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Bioremediation in a Fractured Bedrock Aquifer Using High Concentration Sodium Lactate

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Background/Objectives. This presentation will describe the effectiveness of sodium lactate injections in stimulating biological remediation of subsurface contaminants at the White Chemical Corporation Superfund Site, Newark, New Jersey. Site contamination consists of a highly complex and concentrated mixture of chlorinated and brominated ethenes and ethanes in the overburden and bedrock aquifers. Principal contaminants include: 1,2-dichloroethane (1,2-DCA), trichloroethene (TCE), 1,1,2-trichloroethane (1,1,2-TCA), and 1-bromo-2-chloroethene. The contaminants might have been released in dense non-aqueous phase liquid (DNAPL) form. The bedrock aquifer is characterized as a complex, leaky, multi-layer flow system in fractured shales of Brunswick Formation. A bedrock matrix diffusion test indicated that contaminants have migrated into the bedrock matrix, which could serve as a long-term source for bedrock aquifer contamination. An EPA technical impracticability waiver was obtained for the bedrock aquifer. The objective of bedrock bioremediation is to reduce contaminant mass to the extent practicable.

Approach/Activities. Bioremediation was conducted by delivering sodium lactate at 30 percent concentration into nine on-site bedrock wells. Sodium lactate at 30 percent is heavier than water; therefore, it could migrate in the bedrock aquifer in a similar behavior as a DNAPL, which would maximize the effectiveness of treatment. Four rounds of groundwater samples were collected: Baseline round and Round 1 (eight months after amendment injection), Round 2 (16 months after the lactate injection), and Round 3 (25 months after lactate injection).

Results/Lessons Learned. Effective contaminant mass removal in bedrock has been observed in eight of the nine wells from Baseline to Round 2. Removal rates were up to 99 percent for 1,2-DCA, TCE, 1,1,2-TCA, and 1-bromo-2-chloroethene. Significant increases of ethene were observed in six wells, indicating that complete dechlorination has occurred. This observation is supported by the QuantArray results, which demonstrate the presence of a medium-to-high population of bacteria that can degrade chlorinated ethanes and ethenes. In addition, concentration increases of selected metals were observed. After 16 months of treatment, the total organic carbon (TOC) concentrations ranged from 12 mg/L to 54,000 mg/L in the nine wells. With the high TOC concentrations, further progress of biological degradation is expected. This presentation will evaluate the effectiveness of bioremediation and the longevity of lactate with the Round 3 sample results. (Round 3 data will be available in December 2016).

Overall, available data demonstrated that lactate can last more than 16 months in the subsurface. The lactate has effectively degraded high concentrations of site contaminants in this complex bedrock aquifer.