TERRATHERM
a Cascade Company

In Situ Thermal Desorption (ISTD) combined with Steam Enhanced Extraction (SEE) at an active manufacturing facility in Florida

Results:

- Air emissions discharge criteria were achieved for individual and total Hazardous Air Pollutants (HAPs) throughout the entire thermal remedy.
- Heaters were cycled during on and off during peak energy demand periods to decrease overall utility costs, which resulted in a savings of $50,000.
- The total mass removed was approximately 4,000 lbs (1,800 Kg) in the vapor phase and another 700 lbs (320 Kg) in the liquid phase.

Approach:

- In Situ Thermal Desorption and Steam Enhanced Extraction
- Target Temperature: Boiling point of water
- Use of a Fourier Transform InfraRed (FTIR) field analytical package for continuous system and air discharge monitoring
- Target Treatment Zone (TTZ):
  - ◊ Area=70,000 ft² (6,500 m²)
  - ◊ Average depth= 41 ft (12.5 m) bgs
- TTZ located within and outside of a building

For further information:

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Site Information: The Site was located on the west- central coast of Florida. Several entities have operated at the Site from the late 1950s to present. The primary activity at the site since October 1957 was manufacturing of electronics, communication hardware, and general office operations.

Partial view of ISTD/SEE wellfield inside building

Objectives: The goal of this thermal effort was to remove mass as practicable from the source area in order to reduce future treatment requirements, treatment costs, and duration of the downgradient groundwater treatment. In particular, thermal remediation focused on eliminating the potential for residual non-aqueous phase liquid (NAPL) in the source zone, and enhanced the overall groundwater remediation program.

Contaminants of Concern (COCs): The primary COCs included trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), vinyl chloride (VC), and 1,4-dioxane (although not specifically targeted for the vapor stream).

Geology: The surficial geology reflected the coastal environment of Florida where surficial deposits were composed of fine to very fine quartz sand, silt, clayey sand, and shell fragments. The surficial deposits occurred from land surface to a depth of about 55 ft (17 m) bgs. The surficial sediments were underlain by the Hawthorn Group that consisted of fine grained clastic deposits interlayed with carbonate rocks identified to be approximately 110 ft (34 m) thick and consisting of clay, sand-clay mixtures, limestone, and limestone fragments within a clay matrix. Below the Hawthorn Group is a thick package of carbonate rocks that serves as a regional water-bearing unit.

Challenges:

- Approximately 90% of the Target Treatment Zone (TTZ) was located beneath a building. Although the building was vacant, partition walls, drop ceilings, and existing utilities existed within the limits of the treatment zone.
- Strong public/community involvement.
- Thick sand zones presented the possibility of groundwater flow and cooling during thermal treatment.
- The extraction and treatment of 1,4-dioxane using synthetic media in addition to the chlorinated compounds presented an additional challenge for both vapor and liquid treatment systems.

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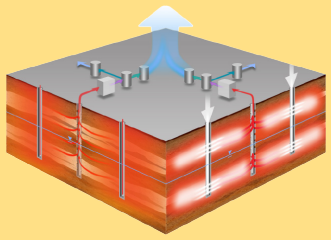
Heating Method:
In Situ Thermal Desorption and Steam Enhanced Extraction



Location: Florida, USA

Time Frame:

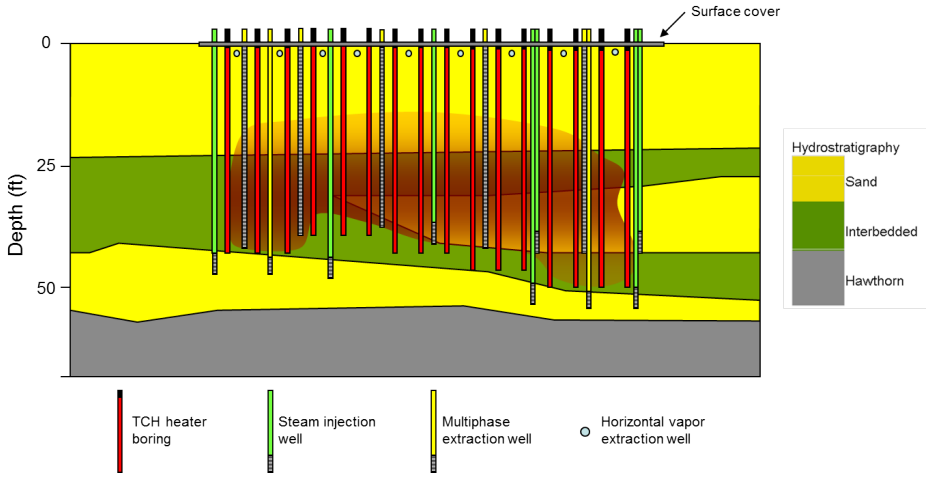
December 2011 to June 2013

Regulatory Oversite:

Florida Department of Environmental Protection for air discharge emissions only

Project Summary: ISTD was implemented for the treatment of contaminated soils and groundwater within a building located in Florida. ISTD combined with SEE was implemented as a supplemental action to the primary Site remedy - groundwater pump and treatment.

The ISTD heaters delivered energy to the upper sand unit and to the interbedded unit, by thermal conduction. Steam injection delivered energy to the permeable layers of the interbedded unit, and created a hot steam floor in the lower sand unit under selected areas of the interbedded unit.



Vapors were extracted from the subsurface under vacuum and treated through a thermal oxidizer/acid gas scrubbing prior to discharge to the environment. Water was extracted and treated through various synthetic medias to target chlorinated Volatile Organic Compounds (VOCs) as well as 1,4-dioxane.

A subset of heaters were cycled on and off to correspond with peak/non-peak community energy demands in an effort to reduce overall energy use/costs.

Real time air discharge emissions were monitored continuously with the use of an FTIR field analytical package throughout the thermal remedy for compliance with individual and total HAPs.

After temperature performance criteria were achieved, thermal remediation was suspended. It is estimated that upon completion of thermal operations, approximately 4,000 lbs (1,800 kgs) of chlorinated VOCs had been removed from the vapor phase and another 700 lbs (320 kgs) from the liquid phase.

A view of the thermal process equipment

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