Application of MPE and ISCR in Remediation of a Chlorohydrocarbon-Contaminated Site

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Background/Objectives. Shallow groundwater in a mechanical manufacturing site in Shanghai China was contaminated by chlorohydrocarbons and the main pollutants included trichloroethane (TCA), dicloroethane (DCA) and dichloroethylene (DCE). The contaminated groundwater was located in the unconfined aquifer beneath the site with contamination at a depth from 1 m to 8 m below ground surface (bgs), in other words from the stable groundwater level to the bottom of the unconfined aquifer. Several groundwater contamination plumes with different degrees of contamination were identified on the site by previous investigations. The soil profiles of the aquifer mainly included a silty clay layer and sandy silt layer with limited hydraulic gradient. Combined remediation technologies were adopted to clean up the contaminated groundwater on the site.

Approach/Activities. Multi-phase extraction (MPE) combined with in situ chemical reduction (ISCR) remediation technology was selected for the full-scale remediation of contaminated groundwater on the site. For the identified high contaminant concentration area with significant dense non-aqueous phase liquid (DNAPL) at the bottom of the aquifer, MPE technology was adopted first to reduce the contamination loading in groundwater as much as reasonable practical and ISCR was carried out later after MPE operation for a period of time. For the identified low contaminant concentration areas, ISCR was carried out directly. The dual-pump extraction approach was adopted for the MPE system and the contaminated groundwater and soil vapor was extracted respectively by the MPE system for groundwater remediation. The extracted groundwater was discharged to the municipal sewer system nearby after pretreatment of air stripping onsite and the extracted soil vapor was treated by condensation followed by activated carbon adsorption. A patented chemical named EHC was selected as the reduction agent of the ISCR. 30% EHC slurry by weight was prepared with EHC particles and industrial water and high-pressure injection via direct push was adopted for the chemical injection. The MPE system operated two years in the high contaminant concentration area and a total of 200 tons of EHC was injected on the site.

Results/Lessons Learned. Remediation monitoring results showed that the MPE was able to decrease the contamination load of chlorohydrocarbons in groundwater effectively in the high contaminant concentration area and created a good condition for following ISCR application. ISCR was able to remove dissolved chlorohydrocarbons in groundwater effectively by reductive dechlorination. EHC agent had a longer aging process and dechlorination reaction could occur at an extended period in the subsurface after chemical injection, which would gradually decrease the chlorohydrocarbon concentrations in groundwater. MPE and ISCR are cost-effective when combined in-situ and are suitable for the remediation of contaminated groundwater on the site with different degrees of contamination.