



## **Geo-Cleanse® Remediation Summary Augusta, GA Former MGP Plant Coal Tar**

### **Overview:**

Geo-Cleanse International, Inc. (GCI) was contracted to perform a full-scale in-situ chemical oxidation (ISCO) treatment program to remediate by-product like material (BPLM) on the on- and off-site properties surrounding a former manufactured gas plant (MGP) facility in Augusta, Georgia. BPLM is identified as “free phase” coal tar residuals measured as BTEX (benzene, toluene, ethylbenzene, and xylenes) and PAH (polycyclic aromatic hydrocarbons), which are MGP-specific constituents. Results from the pilot ISCO treatment program indicated these constituents were amenable to chemical oxidation using Fenton’s reagent.

### **Site Background Characteristics :**

This site was a former manufactured gas plant (MGP) located in Augusta, Georgia. From the early 1800s until the 1950s, the MGP site was used to produce gas from coal, coke, or 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.

### **Program Goals:**

The full-scale ISCO treatment program was designed to remediate BPLM mass to the extent practicable. Treatment to the extent practicable is 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: injector installation; mass calculations and hydrogen peroxide proportioning; injection; and post-treatment sampling. Each phase of the treatment program was specifically designed to attain the overall goal of meeting the criteria for closure at this site.

### **Injector Installation:**

The injector installation for the full-scale treatment program at the Augusta site began on July 6, 2004 and was completed on October 27, 2004. The installation phase consisted of approximately 88 days of active installation. Over this time period, 686 injectors were installed on an approximate 15-foot by 15-foot grid pattern across the site in a maximum of three vertical treatment intervals, labeled A through C. In addition, the 43 injectors installed for the pilot treatment program at this site were also utilized as active injection points for the full-scale, equating to a total of 729 injectors. In addition to the injection wells, 33 vent wells were installed at this site.

The depths and amounts of injector layers varied based on the presence of BPLM. Injectors were installed and screened where BPLM was observed. Once an injector was installed, four adjacent injectors were installed in the same screened interval to ensure sufficient oxidant solution contact with the contaminated area. The entire treatment area was subdivided into 39 blocks, which each consisted of 43 injectors or less. These divisions were implemented to simplify the sampling, injection, and data management activities for the site.

### **Baseline Sampling and Mass Calculations:**

During the injector installation, several injector locations were continuously cored and sampled. Soil samples were obtained in 5-foot increments from approximately 20% of the locations 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 using EPA Method 8260B and PAHs using EPA Method 8270C.

Using the analytical data from these samples, injectors were assigned a contaminant mass and a target volume of hydrogen peroxide for each injector was calculated. The target 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 required to be injected to establish the radius of influence, a minimum volume of 100 gallons of 50% hydrogen peroxide was used for that injector.

The injection activities implemented during the full-scale treatment program took place in the following stages:

- 21:1 Ratio/Minimum Injection (Target Volumes)
- PID Headspace
- 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. A description of the treatment criteria is described in more detail below.

#### **Remediation Operations:**

Each day prior to oxidant injection, groundwater samples were obtained from all of the injectors 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 the target volume to each injector was complete in an active block, treatment focused on the injector 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 injector within an active block had headspace reading below 50 ppm, thus oxidant delivery refocused on the locations that did not meet this criteria. Once all injectors within an active treatment block were all below 50 ppm, GCI 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 injector for 8 hours. The following day groundwater samples verified that sufficient hydrogen peroxide concentrations existed in each injector within the treatment block.

After the concentration of hydrogen peroxide decreased to 2.5 ppm or below in every injector block, volatile constituents in groundwater were still monitored for a period of 21-days. 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, GCI also implemented other innovative remedial technologies and procedures to increase the efficiency of the overall ISCO program.

GCI created an above ground piping network designed to contain all fluids generated during the treatment program. As injection activities proceeded, offgasses created from the reaction caused fluids to mound from the subsurface through the injection points. In order to manage these mounding fluids, controls were placed on each injector to direct the groundwater into pipes of the water collection system. At the end of the system, the groundwater was directed through an oil water separator and then into a frac tank. GCI personnel treated and discharged the groundwater on-site eliminating many of the transport, treatment and disposal costs.

GCI personnel also used vacuum extraction to reduce the coal tar mass, influence the direction of injected oxidant solution, and create larger pathways for oxidant migration. During the treatment program, GCI harnessed the exothermic nature of Fenton's reagent to desorb and extract some of the free phase and residual product. GCI used a vacuum truck equipped with a multiple port manifold system to extract the liberated contaminants, using the injectors as extraction points. These collected materials were then discharged into the frac tank portion of the water collection system and treated. This system helped to remove the free phase and residual product and opened up the site for better oxidant delivery.

**Treatment Results:**

The full-scale treatment program conducted at the former MGP site in Augusta, Georgia met the criteria required to establish that the BPLM mass at the site was treated to the extent practicable. Based on the injection activities and groundwater quality data, the full-scale treatment program conducted by GCI obtained closure in each of the 39 blocks on the site. Therefore, the treatment criteria for treating BPLM mass to the extent practicable was achieved and maintained for the length of the treatment program.

**Summary:**

Injection at the site began in Block A on November 3, 2004, where the pilot was originally conducted. Injection activities were completed in Block AH on September 14, 2005. A total of 7 injection rigs were used throughout the duration of the injection program. The entire treatment program from start to finish included the injection of approximately 5,285,540 pounds (528,554 gallons) of 50% hydrogen peroxide and a proportional quantity of site-specific catalyst solution totaling 1,679,128 gallons, which equated to a 12% peroxide solution being injected into the subsurface. The full-scale treatment program at the former MGP site in Augusta, Georgia was completed on October 9, 2005.

*This summary sheet is intended to provide a general overview of the referenced site. For more detailed information, please contact us at 908-206-1250.*