

In Situ Injections for Remediation of a Former Gas Station

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Background/Objectives. Normal operations of a now out of business gas station in Denver, Colorado resulted in petroleum hydrocarbon contamination in the subsurface at the site. Contamination was first discovered in 1999.

Previous treatment at the site included a hydrogen peroxide injection system that ran for approximately 2 years until July of 2011. Little if any contaminant reduction was seen as a result of this approach.

The lithology at the site consists of a clayey silt overburden above a consolidated claystone. Sampling activities in 2013 confirmed that the contamination is present primarily in the dissolved phase. Unfortunately, the bulk of that contamination resides within the claystone and not in the clayey silt overburden as shown by the difference in contaminant levels in the shallow alluvial wells versus the deeper bedrock wells.

A pilot-scale in situ application of BOS-200® was performed in September of 2013, followed by larger installations in December of 2014 and February of 2015. The challenge associated with this site was how to install the BOS-200® in a lithology that was not accessible by direct-push technology.

Approach/Activities. Groundwater concentrations for benzene throughout the plume were as high as 5 mg/L. A total of 20,100 pounds of BOS-200® was installed within the 5,000 square foot area. More than one installation was performed to limit the amount of moisture being added to the claystone at once. BOS-200® works by trapping the contaminants of concern via activated carbon and then treating them by bacterial mineralization. The BOS-200® was mixed with water and inoculated with a blend of naturally occurring organisms to form a slurry which was then injected into the subsurface. The amount of product needed was tailored at each location and depth based on the amount of contamination present.

In order to complete the installation, each of the injection boreholes was augered to 27 feet below ground surface (bgs) the week before injections were performed. Each location was then filled with hydrated bentonite and allowed to set. Injections occurred between 6 and 23 feet bgs with the majority of the product being placed into the claystone between 14 and 23 feet bgs. The Well Improvement Company used its high flow/high pressure piston pump to perform the injections. Pressures as high as 2,000 psi at breakdown and 1,100 psi during injection were experienced.

Results/Lessons Learned. The majority of the site is non-detect for MVTEX and TVPH. The only exceptions would be a small area around the USTs (removed in February 2016) and an area down-gradient of a low-lying canopy that prevented treatment of that area.