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Soil Remediation Technology

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THERMAL DESORPTION SYSTEMS

What Is Thermal Desorption?

Thermal desorption is one of many methods used to clean up soil that has been contaminated with hazardous chemicals.

Thermal desorption removes organic contaminants from soil, sludge or sediment by heating them (200-1,000 degrees F) in a machine called a "thermal desorber" to evaporate the contaminants.

Evaporation changes the contaminants into vapors (gases) and separates them from the solid material. Many organic contaminants can be removed by thermal desorption. These include volatile organic compounds or "VOCs" and some semi-volatile organic compounds or "SVOCs." VOCs such as solvents and gasoline evaporate easily when heated. These vaporized contaminants are then collected and treated, usually by an air emissions treatment system. (If there are other contaminants present in the soil, they are treated in other ways.)

SVOCs require higher temperatures to evaporate and include diesel fuel, coal tar, and several pesticides. Thermal desorption generally is not used to treat metals but can partially remove metals like mercury and arsenic, which evaporate at the temperatures sometimes reached in thermal desorption.

Thermal desorption is a different process than incineration because it uses heat to physically separate the contaminants from the soil. They will then require further

How it Works?

Thermal desorption involves excavating soil or other contaminated material for treatment in a thermal desorber. The desorber may be assembled at the site for onsite treatment, or the material may be transported to an offsite thermal desorption facility. To prepare the soil for treatment, large rocks, debris or metal parts first must be removed or crushed.

The prepared soil is placed in the thermal desorber to be heated. Low-temperature thermal desorption is used to heat the solid material to 200-600ºF to evaporate VOCs. If SVOCs are present, then high-temperature thermal desorption is used to heat the soil to 600-1000ºF.

Gas collection equipment captures the contaminated vapors. Vapors often require further treatment, such as removing dust particles. The remaining organic vapors are usually destroyed using auxilary thermal oxidizer,which heats the vapors to temperatures high enough to convert them to carbon dioxide and water vapor. At some sites with high concentrations of organic vapors, the vapors may be cooled and condensed to change them back to a liquid form. The liquid chemicals may be recycled for reuse, or treated by incineration. If the concentrations of contaminants are low enough, and dust is not a problem, the vapors may be released without treatment to the atmosphere.

Often, treated soil can be used to fill in the excavation at the site. If the treated soil contains contaminants that do not evaporate, such as most metals, they may be disposed of and capped onsite, or transported offsite to an appropriate landfill.

Where is thermal desorption being used?

Contaminated soil is treated for remediation of:

- Hydrocarbon/oil.
- Pesticide.
- Chlorine and Sulfur gas.
- PCB.
- Biological.
- Paints.
- Solevents.
- Aspestos.
- Dioxin.
- PVC, PE, & PP waste residues.

Why Use Thermal Desorption?

Thermal desorption is typically used to clean up soil that is contaminated with VOCs and SVOCs at depths shallow enough to reach through excavation. Thermal desorption may be faster and provide better cleanup than other methods, particularly at sites that have high concentrations of contaminants. A faster cleanup may be important if a contaminated site poses a threat to the community or needs to be cleaned up quickly so that it can be reused.

Thermal desorption works well at separating organics from refining wastes, coal tar wastes, waste from wood treatment, and paint wastes. It can separate solvents, pesticides, PCBs, dioxins, and fuel oils from contaminated soil.

Case Histories

High-temperature thermal desorption was used to clean up contaminated soil at the Industrial Latex Superfund site in New Jersey. From 1951 to 1983, Industrial Latex manufactured rubber and adhesives, contaminating soil with SVOCs, PCBs, and arsenic.

From April 1999 to June 2000, about 53,600 cubic yards of contaminated material were excavated to depths of contaminated material were excavated to depths of up to 14 feet. Materials greater than 2 inches in diameter were removed before placing the soil in the desorber and heating it to 900°F. About 225 tons of contaminated soil were treated each day. A small amount of treated soil had to be placed back in the desorber a second time to meet cleanup goals for PCBs, SVOCs, and arsenic. The cleaned soil was used to backfill the areas that had been excavated.

Vapors from the desorber passed through scrubbers and filters that removed dust particles and a filter that removed contaminant vapors.

