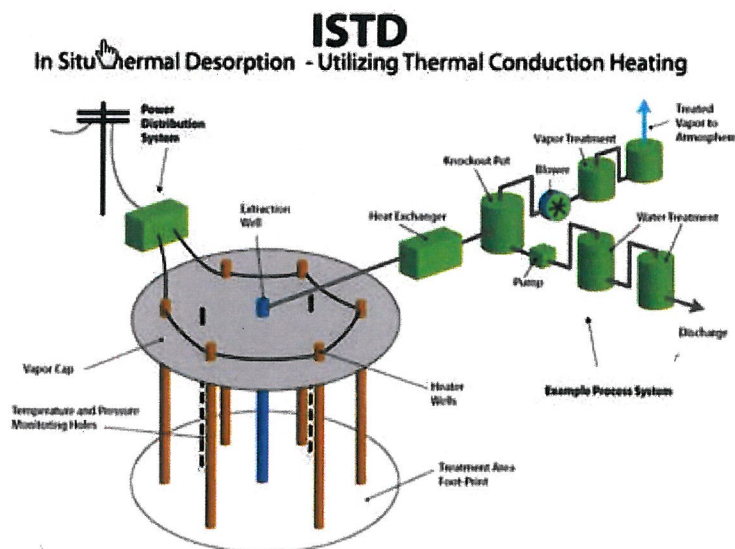


## In-situ Technology for Clean up of Halogen Contaminated Sites

Halogenated volatile organic solvents are found in the soil or groundwater at many former and active industrial sites. Fortunately highly effective remediation technologies are available to restore these former brownfields to a healthy state.

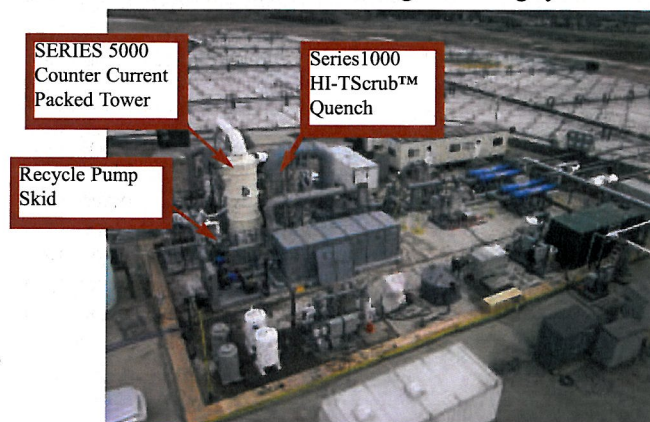
The range of technologies includes the traditional approach where the contaminated soil is excavated and the volatile halogenated contaminants are thermally or atmospherically stripped, followed by thermal oxidation of the vapors and scrubbing of the formed acid gases. More recently developed advanced technologies, such as the one available from TerraTherm, Inc. avoids the needless costly and disruptive digging and instead removes the contaminants without soil excavation. Proven at various locations, around the world, the system uses electrical energy to heat the soil in place, volatilize the contaminants, and extract them under vacuum for treatment. Since these sites are remediated over a period of a few months, the equipment is designed to be set up, operated, dismantled and be moved to the next site.

Heater pipes are installed to raise the soil temperature, causing the contaminants to vaporize. The soil vapor extraction piping delivers the vapors to specially designed above ground thermal oxidation equipment that is fitted with high efficiency gas cooling and cleaning equipment. During the thermal oxidation process, halogens such as chlorides, bromides or fluorides are converted to acidic gases. These gases are first cooled and quenched using direct contact with water and are then scrubbed from the oxidizer exhaust using custom designed and pH- controlled gas cleaning equipment. Water vapor is discharged through an exhaust stack. The entire process operates automatically.



Typically, a site investigation has delineated the volume of contaminated soil requiring treatment. TerraTherm's engineers then model the site and strategically locate the heater and extraction wells that remove the contaminants from the soil. The extraction piping is located with the aid of a computer so that the vapors are efficiently captured. If covering of the area is required, suitable vapor covers are also installed.

The collected vapors are drawn through the piping manifold to the inlet of the thermal oxidizer. Instrumentation is used to provide a safe and uniform flow of vapors to the unit. By weight, most of the vapors consist of water vapor. The TerraTherm method minimizes the amount of air drawn through the system. In the thermal oxidizer, the vapors are subjected to temperatures that destroy the volatile organic compounds, releasing the halides, which then react with the water vapor to form acids. To ensure air emissions are properly cleaned to meet federal and local air pollution requirements, TerraTherm elected to have Bionomic Industries, a worldwide air pollution control systems supplier, provide their proven HI-TScrub™ hot gas quencher/scrubbing systems to guarantee gases are scrubbed to levels well below emission standards. To meet the site remediation allowed time constraints, the system must be reliable and normally operate 24 hours per day 7 days per week with minimal operator involvement. In the gas cleaning system, the hot gases (often over 1000 deg. F) are quenched with water. The gases, now below 150-180 deg. F, are placed into intimate contact with recirculated, pH adjusted water in a custom designed absorption tower. The acid halide gases are absorbed into the water and the alkalinity of the water neutralizes the acids to salts such as sodium chloride. The salt water is typically treated onsite to meet the requirements of the local sewer system. The following diagram shows the primary components of the Bionomic HI-TScrub™ gas cleaning system.



The result is that a site containing volatile organic contaminants that may pose a threat to consumers of groundwater or the neighborhood is now free of that threat. The remediation is conducted with minimal movement of material and with minimal disruption of the site or the surrounding area. Once the task is completed, the equipment is disassembled and moved to the next location. Within a short period of time, little or no evidence of the effort remains and the site can return to productive use.

TerraTherm has met the remedial goals at 100% of its projects, upon completion.

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