In Situ Enhanced Bioremediation of TCE-Impacted Groundwater in an Aerobic Aquifer

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Background/Objectives. In situ enhanced reductive bioremediation (ISERB) process for trichloroethylene (TCE) with anaerobic and reducing aquifer system has been well researched and documented in the literature (Bardos et al., 2000). The most common limiting factor in the breakdown of TCE is the lack of organic carbon. The object of adding carbon source is to facilitate biodegradation by allowing a rapid proliferation of anaerobic microbes feeding on both the carbon substrate and on the contaminant, in turn causing more rapid breakdown of the contaminants.

Processes involved in biodegradation of the TCE depend on certain environmental parameters. Limiting factors for biodegradation include aerobic (oxidizing) conditions, weak reducing conditions, organic carbon deficit, electron acceptor deficit, nutrient deficiency and a bacterial population that is compromised by stressors. Consequently, turning the aerobic system to anaerobic condition involves pumping of carbon source. Methods vary with the particular contaminants as well as the geology of the area.

Approach/Activities. The site investigation result demonstrated aerobic and low reducing condition the controlling factors and that a lower hydraulic conductivity will slow down both the injection and the dispersion of the reagent. The site is located on the lower Adelaide Alluvial Plain with strongly weathered and fine-grained sediments of the Hindemarsh and Pooraka Formations. The project conducted microbiological characterization of groundwater using advanced molecular microbiological techniques and laboratory treatability studies for bioremediation of TCE using a carbon source for stimulating TCE co-metabolizing bacteria. Groundwater fate and transport model was set up as a tool to design and upscale remediation technologies. A solar driven recirculation system has been installed. The laboratory findings were taken to the field and in situ pilot-scale feasibility studies subsequently scaled-up to full-scale remediation system.

Results/Lessons Learned. The laboratory studies demonstrated the presence of aerobic TCE degrading microbes at the site. Finally, the cost of molasses is relatively low, when compared with other methods of remediation. The controlling factor for the injection system such as water-level elevation, pH, conductivity, temperature, total dissolved solids, dissolved oxygen, oxidation-reduction potential, alkalinity, and ferrous iron was measured. Approximately 5 m^3 of diluted molasses was injected over five years and the groundwater was tested six monthly during the five years through test and monitoring wells.

Fieldwork conducted thus far demonstrated source remediation that has reduced the TCE concentration levels from 4,956 ppb to approximately 500ppb (the Dutch Intervention level trigger value for remediation action of TCE contaminated groundwater). The result shows that the TCE groundwater plume is shrinking significantly with 95% confidence level and P-value <0.002. This is seen as an outstanding success given the challenge that most companies have faced concerning remediation of this site.

Bardos, R.P., Morgan, P. and Swannell, R.P.J (2000) Application of In Situ Remediation Technologies – 1. Contextual Framework. Land Contamination and Reclamation 8 (4)