GeoMelt Process: An alternative for pesticides waste and soil treatment

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Introduction

GeoMelt is a mobile, thermal treatment process that involves the electric melting of contaminated soils, sludges, or other earthen materials and debris either in situ (in ground) or ex situ (above ground) for the purpose of permanently destroying, removing, and/or immobilising hazardous and radioactive contaminants.

The basic GeoMelt technology can be deployed in four different configurations, collectively called GeoMelt vitrification technologies, to meet a wide range of site remediation and waste treatment needs. The four GeoMelt treatments include:

- GeoMelt-ISV for in situ treatment. This provides treatment and disposal in a single step.
- GeoMelt-Staged ISV for treating materials that have been staged in the ground for processing. This method is used when it is desired to consolidate materials from several on-site locations into a single location in an optimal configuration for treatment. This also provides treatment and disposal in a single step.
- GeoMelt-Stationary Batch for repetitive melt cycling at a single above or below ground location. This method has been demonstrated using in-ground re-usable cells and in above-ground, refractory-lined, steel vessels.
- GeoMelt-Planar vitrification for subsurface melting or for the treatment of buried structures such as tanks.

Process description

The GeoMelt process works by establishing a melt between pairs of electrodes. Initially, electrical current is passed through a starter path causing it to heat and melt. Heat from the starter path is transferred to the surrounding soils causing the surrounding soils to melt. Once molten, the soil becomes sufficiently conductive to support the flow of electrical current, thereby dissipating enough joule heat to propagate the melting process. The addition of power is continued to the melt until such time that the melt has encompassed the entire treatment volume.

Individual melts in excess of 1,000 tonnes can be formed. Individual melts can range in size from 30 to 35 feet in diameter and up to 20 feet deep. Greater treatment depths are possible with the GeoMelt-Planar method. Off gases generated by the process are contained under a steel hood covering the treatment area and are drawn to an off-gas treatment system.

When electrical power is shut off, the molten mass solidifies into a vitreous and crystalline, rock-like monolith with unequalled physical, chemical, and weathering properties compared to alternative solidification/stabilisation technologies. The resulting product is typically ten times stronger than concrete and is extremely leach resistant. The process destroys organic contaminants such as dioxins, pesticides, and PCBs. Heavy metals and radionuclides are retained in the melt and immobilised in the resulting product. The resulting product is far superior (orders of magnitude better) in terms of durability, strength and leach resistance compared to other stabilisation or encapsulation technologies.

