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TECHNOLOGY EVALUATION

Demonstration Bulletin

Low Temperature Thermal Aeration (LTTA®) Process

Canonie Environmental Services, Inc.

Technology Description: The Low Temperature Thermal Aeration (LTTA®) process was developed by Canonie Environmental Services, Inc. (Canonie), as a treatment system that desorbs organic contaminants from soils by heating the soils up to 800 °F. The main components of the LTTA® process include the following: (1) a materials dryer, (2) a pug mill, (3) two cyclonic separators, (4) a baghouse, (5) a wet Venturi scrubber, (6) a liquid-phase granular activated carbon (GAC) column, and (7) two vapor-phase GAC beds (see figure 1).

A front-end loader transports contaminated soils to feed hoppers, which release the soil onto a conveyor belt. The conveyor belt transports the contaminated soils into the materials dryer. Contaminated soils in the materials dryer are heated by a parallel-flow hot air stream heated by a propane/fuel oil burner. The materials dryer is a rotating drum 8 ft in diameter and 40 ft long equipped with longitudinal flights for soil mixing.

Processed soil is discharged to an enclosed pug mill, where water is added to cool it and to control fugitive dust emissions. Treated soil is released onto a discharge conveyor and stockpiled. The stockpiled soil is tested onsite to confirm that the treated soil meets clean-up goals and then disposed of onsite or re-treated, as required.

The exhaust air stream from the materials dryer, containing vaporized organic contaminants and airborne soil particulates, is treated with a series of standard air pollution control devices before being vented to the atmosphere. The exhaust air stream is first vented into two cyclonic separators operating in parallel to remove coarse particulates. The exhaust air stream from the cyclonic separators is then directed to a baghouse that removes the remaining coarse particulates. The particulates collected at the base of the cyclonic separators and at the baghouse are transferred by a screw auger to the pug mill, where they are incorporated into the treated soil.

Following removal of coarse particulates, the exhaust air stream is directed to a wet Venturi scrubber that (1) removes fine particulates, (2) neutralizes acid vapors, and (3) removes any water-soluble organic contaminants. Sodium hydroxide is added as needed to the scrubber liquor to maintain a system pH above 7.0. Scrubber blowdown is treated by a liquid-phase GAC column before being used as quench water in the pug mill; no scrubber wastewater is discharged from the process.

The final portion of the air pollution control system includes two vapor-phase GAC beds operating in parallel that remove any remaining organic

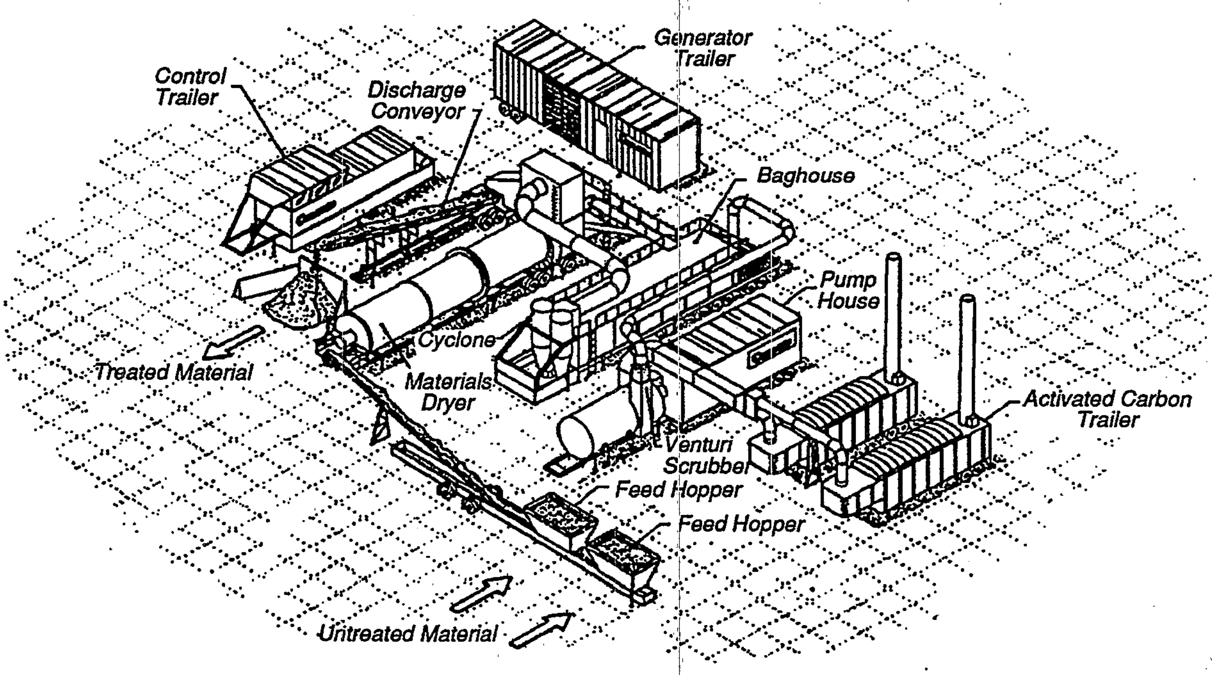

Figure 1. LTTA® soil processing equipment layout.

