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ISCO TECHNOLOGY REVIEW

GCI Implements a Cost Effective Approach to Target MGP Residuals in a Fractured Bedrock Environment

Geo-Cleanse International, Inc. (GCI) conducted an in-situ chemical oxidation (ISCO) treatment program using catalyzed hydrogen peroxide (CHP) at a former manufactured gas plant (MGP) in Somersworth, New Hampshire. Baseline soil samples revealed two source areas with contaminants consisting of monocyclic aromatic hydrocarbons (MAHs) and polycyclic aromatic hydrocarbons (PAHs) located at the soil/bedrock interface. Baseline groundwater sampling indicated elevated readings for both naphthalene and benzene, which were the only MAH and PAH constituents that had not met the NHDES GW-1 standards prior to treatment.

Injectors were installed and screened across the vadose/saturated zone which encompassed the soil/bedrock interface in order to treat both groundwater and overburden soils.

Based on a radius of influence study at the beginning of the treatment program, GCI concluded that lateral dispersion of the oxidant was good in groundwater but was not sufficient in the vadose zone soils. In order to promote vertical migration of the oxidant, GCI modified the existing injector network by blocking the flow of injectate to the more permeable bedrock fractures.

Process monitoring parameters were created to verify that the modified injector network was effectively delivering the CHP to the target areas. These monitoring parameters consisted of pressure readings, carbon dioxide off-gas measurements, and oxidant breakthrough at adjacent injection wells locations. The success of this methodology eliminated the need to install additional injection wells at shallower depths in order to effectively treat

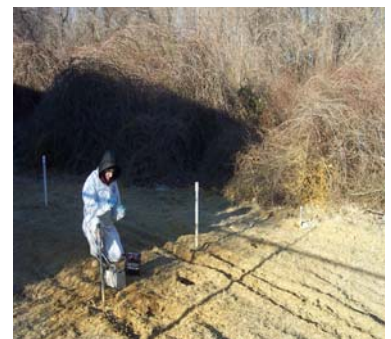


GCI's mobile lab inside the treatment vehicle.

the source material in overburden soils.

The analytical results indicate a reduction of both naphthalene and benzene by 94% along with reductions between 83% and 100% of additional MAH and PAH compounds in the soil. Prior to the polishing treatment at this site, naphthalene and benzene concentrations were almost at or below NHDES GW-1 standards in groundwater in both compliance locations. GCI's methodology to treat

fractured bedrock and overburden material prevented additional costs by eliminating the need for a multiple screened interval injection design.



GCI Field Technician Groundwater sampling

“GCI's methodology to treat fractured bedrock and overburden material prevented additional costs by eliminating the need for a multiple screened interval injection design.”

GCI Customizes Field Demonstration to Illustrate the Ability of CHP to Achieve Site Specific Remedial Objectives

GCI recently performed a field demonstration for clients and regulators at a site in Queens, NY. The purpose of the demonstration was to provide a background on chemical oxidation, to report the results of a bench scale treatability test previously conducted and to demonstrate the effectiveness of CHP on destroying free-phase liquids. Between the bench scale treatability test conducted and the field demonstration, GCI established the client's treatment criteria could be met through the use of CHP. The treatment criteria was to monitor the effects of CHP and the Geo-Cleanse® Process on metals, to address the natural oxidant demand in fill material, to eliminate soil odor, and to treat free or otherwise detectable product. The bench scale treatability test illustrated the ability of CHP to eliminate odors in soils, and the effects of natural oxidant demand and metals in CHP systems in 50% soil/ water slurry systems.

The destruction of residual and free product was revealed in column test experiments conducted at the field demonstration. Three columns were displayed in order to represent different stages of treatment: pre-treatment, partial treatment and post-treatment. These

“The post-treatment column displayed the elimination of free product ...”

columns were all initially packed with silica sands and spiked with free product collected from the site. The untreated column was exposed to a site specific catalyst and oxidant blend during the field demonstration where reaction of CHP with the free phase material was observed. The partially treated column showed the deposition of fatty acids in the pore space of the silica sands. Additional exposure to the oxidant ultimately breaks down the carboxylic acids even further to carbon dioxide and oxygen. The post-treatment column

displayed the elimination of free product and of the fatty acids. Pre-treatment spiked silica sand samples were found to have headspaces of approximately 106 ppm. Although some slight staining of the silica sand remained, the post-treatment PID headspace of the sand was less than 5 ppm.

A GCI field demonstration is an excellent way to visually confirm the capabilities of a particular oxidant to meet the client's goals as well as to view the treatment vehicle prior to field implementation. This can be performed in conjunction with a bench-scale test as well as prior to or during pilot-scale or full-scale field operations.

Photos Right & Below: Typical Set-Up For a GCI Field Demonstration



“If you are interested in having a GCI field demonstration, please contact us by phone: 732 - 970 - 6696 or via e-mail: contact@geocleanse.com.”

