Full-Scale Enhanced Anaerobic Bioremediation of Two Low Permeability Source Areas

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Background/Objectives. Trichloroethylene (TCE) and reductive dechlorination daughter products are found in soil and groundwater at an active manufacturing site in New York. The geology of the site consists of fine grain flood plain deposits extending down to 18-20 feet overlying highly permeable channel fill soils. TCE source areas existed at two separate locations at the site in the flood plain deposits, while the channel fill is the primary conduit for groundwater transport of cis-1,2 dichloroethyene (cis-DCE) and vinyl chloride (VC). There is significant natural attenuation occurring in the channel fill, so that minimal chlorinated compounds leave the site.

Approach/Activities. Enhanced anaerobic bioremediation through biostimulation was used to treat both sources areas. The treatment system included the design and installation of biobarriers using emulsified vegetable oil (EVO) in the channel fill surrounding the source areas and direct injections into lower permeability flood plain deposits containing the source material using EHC®. A total of 21,120 pounds of 60% EVO solution was delivered to the aquifer through a series of 55 injection wells screened across the zone of highest dissolved phase VOC concentrations in the channel fill. The biobarriers were emplaced prior to source treatment to allow time for the bioactive zones to develop around the source areas to minimize the transport of contaminants potentially liberated by the source treatment.

EHC® was selected as the electron donor amendment for the flood plain deposits because it could be injected into the low permeability formation. A total of 28,897 pounds of EHC® was injected into the two source areas at four separate intervals under high (100-400 psia) pressure through 87 injection points. The distribution of EHC® in the subsurface was directly and quantitatively measured using confirmation soil cores and magnetic susceptibility measurements.

Results/Lessons Learned. Groundwater sampling completed one year post injection demonstrates that extensive reductive dechlorination is occurring in both source area locations as well as at downgradient locations. In several cases groundwater collected from downgradient monitoring wells now contains predominantly ethene and ethane compared to TCE and its daughter products that were present prior to the injection. TCE concentrations in the source area locations have decreased by 93-100% in one location at the site and by 73-100% in the other location on site. Although initially formed during the dechlorination process, cis-DCE concentrations have now substantially decreased in most source area wells. An increase in vinyl chloride, ethane and ethane concentrations have been observed in the channel fill outside the two source area locations. It is expected that the VC concentrations will degrade via natural attenuation over time and distance.

Extensive surfacing in one source location resulted in only 48% of the planned EHC® being injected. It is believed that multiple conduits including utility lines, former building foundations and pre-clearing procedures via air knife/vacuum truck techniques contributed to the observed surfacing.