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EPA

A Citizen's Guide to Thermal Desorption

Technology Innovation Office _____ **Technology Fact Sheet**

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What Is Thermal Desorption?

Thermal desorption is an innovative treatment technology that treats soils contaminated with hazardous wastes by heating the soil at relatively low temperatures (200-1000°F) so that contaminants with low boiling points will vaporize (turn into gas) and, consequently, separate from the soil. (The other soil contaminants, if any, are treated by other methods.) The vaporized contaminants are collected and treated, typically by an air emissions treatment system.

Thermal desorption is a different treatment process than incineration. Thermal desorption uses heat to physically separate the contaminants from the soil, which then require further treatment. Incineration uses heat to actually destroy the contaminants.

How Does Thermal Desorption Work?

Thermal desorption makes use of either in situ or ex situ processes. *In situ* -- in place -- treats soils without excavating them. Ex situ treats excavated soils.

There are three steps in thermal desorption: 1) heating the soil to vaporize the contaminants; 2) treating the vaporized contaminants; and 3) testing the treated soil. There are four different methods for heating the soil to vaporize the contaminants:

- In situ steam extraction
- Direct heating
- Indirect heating
- Oxygen free heating

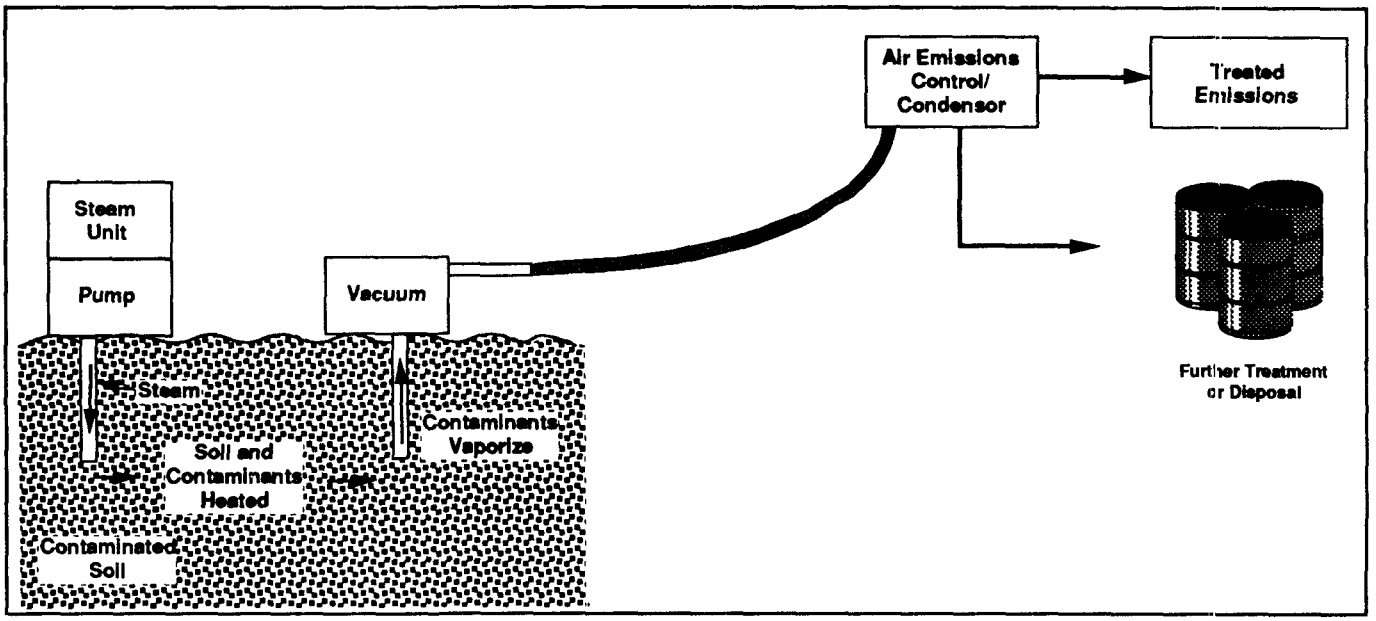
See Figure 1 on page 2 for an illustration of in situ steam extraction. Figure 2 on page 2 shows the processes that require excavation: direct heating, indirect heating, and oxygen free heating.

