



Geo-Cleanse Remediation Summary Savannah, GA Former Manufactured Gas Plant Coal Tar

Overview

Geo-Cleanse International, Inc. (Geo-Cleanse) was contracted to perform an in-situ chemical oxidation (ISCO) full-scale treatment program utilizing catalyzed hydrogen peroxide (CHP) to remediate by-product like material (BPLM) on the on- and off-site properties surrounding a former manufactured gas plant (MGP) facility in Savannah, Georgia. BPLM is identified as “free phase” coal tar residuals measured as BTEX (benzene, toluene, ethylbenzene and xylenes) and PAHs (polycyclic aromatic hydrocarbons), which are MGP-specific constituents.

For 100 years (1853 - 1953), the former MGP produced gas from coal, coke, and oil. During the gas production process, various residuals such as tars, liquors, sludges, coal fragments and gas purifying wastes were produced, some of which were released into the soil and groundwater. The BPLM impacted an approximate 4 acre area, which was located in downtown Savannah and was adjacent to a large hotel and restaurant. Depth to groundwater ranges from 2 to 7 feet below ground surface (ft bgs) with a vertical treatment interval from approximately 5 to 47 ft bgs. The treatment matrix was comprised of fill material, interbedded sands, silts, and clays intermixed with timber, glass, brick, and other debris fragments. Bedrock was encountered at approximately 47 ft bgs.



During Remediation

The full-scale ISCO treatment program was designed to remediate BPLM mass to the extent practicable. Treatment to the extent practicable was defined as the point where no significant BPLM reduction will occur with further treatment. Activities at the site consisted of four main phases of implementation: injection well installation; mass calculations and hydrogen peroxide proportioning; injection and recovery; and post-treatment sampling. Each phase of the treatment program was specifically designed to attain the overall goal of the treatment program and to meet the criteria for closure at this site.



Post-Remediation

Well Installation

The injection well installation for the full-scale treatment program at the site began on January 6, 2004 and was completed on April 30, 2004. Over this time period, 1,238 injection wells were installed on an approximate 15-foot by 15-foot grid pattern, across a maximum of five vertical treatment intervals. In addition, the 45 injection wells that were installed for the pilot treatment program at this site were utilized as active injection points for the full-scale. A total of 74 vent

wells were also installed at this the site, which were utilized primarily for process monitoring and off-gas mitigation.

The depths and quantity of the injection well layers varied based on the presence of BPLM. Injection wells were installed and screened where BPLM was observed. Once an injection well was installed, four adjacent injection wells were installed in the same screened interval to ensure sufficient oxidant solution contact with the contaminated area. The entire treatment area was subdivided into 28 blocks, with each consisting of 91 injection wells or less. These divisions were implemented to simplify the sampling, injection and data management activities for the site.



Injection on East Bay Street

Baseline Sampling and Mass Calculations

During installation, several injection wells were continuously cored and sampled. Soil samples were obtained in 5-foot increments from approximately 20% of the injection wells across the site, in order to define the lateral and vertical extent of the contaminant mass present at the site. The samples were analyzed for BTEX (EPA Method 8260B) and PAHs (EPA Method 8270C).

Using the analytical data from these samples, injection wells were assigned a contaminant mass and a target volume of hydrogen peroxide for each injection well was calculated. The volume of hydrogen peroxide required was based on a 22:1 ratio of hydrogen peroxide to contaminant mass. This ratio was proven to be effective during the pilot ISCO treatment program. If the mass volume calculation was less than the minimum amount of hydrogen peroxide required to be injected to establish the radius of influence, a minimum volume of 480 gallons of 12.5% hydrogen peroxide was used for that injection well.

Once mass volume calculations were achieved, the injection activities were implemented and the full-scale treatment program took place in the following stages:

- 22:1 Ratio/Minimum Injection (Target Volumes)
- Photoionization Detector (PID) Headspace Chasing
- Peroxide Stability
- 21-Day Post-Treatment Monitoring
- Long Term Monitoring

These stages of injection were developed to demonstrate that the performance criteria for treating BPLM to the extent practicable were achieved.

Remediation Operations

Each day prior to oxidant injection, groundwater samples were obtained from all of the injection wells within an active treatment block and analyzed for pH, alkalinity, iron and hydrogen peroxide concentrations, temperature, and PID headspace. This process continued throughout the program on a daily basis to monitor the changes in groundwater chemistry and volatile constituents.

Once the delivery of target volume to each injection well was complete in an active block, treatment focused on the locations with PID headspace readings in groundwater greater than 50 ppm. Results from the pilot ISCO treatment demonstrated that PID headspace in groundwater

was directly proportional to remaining VOC concentrations. Treatment to the extent practicable was achieved when every injection well within an active block had a headspace reading below 50 ppm, thus oxidant delivery refocused on the locations that did not meet this criteria. Once all injection wells within an active treatment block were all below 50 ppm, Geo-Cleanse conducted a hydrogen peroxide stability test. This test involved injecting hydrogen peroxide over the course of one day to obtain a concentration of peroxide equal to or greater than 250 ppm at each injection well for 8 hours. The following day groundwater samples verified that sufficient hydrogen peroxide concentrations existed in each injection well within the treatment block.

After the concentration of hydrogen peroxide decreased to 2.5 ppm or below in every injection well, 21-day post-treatment monitoring began, which consisted of obtaining daily PID headspace readings. If headspaces remained below 50 ppm during this 21-day period, the final treatment criterion was effectively met and the block was considered closed, however select locations within each treatment block were still monitored weekly until active treatment in all the blocks across the site was complete. The long-term monitoring served as an assessment of BPLM rebound and as a final check that the block was treated to the extent practicable.

Including the standard ISCO remediation operations, Geo-Cleanse also implemented other innovative remedial technologies and procedures to increase the efficiency of the overall ISCO program. During the treatment program, Geo-Cleanse harnessed the exothermic nature of CHP to desorb, reduce the BPLM viscosity and extract the mobilized free phase and residual product. As injection activities proceeded, off-gases created from the reaction caused fluids and BPLM to mound from the subsurface through the injection wells.



Post-Remediation

In order to manage these mounding fluids, controls were placed on each well to direct the groundwater into collection tanks. In some treatment areas, a vacuum truck was used to collect and transfer the groundwater and BPLM to the collection tanks. The groundwater and BPLM was then transferred by Geo-Cleanse personnel to an on-site treatment facility.

Summary and Treatment Results

Injection at the site began on February 6, 2004 and injection activities were completed on January 17, 2005. A total of seven injection rigs were used throughout the duration of the injection program. The entire treatment program from start to finish included the injection of approximately 3.1 million gallons of 8% hydrogen peroxide and a site-specific catalyst solution. The treatment criteria for treating BPLM mass to the extent practicable was achieved and maintained for the length of the treatment program across the entire site. Based on the injection activities and groundwater quality data, the full-scale treatment program conducted by Geo-Cleanse obtained closure in each of the 28 blocks on the site. The full-scale treatment program at the former MGP site in Savannah, Georgia was completed on February 17, 2005. This site is considered one of the largest ISCO projects to date based on injection volumes and total area addressed.

This summary sheet is intended to provide a general overview of the referenced site. For more detailed information, please contact us at (732) 970-6696 or www.GeoCleanse.com.