Application of Multifunctional Permeable Reactive Barrier and Enhanced In Situ Bioremediation for Chlorinated Solvents Remediation

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Background/Objectives. The contaminated site is located in northern Taiwan. Due to the mishandling of liquid waste such as trichloroethene (TCE) decades ago and without proper management, the pollution area has expanded outward from the factory. The estimated contamination area is approximately 4,608m^2 and the thickness of TCE-affected aquifer is around 2 to 18 meter. To deal with the issue, Enhanced In-situ Bioremediation (EISB) and Multifunctional Permeable Reactive Barrier (MultiPRB) were adopted to treat the contaminants and to prevent the contamination from expanding.

Approach/Activities. Based on preliminary survey, the main geological material consisted of gravel with sand and silt with hydraulic conductivity of $8.7x10^{-5}$ m/s. Using biological agents with various viscosities and different configurations of the MultiPRB, we would expect to contain the pollutants within the control area and achieve contaminants treatment effectively. Additionally, molecular biology tools including Hierarchical Oligonucleotide Primer Extension (HOPE) and qPCR were used to monitor the presence and distribution of dechlorinating bacteria.

Results/Lessons Learned. The remedial project has been operated for 15 months since 2017. TCE concentrations in one of the monitoring wells had decreased significantly from 0.367 mg/L to 0.006 mg/L. During the process, dichloroethene and other intermediates were fluctuating but generally showed a decreasing trend. Vinyl chloride accumulation was observed during the last 9 months with maximum concentrations reached 0.389 mg/L and gradually decreased to 0.017 mg/L. The monitoring data from the downgradient of the MultiPRB also indicated the contamination concentration decreasing during the project. In addition to contaminants analysis, we also monitored the underground water quality. During active remediation, DO (0.5~2.7 mg/L), ORP (-50~-300 mV), and pH (5.5~7.5) data indicated that the subsurface environment was maintained under anaerobic and reducing conditions which favored dechlorinating bacteria activity. HOPE analysis showed that *Dehalococcoides* genus bacteria (Dhc) belonged to Cornell subgroup and Victoria subgroup were present at this site and total Dhc concentrations were up to 10^4 copies/mL. Altogether, the combination of EISB and MultiPRB showed promising results for restricting the plume movement and treatment for chlorinated solvent contamination.