Pilot Testing of Multi-Phase Extraction Technology for Full-Scale Remediation of a High-Concentration MTBE Source Area

Matthew Poltorak (matthew.poltorak@stantec.com) and David Collins, PE (david.collins@stantec.com)
(Stantec, Walnut Creek, CA, USA)

Background/Objectives. Failure of a storage tank fill line resulted in multiple releases containing pure phase MTBE and gasoline range hydrocarbons. Current dissolved MTBE and TBA concentrations range up to 2,500,000 µg/L and 140,000 µg/L, respectively. LNAPL has been historically observed across the site, although was found to be immobile and laterally discontinuous. Recent soil gas surveys showed MTBE soil gas concentrations up to 230,000,000 µg/m^3 in areas near the failed tank fill line. A pilot test was conducted to evaluate the use of multi-phase extraction (MPE) in weathered bedrock consisting of interbedded siltstone and claystone layers as a source zone remediation technology. Objectives consisted of collecting MPE system operation and subsurface data to estimate mass removal rates and radius of influences (ROIs), estimating steady-state heat of combustion values to evaluate heat loading to vapor treatment system and support equipment selection for a full-scale system, testing a range of applied vacuums, and comparing mass removal from MPE to the existing groundwater extraction treatment system. In addition, a new well specifically designed for MPE was installed for comparison of MPE performance to existing site wells.

Approach/Activities. Pilot testing was conducted for 3 to 5 days at each well for approximately 8 hours each day. Three wells were existing and one new well was installed for the pilot test. The new well was constructed 6-inch diameter stainless steel casing consisting of 30 feet of 0.040-inch slotted continuous wire wrap screen from 45 to 15 feet below ground surface (bgs) and blank casing from 15 feet to ground surface. The filter pack was composed of 1/4-inch pea gravel to facilitate potential LNAPL recovery. The MPE system was comprised of a PVC drop tube connected to a 20-horsepower, 410 cubic feet per minute liquid ring vacuum pump and a direct-fired thermal oxidizer. MPE system data collection parameters included drop tube depth, well head vacuum, vapor and liquid extraction flow rates, VOC concentration readings, vacuum response from wells and soil gas probes, and groundwater drawdown from groundwater wells. Vapor and liquid samples were collected from the MPE influent stream and chemically analyzed by a laboratory for TPH-gas, BTEX, fuel oxygenates MTBE and TBA, and fixed gases.

Results/Lessons Learned. The average vapor and liquid extraction flow rates achieved at each well were 20 SCFM and 2.8 gpm, respectively, at an applied well head vacuum of 24 inches of Hg. The extraction rates and chemical analysis were used to estimate an average per well MTBE mass removal rate of 61 pounds/day and heat load of 23,000 BTU/hr. Vacuum response was observed up to 40 feet and drawdown of groundwater was observed up to 45 feet from the test wells. However, changes in MPE system influent concentrations over time at individual wells highlight the inherent heterogeneity of conditions at the site and suggest each well that might be utilized in future remedial activities will likely have a unique response relative to extracted concentrations and mass removal over time. Results indicated that MPE removed six times more MTBE mass removal than SVE alone, 30 times more mass than the existing groundwater extraction system, and that MPE was a suitable source area remediation technology despite the fine-grained bedrock lithology.