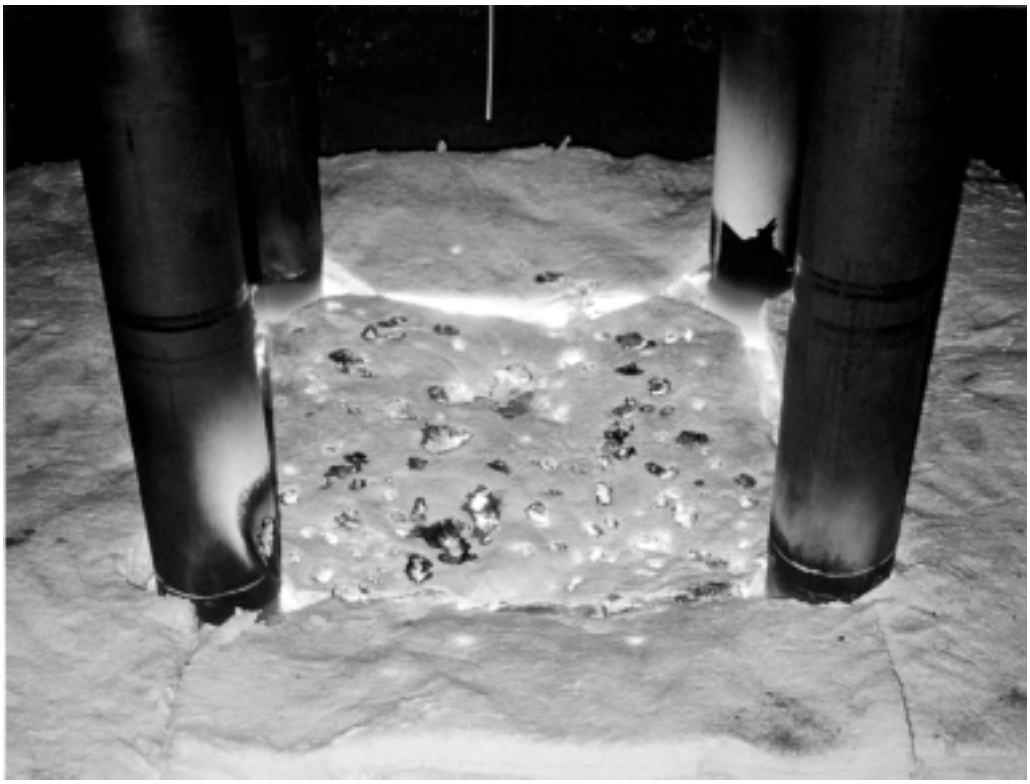

Figure 1. Melt start surface

If necessary, the vitrified product can later be exhumed and removed if it is desired to put the vitrified material in different location. Breaking up vitrified monoliths has been previously demonstrated with conventional rock breaking equipment. One of the benefits of this approach is that the potential for the spread of contamination of heavy metals immobilised in the product is virtually eliminated since inorganic contaminants are immobilised in the glass at the molecular level and remain immobilised in the glass / rock fragments.

The GeoMelt process has been used commercially to successfully treat all contaminant types (volatile and semi-volatile organics, heavy metals, and radionuclides) and all types of soil media (sands, silts, clays, and sludges). GeoMelt is also distinguished by its ability to tolerate significant amounts of debris within the treatment zone. Types of debris previously processed by GeoMelt in commercial operations include scrap metal, steel drums, concrete, asphalt, wood, plastic, paper, protective clothing, HEPA (High Efficiency Particulate Air) filters, and general construction demolition debris. Individual melts can accommodate a hundred or more tonnes of debris.

Treatment experience

The GeoMelt process has been successfully applied on a commercial basis on a number of projects. The process has received significant support from the US EPA. For example, the following is a listing of large-scale commercial GeoMelt projects completed on organo-chlorine wastes:

3,500 tonnes of PCB contaminated soil and debris at a private site in Spokane, Washington

2,500 tonnes of PCB contaminated soil and debris at a private site in Spokane

4,800 tonnes of soil and debris contaminated with pesticides (chlordane, DDT, dieldrin and small concentrations of dioxins and furans) in Grand Ledge, Michigan

6,000 tonnes of soil and debris contaminated with dioxins, pentachlorophenol and a range of other pesticides and herbicides in Salt Lake City, Utah

Figure 2. Hood, which is to be placed over the buried waste for in situ vitrification

The GeoMelt process normally achieves a very high destruction efficiency in the melt, which is the first step of the overall treatment process. Destruction efficiencies of >99% of the organic contaminants are typical for the melt. Any residual contaminants are captured and treated in the off-gas treatment system. The high temperature of the melt promotes pyrolysis and dechlorination reactions in the hot soil around the melt resulting in excellent destruction efficiencies.

GeoMelt process equipment

The GeoMelt treatment equipment consists of the following major components:

- Off-gas containment hood that is positioned above the treatment zone
- Off-gas treatment system
- Process control room
- Power transformer

All of the major GeoMelt treatment equipment components are trailer mounted except for the off-gas containment hoods. The large-scale off-gas treatment system is designed to collect and/or destroy any potentially hazardous materials present in the off-gas. The system consists of the following off-gas treatment steps:

- Prefiltering with HEPA filters to remove particulates from the off-gas stream.
- Quenching to cool the off-gases.
- Two stages of scrubbing with a Hydrosonic scrubber to remove particulates, acid gases and other condensables.
- Dewatering to remove water droplets from the gas stream.
- Heating to increase the dew point of the gas stream to prevent condensation.
- HEPA filtering as a final polishing step to remove any remaining particulates.
- Thermal or catalytic oxidation as a final polishing step to destroy any residual organic compounds.

The off-gas flow through the system is maintained by means of a high volume blower located near the end of the off-gas treatment system. This blower creates a negative pressure throughout the entire system including within the off-gas containment hoods.

A back-up blower provides vacuum to the off-gas hoods in the event of a failure of the main off-gas blower. The back-up blower provides approximately the same volumetric off-gas flow rate as the main blower. The off-gas passing through this back-up system can be processed by a wet cooler/scrubber, HEPA filters and thermal oxidiser before being exhausted to the atmosphere.

The power transformer is designed to accept three phase power supplied from either the electrical grid or diesel powered electrical generators. Both types of electrical supply have been used on GeoMelt projects. The transformer converts the three-phase power into two-phase power for the melt.