The Truth About ISCO Treatment Programs Using Permanent Injectors

Geo-Cleanse International, Inc. uses permanent injection points rather than direct push temporary points for a multitude of reasons.

- **Delivery Efficiency.** Permanent injector locations allow for the delivery to multiple injectors simultaneously. Permanent injection wells can also be injected on for longer durations without the resurfacing of injected fluids occurring. This allows a greater radius of influence (ROI) to be established. A larger ROI equates to having fewer injectors necessary to treat the area of concern. **Less Drilling means less money.**
- **Delineation.** During the injector installation, additional soil and groundwater data can be obtained on a much greater frequency to better establish the contaminant mass. **Better**

definition of the source equates to a lower cost.

- **Monitoring.** GCI uses the injectors during the injection to determine the geochemical conditions present at the site and to proportion the reagents to areas on the site where treatment is not yet complete. Post injection, the injectors double as monitoring locations to pinpoint the source of rebound. **Monitoring and proportioning the reagents allows for a more**

efficient used of the oxidant, an additional cost savings.

- **Additional Treatment.** If additional treatment needs to be performed, permanent injectors remain in place and can be used for subsequent treatment. Permanent injectors are easily abandoned following the completion of the ISCO treatment program. **Zero drilling cost for additional mobilizations.**



Flush mount injection well.



Stick-up injection wells.

ISCO Treatment Program Underneath an Active Facility During Operations

GCI recently performed an ISCO treatment program using CHP at an active manufacturing facility in Branford, Connecticut. The facility was operational 24-hrs a day, 6- days a week. The almost round the clock operation of the facility required the installation and injection phase be conducted while the facility was operational. GCI designed and conducted the treatment program around the slowest hours of operation, which were from 17:00 to 03:00.

The 44 multi screened interval injection wells were installed in two separate areas of the manufacturing plant requiring GCI to create two separate exclusion zones. The exclusion zones were rotated around the activity of workers in the facility in order to not slow down production of the plant.

GCI is dedicated to designing the safest, most effective approach to an ISCO treatment program which works around the project schedule to meet the needs of the client.



Standard GCI Injection Well Head

Dan Bryant Returns to Geo-Cleanse International, Inc.



GCI welcomes Dan Bryant, Ph.D. back to the company! Dan worked for GCI from 1997 through 2002, and played an important role in research and design, project management, and field implementation of chemical oxidation projects around the world. On January 1, 2007, Dan rejoined GCI as a vice president and senior project manager.

Dan has a Ph.D. in geochemistry, with 10 years of experience in the environmental

industry. Dan's experience is focused on remediation, and includes in-situ chemical oxidation with catalyzed hydrogen peroxide, permanganate, and persulfate systems, and coupling in-situ chemical oxidation with complimentary technologies including stimulated anaerobic and aerobic bioremediation, zero valent iron, and monitored natural attenuation.

Please feel free to contact Dan by phone: 732-970-6696 or via email: dbryant@geocleanse.com.

For Past Issues of Our Newsletter Visit Our Website
www.geocleanse.com



**EXPERIENCE
REPUTATION
RESULTS**

**Geo-Cleanse
International, Inc.**

**400 State Route 34
Suite B
Matawan, NJ 07747**

**Phone: 732-970-6696
Fax: 732-970-6697
Email: contact@geocleanse.com**

ABOUT GEO-CLEANSE INTERNATIONAL, INC.

Since 1995, Geo-Cleanse International, Inc. (GCI) has established a reputation as the premier in-situ chemical oxidation company. GCI consistently provides quality service and ensures that the goals of our treatment programs are achieved. We have the most experience of any chemical oxidation firm and were the first to commercially apply oxidants for a successful NAPL remediation. Our experience, together with independently published results

of our work, and an experienced staff of professionals, keeps GCI at the top of the industry.

As the chemical oxidation field continues to evolve, GCI has expanded our services to incorporate the advances occurring within the industry, as well as our own proprietary technologies. GCI offers a variety of different chemical oxidation services to our clientele, including bench testing, pilot-scale applications, and full-scale applications. The Geo-Cleanse® Process can effectively treat a wide variety of contaminants in a range of lithologies. To date, GCI has field experience on over ninety sites in twenty-seven states, Canada, and the Netherlands. GCI has experience remediating a wide variety of contaminants including petroleum,

coal tar, pesticides, and chlorinated hydrocarbons. In addition, GCI currently has the most experience in treating manufactured gas plant (MGP) residuals.

Geo-Cleanse services include:

- Fenton's Reagent Chemistry Injection.
- Sodium and Potassium Permanganate Injections.
- In-Situ Treatment of Heavy Metals.
- Bio-enhancement / Surfactant Injection.
- Field Demonstrations.
- Vacuum Extraction.

If you would like a free site evaluation, please contact us by phone or email or by visiting our website at www.geocleanse.com.



Left: One of GCI's Treatment Vehicles