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contaminants. The treated exhaust air stream is then vented to the atmosphere.

Waste Applicability: The LTTA® process has remediated contaminated soils at six sites including three Superfund sites. More than 90,000 tons of soil have been treated by the LTTA® process. The LTTA® process can remove volatile organic compounds (VOC), semivolatile organic compounds (SVOC), organochlorine pesticides (OCP), organophosphorous pesticides (OPP), and total petroleum hydrocarbons (TPH) from soils, sediments, and sludges. Full-scale LTTA® operations have been used to remove VOCs such as benzene, toluene, tetrachloroethene (PCE), trichloroethene (TCE), and dichloroethene (DCE); SVOCs such as acenaphthene, chrysene, naphthalene, and pyrene; OCPs such as toxaphene and dichlorodiphenyltrichloroethane (DDT) and its metabolites; OPPs such as ethyl parathion and methyl parathion; and TPHs. Canonie reports removal efficiencies of greater than 99% for VOCs at concentrations up to 5,400 milligrams per kilogram (mg/kg), greater than 92% for pesticides up to 1,500 mg/kg, and 67 to 96% for SVOCs up to 6.5 mg/kg.

The LTTA® process is best suited for dry granular soils, however soils containing silt and clay have been successfully treated, and sludges are potentially treatable by the LTTA® process.

Demonstration Results: The LTTA® demonstration was conducted in September, 1992, as part of ongoing remediation of a pesticide-contaminated site in western Arizona. Soils at the site had been impacted with toxaphene, DDT, its derivatives DDD and DDE as well as other pesticides. Feed soil consisted of a dry, clayey loam that was pretreated by removing large cobble-sized particles with a vibrating screen prior to entry into the feed hopper. Soils were heated to 730 °F. A feed rate ranging between 34 and 38 tons/hr was utilized during the demonstration.

Three 8-hr replicate test runs were conducted. For each run, samples of intake water, feed soil, treated soil, Venturi scrubber liquor, treated scrubber liquor, stack gas emissions, and the vapor-phase GAC beds were collected. Solid, liquid, and gas samples were analyzed for pesticides, VOCs, SVOCs, dioxins, and furans. To qualitatively trace the fate of chloride through the system, samples were analyzed for chloride and total organic halides. A variety of other parameters were also analyzed to characterize the feed and treated soil. Key findings from the SITE demonstration are summarized below:

- The LTTA® process met the specified cleanup criteria for the site, a sliding scale criteria correlating the concentrations of DDT family compounds (DDD, DDE, and DDT) with concentrations of toxaphene. The maximum allowable pesticide concentrations in the treated soil were 3.52 mg/kg of DDT family compounds and 1.09 mg/kg of toxaphene.
- Residual levels of all the pesticides in the treated soil were generally below or close to the laboratory detection limit, with the exception of 4,4-DDE which was found at residual concentrations of 0.1 to 1.5 mg/kg. Removal efficiencies for pesticides found in the feed soil at quantifiable concentrations are summarized below:

Compound	Efficiency
4,4'-DDD	>99.97%
4,4'-DDE	90.26%
4,4'-DDT	99.97%
Endrin	>99.85%
Toxaphene	>99.83%
Endosulfan I	>99.98%

- The LTTA® process did not generate dioxins or furans as products of incomplete combustion or thermal transformation.
- Some thermal breakdown products were formed within the LTTA® process, which mainly included acetone, acrylonitrile, benzoic acid, benzyl alcohol, benzaldehyde, dihydrofuranone, phenol, and methyl phenol. These products were extensively removed in the untreated scrubber liquor and the vapor-phase GAC beds. The stack emissions included some of the compounds at low concentrations.
- The average emissions rate for compounds detected at quantifiable levels in the stack gas included 4,4-DDE at 0.000043 plb/hr, chloromethane at 0.020 lb/hr, benzene at 0.053 lb/hr, and toluene at 0.008 lb/hr. The presence of acetonitrile and acrylonitrile in the stack emissions are currently being confirmed.
- The LTTA® process performed efficiently with no down time during the demonstration. A staff of 6 to 8 is required to operate the LTTA® process, including site supervisors, an excavation crew, support staff, and laboratory chemists for next day confirmation testing. The LTTA® process layout requires space for eight to 10 flat-bed trailers and sufficient area (150' x 150') to stage feed and treated soils.

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