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Demonstration Bulletin

Low Temperature Thermal Treatment (LT³®) System

Roy F. Weston, Inc.

Technology Description: The Roy F. Weston, Inc. (Weston) low temperature thermal treatment (LT³®) system thermally desorbs organic compounds from contaminated soil without heating the soil to combustion temperatures. The transportable system is comprised of equipment assembled on three flat-bed trailers. With ancillary and support equipment, the system requires an area of about 5,000 sq ft. It was demonstrated under the SITE program at the Anderson Development Company (ADC) site in Adrian, MI, which was contaminated with volatile and semivolatile organic compounds (VOC and SVOC), and 4,4'-methylenebis (2-chloroaniline) (MBOCA). The LT³® system is divided into three main areas of treatment: soil treatment, emissions control, and water treatment. The system is shown in Figure 1 and described below.

The LT³® thermal processor consists of two jacketed troughs, one above the other. Each trough houses four intermeshed screw conveyors. A front-end loader transports feed soil (or sludge) to a weigh scale and deposits the material onto a conveyor that discharges into a surge feed hopper located above the thermal processor. The surge hopper is equipped with level sensors and provides a seal over the thermal processor to minimize air infiltration and contaminant loss. Soil moves across the upper trough, drops to the second trough, and exits the processor at the same end that it entered. Heat transfer fluid (or hot oil) circulates through the hollow screws and trough jackets. Thus, each screw conveyor mixes, conveys, and heats the contaminated soil during treatment. Soil is discharged from the thermal processor into a conditioner, where water is sprayed onto it for cooling and to minimize fugitive dust emissions. An inclined belt conveys the treated soil to a truck or pile.

A burner heats the oil to an operating temperature of 400 to 650 °F (about 100°F higher than desired soil temperature). Combustion gases released from the burner are used as sweep gas in the thermal processor. A fan draws sweep gas and desorbed organics from the thermal processor through a fabric filter baghouse. Depending on contaminant characteristics, dust collected on the fabric filter may be retreated, combined with treated material, or drummed separately for offsite disposal. Exhaust gas

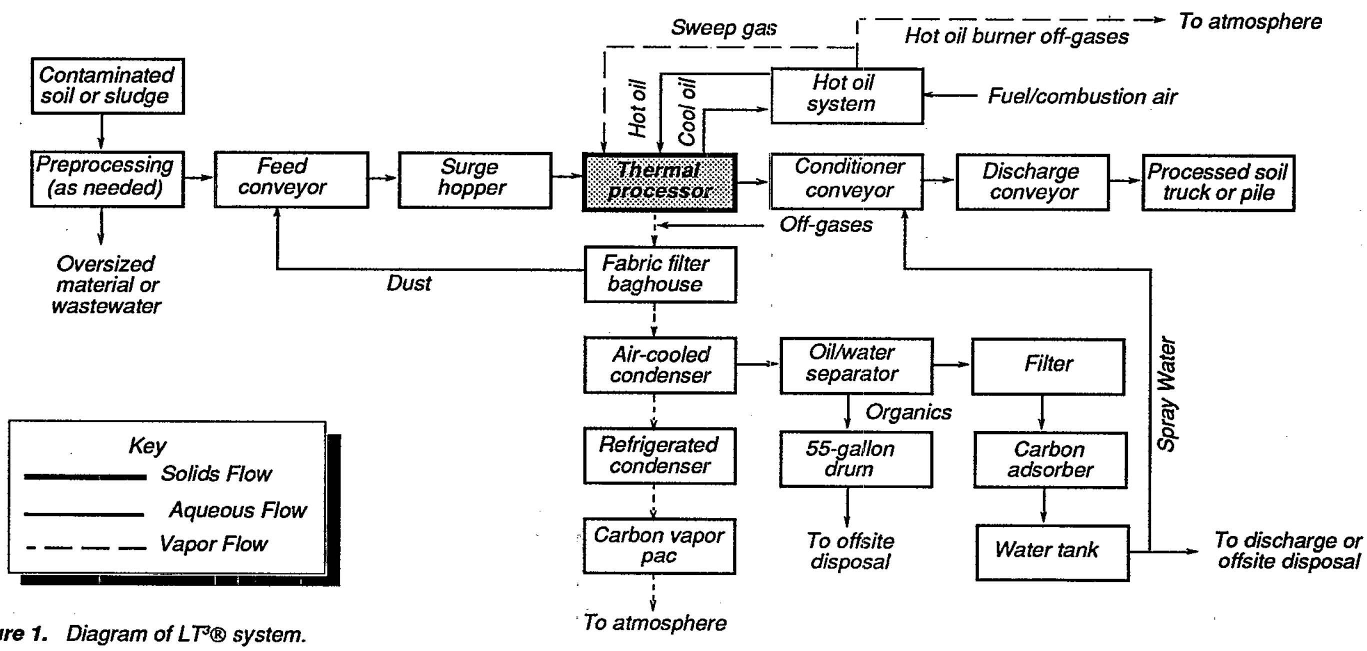

Figure 1. Diagram of LT³® system.

