In Situ Propane and Oxygen Biosparging for Cometabolic Bioremediation of 1,4-Dioxane

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Background/Objectives. Enhanced in situ cometabolic biodegradation is an attractive remediation strategy for 1,4-dioxane in groundwater. Because cometabolic biodegradation reactions are dependent on supply of primary substrates rather than 1,4-dioxane present in groundwater, this approach is particularly applicable when 1,4-dioxane concentrations are below what would be expected to support robust metabolic biodegradation. Over the past few years, in situ propane-linked 1,4-dioxane cometabolic bioremediation systems have been successfully applied at an increasing number of sites.

Approach/Activities. Here we present a pilot-scale case study of the application of a propane-linked cometabolic biosparge approach to treatment of a 1,4-dioxane plume in a weathered bedrock environment. During this study, propane, oxygen, nutrients (diammonium phosphate), and a bioaugmentation culture (*Rhodococcus ruber* ENV425 provided by EOS Remediation, LLC) were supplied. Compressed air and propane were injected into weathered bedrock at up to 35 percent of the lower explosive limit (LEL) and 3 cubic feet per minute for 11 to 12 hours per day into each of two sparge wells. Success with this bioremediation approach is predicated on effective delivery of propane and oxygen, achieving substrate distribution at levels that support biodegradation rates necessary to achieve remediation goals. In aerobic bioremediation systems, oxygen supply must be sufficient to overcome demand from non-target substrates and support the biodegradation reactions of interest. Additionally, with the cometabolic approach, the potential for competitive inhibition of 1,4-dioxane biodegradation by excess propane must be balanced with the need to supply sufficient propane to support ongoing microbial growth.

Results/Lessons Learned. During the pilot study, 1,4-dioxane concentrations decreased by up to 98 percent at monitoring well locations within the test area. However, differences in substrate concentrations achieved at monitoring points across the study, and corresponding differences in efficacy of 1,4-dioxane treatment, highlight the importance of well-engineered substrate distribution for remedy success. Full-scale design details based on previous characterization of the weathered bedrock and pilot study results will be presented.