A Pilot Study to Determine the Feasibility of Biological Degradation and Chemical Reduction to Turn Off an Extraction System

Robert E. Mayer, Jr. (robert.mayer@aptim.com) (APTIM, Knoxville, Tennessee, USA)
Cecelia Byers (APTIM, Pittsburgh, Pennsylvania, USA)

Background/Objectives. A pilot study was conducted at a site near Niagara Falls, New York which had been an active research, testing and manufacturing facility since 1940. A neutralization pond, formerly used for treatment of waste fluids, was physically closed in 1987, piping was rerouted, and soils were excavated to bedrock. Investigative work was completed and determined the presence of residual contamination including both dissolved and DNAPL volatile organic compounds (VOC) trichloroethene, methylene chloride, 1,1,1-trichloroethane, 1,2-dichloroethene (total), and vinyl chloride.

Detections of DNAPL have been limited to the uppermost bedrock strata and the plume originally extended to a maximum of 750 feet downgradient of the pond. Aqueous phase impacts have been detected in the overburden and bedrock aquifers beneath the facility. The extent of the aqueous phase VOC impacts in the bedrock aquifer extends from the former pond to approximately 4,000 feet downgradient.

The remedial approach originally included the installation and operation of on-site and off-site groundwater recovery and treatment systems to address dissolved VOC impacts. Operations of the on-site groundwater treatment system was suspended in October 2017 at the initiation of this pilot study. The purpose of this study was to determine if in situ bioremediation and can be enhanced and combined with chemical reduction to more rapidly reduce contaminant mass and reduce the amount of groundwater being extracted, with the possibility of permanently decommissioning the on-site groundwater treatment system.

Approach/Activities. A carbon source, ferrous iron, and a microbial consortium were injected into 10 wells to enhance the degradation of the site contaminates. Prior to the implementation, an injection test was completed to determine the hydrogeological properties of the treatment zone and radius of influence. This test determined injection rates and well spacing for the pilot test. The in situ groundwater treatment was completed in December 2017, following the injection of 36,000 pounds of 3D Microemulsion (3DMe®), 18,000 pounds of chemical reducing solution (CRS®), and 45 liters of SDC-9™ into 10 locations.

Results/Lessons Learned. Four post-injection sampling events have been completed. During the first six months, a decrease in VOC concentrations has been observed in 12 monitoring wells (ranging from 15 to 99 percent). Increases in VOCs have been observed in six wells, however, they are accompanied by increases of ethene and ethane which are final degradation products of TCE, indicating on-going degradation activity. The decreases in contaminant mass suggest that in-situ enhanced bioremediation and chemical reduction of site contaminates is occurring. These reductions are allowing for the on-site extraction system to remain shut down, which has prevented the treatment of approximately 9 million gallons of groundwater and a significant reduction in operation and maintenance cost. A full-scale injection program will target a larger treatment area, and reduce the amount of groundwater being extracted by the off-site groundwater extraction system. Additional sampling this year will aid in determining the effectiveness of this pilot study and the decreases in groundwater extraction O&M cost.