations in the United States. The sediment was acquired from existing gasoline spill sites where benzene was being degraded under methanogenic conditions. The pore water in the microcosms contained approximately 2 mg/liter of benzene, 20 mg/liter of toluene, ethylbenzene, xylenes, and trimethylbenzenes, and 2,000 mg/liter of ethanol. The microcosms were incubated in an anaerobic glove box at room temperature. The effect of ethanol on benzene biodegradation was a mixed story in the sediment from the five locations. In sediment from two locations in California, Vandenberg AFB and Petaluma, benzene biodegradation was rapid in the absence of ethanol. Benzene was entirely consumed in three months. In the presence of ethanol, the degradation of benzene was inhibited. In sediment from Petaluma, benzene persisted for 15 months, and then was entirely degraded after two years of incubation. In sediment from Vandenberg AFB, amended with ethanol, there was no benzene biodegradation up through sixteen months of incubation. In sediment from a site in Parsippany, New Jersey, which was not amended with ethanol, there was a long lag before benzene degraded. Degradation began after twelve months. Concentrations were reduced at least ten fold in eighteen months, and benzene was entirely degraded after twenty four months. In sediment that received ethanol, benzene did not degrade up through twenty-four months of incubation. Completely opposite effects were observed in the sediment for a site at Deer Park, New York. Ethanol actually stimulated the degradation of benzene. In sediment from Boca Raton, Florida no biodegradation of benzene occurred with or without ethanol within twenty four months of incubation.

In the three sediments where the natural fermentation of benzene was extensive, and would have contributed to natural attenuation, ethanol inhibited benzene biodegradation or prevented it altogether.

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