Trichloroethene (TCE) Remediation in Saprolite and Fractured Rock at an Active Manufacturing Facility

TERRATHERM
a Cascade Company

Results:

- Remedial Goals Met
- 95% UCL of mean trichloroethene (TCE) concentration less than 0.02 mg/kg
- Ran consistently 100% of the time with no downtime
- Project finished within the planned 120 day heating period
- Site reached target temperature within 100 days
- Effective treatment of saprolite and gneiss

Approach:

- In Situ Thermal Desorption (ISTD)
- Target temperature: 100°C
- Spacing between thermal wells: 15 ft (4.5 m)
- Thermal wells: 24
- Surface vapor barrier
- Heating Interval: 1 ft -~90 ft (0.3-27 m) bgs

For further information:

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Site Information: At an active manufacturing facility in the South Eastern United States, trichloroethene (TCE) was released via a sump/ catch basin system associated with an aboveground TCE storage tank and a TCE reclamation unit.

Bird's Eye View of ISTD Well Field

The Target Treatment Zone (TTZ) was approximately 33 ft (10 m) x 76 ft (23 m) (2,508 ft^2 [71 m^3]), extending from the ground surface to approximately 10 ft (3 m) below bedrock surface (bgs) or 85 ft (29 m) bgs. The total volume encompassed by the TTZ was 7,900 cubic yards (6,040 m^3). The extended TTZ depth allowed for undulations in the bedrock surface and ensured treatment of all of the soil and bedrock within the TTZ. The heated interval extended to approximately 90 ft (27 m) bgs to ensure complete heating of the TTZ.

Geology: The source area targeted for treatment consisted of 4 geologic units as follows, from the ground surface down:

1. Fill (re-worked saprolite): 0-25 ft (0-8 m) bgs
2. Saprolitic Soil (weathered granite): 25-55 ft (8-17 m)bgs
3. Partially Weathered Bedrock: 55-75 ft (17-23 m) bgs
4. Fractured Bedrock: The bedrock surface undulates with an average depth to the bedrock surface of approximately 75 ft (23 m).

The water table was at the bottom of the saprolitic soil at approximately 55 ft (17 m) bgs, resulting in a total saturated thickness of approximately 20 ft (6 m) of partially weathered bedrock overlying the fractured bedrock.

View of ISTD Well Field

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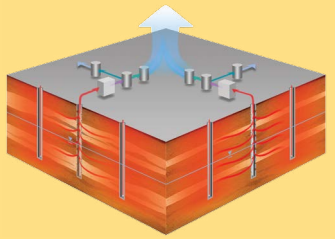
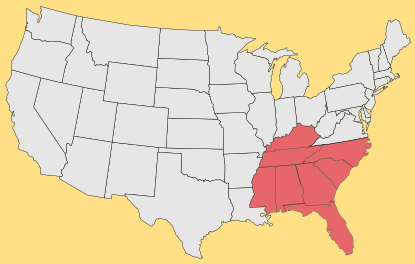
Heating Method:
In Situ Thermal Desorption (ISTD)



Location: EPA Region 4



Consultant:
Rogers and Callcott Environmental

Time Frame: 2006-2007

TerraTherm has completed a number of other ISTD projects in fractured rock.

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Mass Removal Rates and Energy Inputs: During the course of ISTD operations, data were collected and compiled to monitor the performance of the ISTD system. This was used to measure the amount of electrical energy used, and to calculate the approximate mass of contaminants extracted from the subsurface.

The total mass of VOCs extracted from the subsurface in either vapor phase or dissolved liquid phase during the course of the project was approximately 11,590 lbs (5,260 kg). The total amount of energy used was 1,860,600 kWh. Therefore, the amount of electrical energy expended per pound of VOC extracted from the subsurface was approximately 161 kWh/lb.

The total amount of energy used during the course of the project was approximately 60% of the amount projected in the system design. This indicates that subsurface heat losses to areas surrounding the TTZ were lower than anticipated, and the applied energy was used very efficiently to raise the temperature inside the TTZ. This difference between the projected energy use and actual usage remained at a constant differential during the entire project.

Results: The ISTD treatment at the Southeastern U.S. Site met the remedial goal. In fact, results demonstrated substantially lower concentrations than the remedial goal for all soil samples collected both from above and below the water table, with the 95% UCL of the mean of all samples being 17.05 µg/kg. These are exceptional results given that TCE Dense Non-Aqueous Phase Liquid was present within the treatment zone at the start of heating. In addition, the results demonstrated that there was no mobilization of contaminants outside of the treatment zone during ISTD treatment.