Thermal Desorption Profile

- **Heats soil at relatively low temperatures to vaporize contaminants and remove them.**
- **Is most effective at treating volatile organic compounds, semivolatile organic compounds and other organic contaminants, such as polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs).**
- **Offers a variety of heating methods for vaporizing the organic contaminants from the soil. These heating methods include transportable and in situ technologies.**

Produced by the Superfund Program

Figure 1
In Situ Steam Extraction



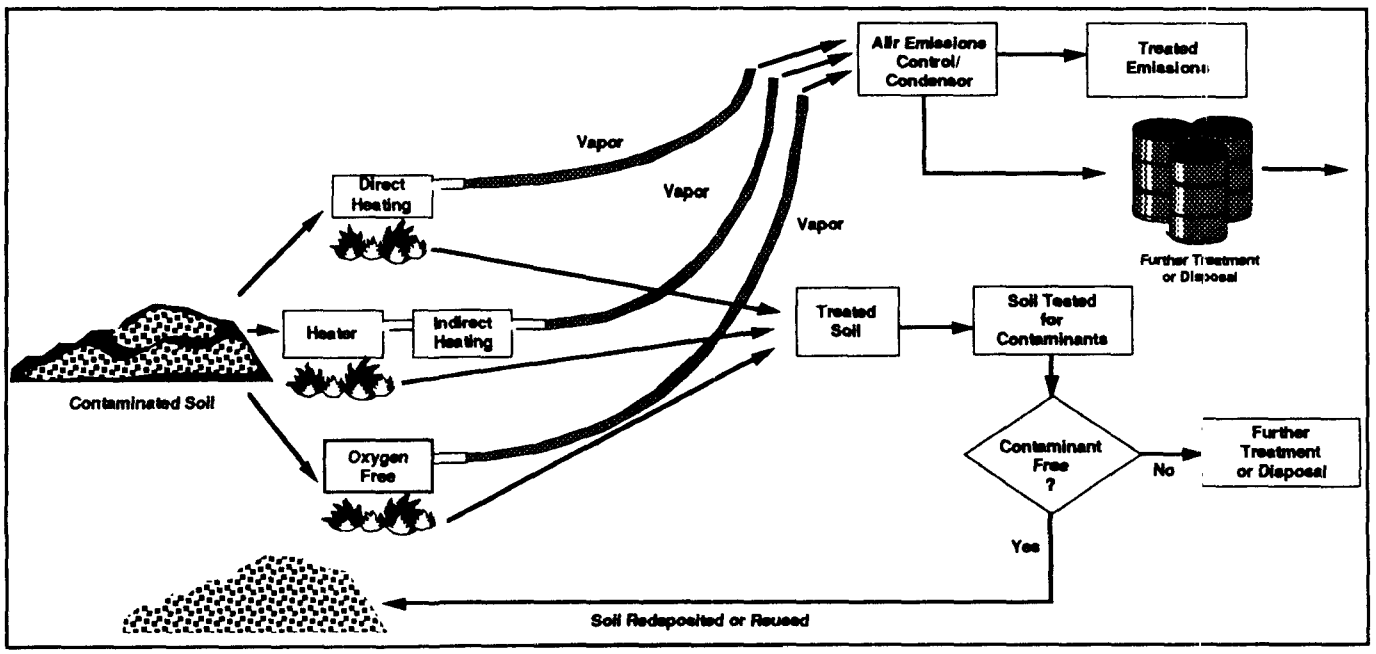
A variety of factors determine which heating method will be used, including soil type and amount, contaminant type and amount, and cost. Each of the four heating methods are briefly described below:

In situ (in place) steam extraction (Figure 1, above) - the soil is kept in place, and hot steam is pumped through the ground. The volatile contaminants vaporize and are collected in a vacuum. A disadvantage to this heating method is that a limited area of soil is treated at one time. Contaminants are, therefore, removed at a slower rate.

Direct heating (Figure 2, below) - the soil is excavated and put into a treatment vessel. The treatment vessel is heated and the heat is transferred to the soil. As the contaminants become heated they vaporize. The advantage of this heating method is that it is simple and cost effective to set up.

Indirect heating (Figure 2, below) - the soil is excavated and put into a treatment vessel. A burner is transported to the site, which heats an air source. The heated air is pumped into the treatment vessel by a blower. The air heats the soil, which causes the contaminants to vaporize. This heating method requires more fuel because some heat is lost during transfer.

Figure 2
Three Ex Situ Thermal Desorption Methods



Oxygen free (Figure 2, page 2) - the soil is placed in a treatment vessel which has no oxygen and which is sealed and filled with nitrogen to avoid any contact between the soil and oxygen. The outside of the vessel is heated, and the contaminants vaporize.

Once vaporized, the contaminants can be treated in the same manner regardless of the heating method. The vaporized contaminants are either: 1) cooled and condensed into a liquid, which is then placed in drums for treatment or disposal; or 2) trapped in carbon filters which are then treated or disposed of; or 3) burned in an afterburner. All disposals must meet Federal, State, and local standards. The selection of the vapor treatment system depends on the concentration of the contaminants, cleanup standards, and various economic and engineering considerations.