from the fabric filter is drawn into an air-cooled condenser to remove most of the water vapor and organics, and then through a second, refrigerated condenser to further lower the temperature and reduce the moisture and organic content of the off-gases. Electric resistance heaters then increase the off-gas temperature back to 70°F to optimize the performance of the vapor-phase activated carbon column which removes any remaining organics. While this is a typical operation, caustic scrubbers and afterburners have been employed as part of the air pollution control system at some sites.

Condensate streams are typically treated in a three-phase oil-water separator to remove light and heavy organic phases from the water phase that is then treated in the carbon adsorption system to remove residual organic contaminants. Treated condensate is often used for soil conditioning, and only the organic phases are disposed offsite. However, the separation step may not be appropriate when processing extremely wet materials like sludge, due to the high volume of condensate generated. In such cases, aqueous streams from both condensers may be pumped through a disposable filter to remove particulate matter prior to the carbon adsorption treatment and offsite disposal.

Waste Applicability: Weston reports that the LT³® system can process a wide variety of soils with differing moisture and contaminant concentrations, and that the technology is best suited for soils with a moisture content of less than 20% and VOC contaminant concentration of up to 1%. Wastes with moisture content greater than 50% need to be dewatered prior to treatment in the LT³® system. Screening or crushing of oversized material (greater than 2 in.), or clay shredding may be required for some applications.

Bench-, pilot-, or full-scale LT³® systems have been used to treat soil contaminated with the following wastes: coal tar, drill cuttings (oil-based mud), No. 2 diesel fuel, JP4 jet fuel, leaded and unleaded gasoline, petroleum hydrocarbons, halogenated and nonhalogenated solvents, VOCs, SVOCs, and polynuclear aromatic hydrocarbons.

Demonstration Results: The LT³® SITE demonstration was conducted in November and December 1991, as part of a proof-of-process test for full-scale remediation of the ADC lagoon sludge. Feed preparation for the sludge at the ADC site included lime and ferric chloride addition followed by filter press dewatering to a moisture content of 14% to 44%. During the demonstration, contaminated sludge was heated to above 500°F for a residence time of 90 min; the system throughput was approximately 2.1 tons/hr.

Six replicate tests were conducted, each lasting approximately 6 hr. Solid and liquid sampling locations for each test included contaminated feed sludge, treated sludge, fabric filter dust, and condensate liquid. Off-gases were also sampled before and after carbon treatment during each run. Solid, liquid, and gas samples were analyzed for MBOCA, VOCs, SVOCs, dioxins, and furans. Samples were also analyzed for chloride and total organic halides, to trace the fate of chloride through the system, and a variety of other parameters were analyzed to characterize the feed and treated sludge. Continuous emissions monitoring (CEM) of off-gases included total hydrocarbons (THC), carbon monoxide, carbon dioxide, and oxygen. Key findings from the SITE demonstration are summarized below:

- The LT³® system removed VOCs to below method detection limits (less than 0.060 milligrams per kilogram [mg/kg] for most compounds).
- The LT³® system achieved MBOCA removal efficiencies greater than 88%; concentrations in the treated sludge ranged from 3.0 to 9.6 mg/kg.
- The LT³® system decreased the concentrations of all SVOCs in the sludge, with two exceptions. The increase in phenol concentration is most likely due to chemical transformations during heating. A minor leak of heat transfer fluid, which contains triphenylene, probably caused the apparent increase in chrysene concentration.
- Dioxins and furans were formed in the system, but the 2,3,7,8-TCDD isomer was not detected in treated sludge.
- Stack emissions of non-methane THC increased from 6.7 to 11 parts per million by volume (ppmv) during the demonstration; the maximum emission rate was 0.2 pounds per day (ppd). The maximum particulates emission rate was 0.02 ppd, and no chlorides were measured in stack gases.

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