The former chemical and bitumen works at West Bromwich, UK site occupied an area of 6 acres and was left with soils containing elevated levels of hydrocarbons averaging in excess of 45,000 mg/kg. After the remedial works, the TPH levels within the soils were typically reduced down to 98% even though the target clean up criteria stated to be below 5,000 mg/kg.

All soils remained on site during the works and were reused safely on the new residential development reducing the requirement and cost associated with landfill.

Thermal desorption was used at the TH Agriculture & Nutrition Company site in Albany, Georgia,to treat 4,300 tons of soil contaminated with pesticides. The system ran from July to October 1993 and met the cleanup goals, removing over 98% of the pesticides in the treated soil..

In West Bromwich, UK, a 34,000 tonnes of hydrocarbon contaminated soils were cleaned up using mobile thermal desorption technology. The remedial works enabled the construction of 150 new homes on land previously considered unfit for residential housing.

Desorption Unit

Design desorption unit is a rotary desorber, which has a rotating cylindrical metal drum. In a direct-fired rotary desorber, the contaminated soil enters the rotating cylinder and is heated by direct contact with a flame or the hot gasses coming off a flame.

In an indirect-fired rotary desorber, the soil does not come into contact with a flame or combustion gases. Instead, the outside of the cylinder is heated and the hot metal indirectly heats the soil tumbling inside.

As the soil is heated, the contaminants vaporize and become part of the gas stream of air and contaminated vapors flowing through the desorber toward the post-treatment system. Sometimes a non-reactive gas, such as nitrogen, is added to the gas stream to keep the vaporized contaminants from catching fire in the desorption unit and to help in vaporizing and removing the contaminants.

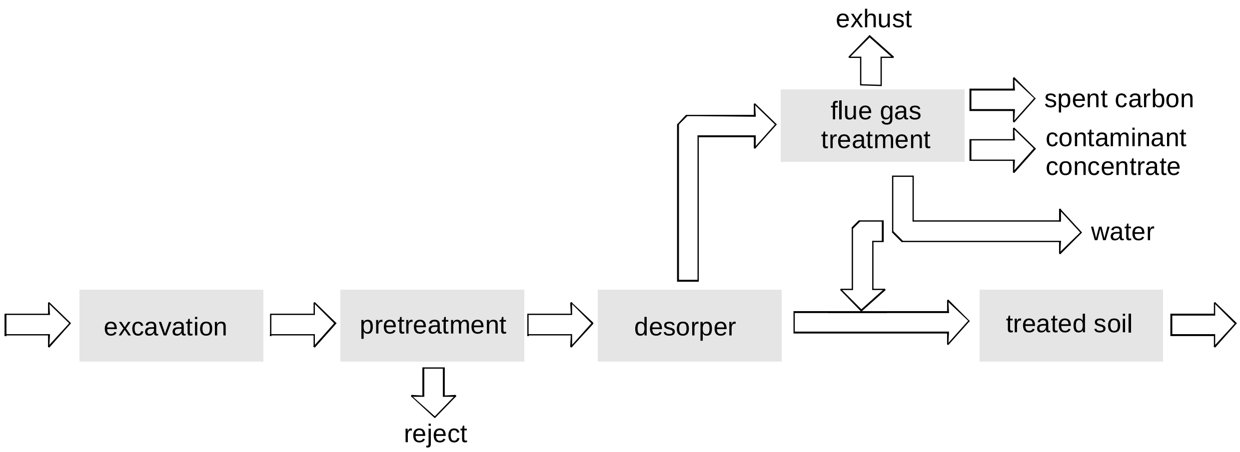
Off-gas. from the desorber is usually processed to take out particulate matter still in the gas stream after the desorption phase. The vaporized contaminants in this off-gas may be burned in an afterburner, collected on activated carbon, or recovered in condensation equipment.

Treated soil from the desorber is tested to see how well the process worked in removing the target contaminants. This is usually done by comparing the contaminant levels in treated soils with those of untreated soils.