The performance of thermal desorption is typically measured by comparing the contaminant levels in treated soils with those of untreated soils. With the ex situ processes, if the treated soil is nonhazardous, it is redeposited on-site or taken elsewhere as backfill. If, however, the soil requires further treatment (for example, there are additional contaminants that do not respond to this process), it may be treated with another technology or transported off-site for disposal.

Why Consider Thermal Desorption?

Thermal desorption can effectively reduce hazards to both people and the environment. Thermal desorption is most successful in treating soils, sediments, and sludges that are contaminated with volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls (PCBs), and some polyaromatic hydrocarbons (PAHs). The equipment available is capable of treating up to 10 tons of contaminated soil per hour. Finally, the low temperatures require less fuel than other treatment methods.

Will It Work At Every Site?

Thermal desorption does not work well on all types of soil. If the soil is wet, water will vaporize along with the contaminants. Because of the additional substance (water) being vaporized, more fuel is required to vaporize all the contaminants in the wet soil. Soils with high silt and clay content are also more difficult to treat with thermal desorption. When heated, silt and clay emit dust, which can disrupt the air emission equipment used to treat the vaporized contaminants. In addition, tightly packed soil often does not permit the heat to make contact with all of the contaminants. It is, therefore, difficult for them to vaporize. Finally, thermal desorption has limited effectiveness in treating contaminants such as heavy metals, since they do not separate easily from the soil, and strong acids, since they can corrode the treatment equipment.

Where Is Thermal Desorption Being Selected?

Thermal desorption has been selected as a treatment method at numerous Superfund sites. For example, thermal desorption was used at the Cannon Engineering Corporation site in Plymouth, Massachusetts to treat soil contaminated with volatile organic compounds and semivolatile organic compounds. Thermal desorption effectively treated 11,330 tons of contaminated soil at the site. The process began in May 1990 and was completed five months later in October 1990. With this technology, cleanup goals for the site were met and exceeded. In addition, the property was restored so that, once again, it can be put to commercial or industrial use. Table 1 on the following page lists some additional Superfund sites where thermal desorption has been selected or used, their locations, and the types of facilities requiring treatment.

What Is An Innovative Treatment Technology?

***Treatment* technologies are processes applied to the treatment of hazardous waste or contaminated materials to permanently alter their condition through chemical, biological, or physical means. Technologies that have been tested, selected or used for treatment of hazardous waste or contaminated materials but lack well-documented cost and performance data under a variety of operating conditions are called *innovative* treatment technologies.**

Table 1
Superfund Sites Where Thermal Desorption Has Been Used or Selected

Site	Location	Types of Facilities*
Cannon Engineering	Massachusetts	Chemical waste handling, storage, and incineration
McKin	Maine	Waste storage, transfer, disposal
Ottati and Goss	New Hampshire	Drum reconditioning
RE-Solve	Massachusetts	Chemical reclamation
American Thermostat	New York	Industrial manufacturing of thermostats
University of Minnesota	Minnesota	University wastes (PCBs)
Martin Marietta	Colorado	Aerospace equipment manufacturer
Caldwell Trucking	New Jersey	Unpermitted septic waste
Claremont Polychemical	New York	Chemical
Fulton Terminals	New York	Former waste tank farm
Marathon Battery	New York	Former battery manufacturer
Metaltec/Aerosystems	New Jersey	Metal manufacturing
Reich Farms	New Jersey	Uncontrolled waste disposal
Sarney Farm	New York	Industrial and municipal landfill
Waldick Aerospace Devices	New Jersey	Manufacturing and electroplating of plane parts
Wamchem	South Carolina	Former dye manufacturing plant
Outboard Marine/ Waukegan Harbor	Illinois	Marine products manufacturing

*All waste types and site conditions are not similar. Each site must be individually investigated and tested. Engineering and scientific judgment must be used to determine if a technology is appropriate for a site.

For More Information

EPA prepared this fact sheet to provide basic information on thermal desorption. Additional technical reports listed below may be obtained by calling (513) 569-7562 or writing to:

Center for Environmental Research Information
26 West Martin Luther King Drive
Cincinnati, OH 45268

There may be a charge for these documents.

- **U.S. Environmental Protection Agency, 1990. In Situ Steam/Hot Air Stripping, Toxic Treatment, Inc., EPA/540/M5-90/003.**
- **U.S. Environmental Protection Agency, 1990. Inventory of Treatability Study Vendors, Volume 1, EPA/540/2-90/003a.**
- **U.S. Environmental Protection Agency, 1990. Second Forum on Innovative Treatment Technologies, Domestic and International, Philadelphia, PA, May 15-17, 1990, EPA/540/2-90/006 (Abstracts) or EPA/540/2-90/010 (Technical Papers).**
- **U.S. Environmental Protection Agency, 1991. Engineering Bulletin: Thermal Desorption Treatment, EPA/540/2-91/008.**

*U.S. Government Printing Office: 1992 — 648-080/60006