Low Temperature Thermal Desorption (LTTD)

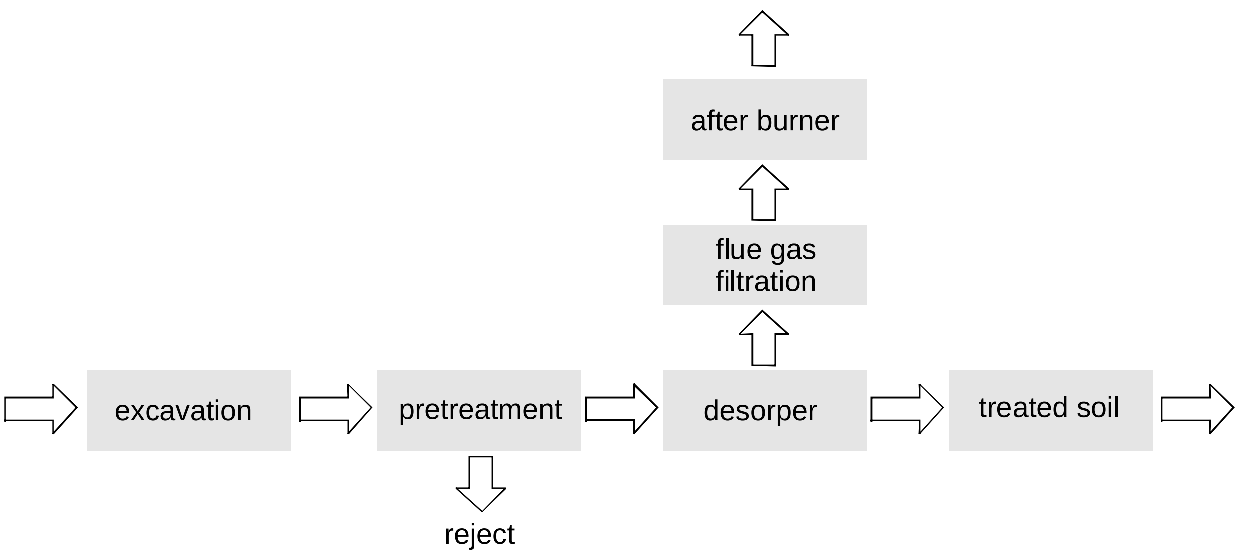
Low Temperature Thermal Desorption (LTTD) is an ex-situ remediation technology that utilizes heat to physically separate contaminants from soil and media. Low Temperature Thermal Desorption Units are designed to heat contaminated soils in a primary treatment unit (rotary kiln) to temperatures sufficient to cause the contaminants to volatilize and desorb (physically separate) from the soil or media. The vaporized hydrocarbons are then treated in a secondary treatment unit (e.g., afterburner/thermal oxidizer) where they are destroyed prior to discharge to the atmosphere.

Some preprocessing and postprocessing of soil is necessary when using thermal desorption. Excavated soils are first screened to remove large objects (greater than 2 inches in diameter). These may be sized (e.g., crushed or shredded) and introduced back into the feed material or decontaminated for beneficial reuse. After treatment soils are rehydrated to control fugitive emissions, stockpiled for analysis, then released for beneficial reuse.



High Temperature Thermal Desorption (HTTD)

HTTD is a full-scale technology in which wastes are heated to 320 to 560 °C (600 to 1,000 °F). HTTD is frequently used in combination with incineration, solidification/stabilization, or dechlorination, depending upon site-specific conditions. The technology has proven it can produce a final contaminant concentration level below 5 mg/kg for the target contaminants identified.



How Long Will It Take?

Thermal desorption may take from a few weeks to a few years. The actual cleanup time will depend on several factors. For example, thermal desorption may take longer where:

- The contaminated area is large or deep.
- Contaminant concentrations are high. The soil contains a lot of dust, clay, or organic material, which causes contaminants to stick to the soil and not evaporate easily.
- A lot of debris must be crushed or removed.
- The capacity of the desorber is small.

Is Thermal Desorption Safe?

Thermal desorption has been safely used at many sites. Environmental Protection Agencies will make sure that materials are handled properly at each stage of the process. Workers will take measures, such as covering loose soil, to control dust and vapors during excavation and treatment. If necessary, they collect and treat the gases that are produced in the desorber.

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