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Demonstration Bulletin

Thermal Desorption System

Clean Berkshires, Inc.

Technology Description: A thermal desorption system (TDS) has been developed by Clean Berkshires, Inc. (CBI), Lanesboro, Massachusetts for ex-situ treatment of soils and other media contaminated with organic pollutants. The TDS uses heat as both a physical separation mechanism and as a means to destroy contaminants. The process is continuous and is composed of three different operations: feed preparation, contaminant volatilization, and gas treatment.

Feed preparation begins with a sequence consisting of crushing, shredding, and screening excavated or dredged waste material to reduce maximum particle size to 3/4-inch. Next, using a front-end loader, the waste is repeatedly folded into itself in an attempt to distribute moisture and pollutants evenly. This step is particularly important since it helps protect the system from severe, sudden thermal shocks caused by "hot spots" in the waste. The prepared material is then dumped into surge bins and fed into a kiln through a two-stage conveyor belt system.

Contaminant volatilization begins after the prepared material enters the kiln. The temperature of the soil is increased through contact with an air stream heated by a natural gas burner located at the entrance of the kiln. The kiln is equipped with specially designed flights which lift and veil the soil, exposing greater surface area to the hot gases, improving volatilization. Treated soil exits the kiln and enters a pug mill which combines the material with solid residuals from gas treatment. Water recycled from the quench tower is added at this time to cool the treated materials and to control fugitive dust emissions. The solids are deposited onto a discharge conveyor and stockpiled.

Gas treatment begins when the gas stream from the kiln, which contains volatilized contaminants and entrained particulate, enters a multi-stage treatment sequence. The sequence uses the following: a cyclone to remove coarse particulate, a high-efficiency afterburner to destroy organics, a quench tower to cool the gas stream, and a baghouse to remove filterable particulate still suspended in the gas stream. A scrubber could be added to remove sulfur dioxide if levels are high enough to impact air quality standards. Treated gases exit the system through a 75-foot high stack. Solid residuals from gas treatment are transferred by a screw auger to the pug mill and are combined with the treated waste material.

The TDS is transportable and is monitored and controlled by a computer-based data acquisition system.

Waste Applicability: The CBI TDS process has been successfully applied at two sites processing soils from throughout New England and New York. To date, over 250,000 tons of solid wastes have been treated using this technology. The CBI TDS can remove volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), organometallic complexes, and total petroleum hydrocarbons (TPHs). Full-scale CBI TDS operations have been used to remove VOCs such as benzene, toluene, ethylbenzene, and xylene (BTEX); SVOCs such as naphthalene, phenanthrene, chrysene, benzo(a)pyrene, and other polynuclear aromatic hydrocarbons (PAHs); organometallic complexes such as ferricyanides; and TPHs in the range of C_4 to C_{12}.

Demonstration Results: The CBI TDS Demonstration took place at the Niagara Mohawk Power Corporation's Remediation Technologies Demonstration Facility at Harbor Point in Utica, New York between November 15 and December 13, 1993. Figure 1 is a photo of the TDS used at this site. Harbor Point is the site of a former manufactured gas plant (MGP) and is contaminated with BTEX and PAHs, ferricyanide compounds, and a variety of heavy metals. Four different types of MGP solid wastes were tested: (1) coke plant residuals; (2) purifier wastes; (3) water gas plant residuals; and (4) Utica Terminal Harbor sediments. Maximum pollutant concentrations were 320 milligrams per kilogram (mg/kg) BTEX; 3500 mg/kg PAHs; 1200 mg/kg cyanide; 60 mg/kg arsenic; and 320 mg/kg lead.

Three 4-hr replicate runs were conducted for each waste type. For each run, samples were collected from feed soil, treated soil, cyclone solids, baghouse solids, quench water, intake water, and stack gases. Samples were analyzed for PAHs, BTEX, cyanide and metals. Feed soil samples were also analyzed for other chemical and geotechnical parameters.

Critical operating parameters were optimized and monitored for each waste type. Soil feed rate and kiln soil exit temperature were varied for each waste stream, based on preliminary results from an experimental test phase. The range for each parameter was as follows: feed rate, 16 to 22 tons per hour; kiln soil exit temperature, 620 to 860 °F; afterburner residence time, 0.82 to 0.87 seconds; and afterburner temperature, 1810 to 1820 °F.

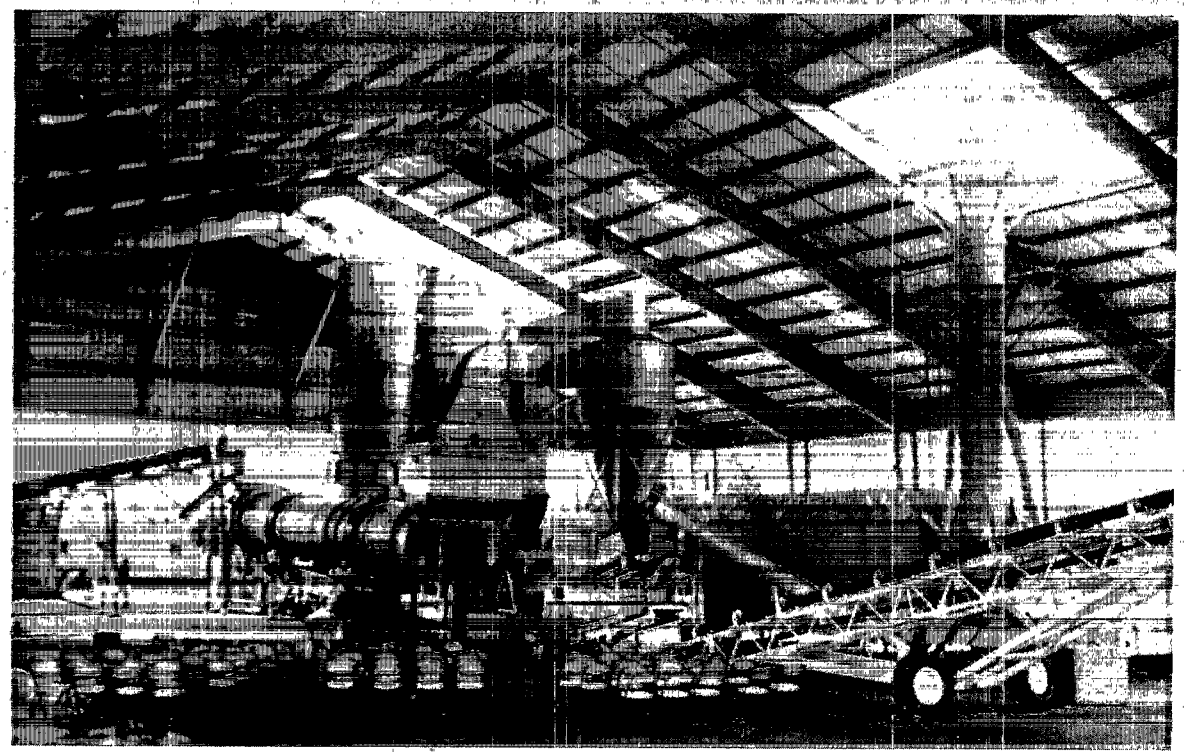

Figure 1. Clean Berkshires, Inc. Thermal Desorption System

Preliminary results from the SITE Demonstration are summarized below:

- The CBI TDS achieved DREs of 99.99 percent or better in all 12 runs using total xylenes as a volatile principal organic hazardous constituent (POHC).
- DREs of 99.99 percent or better were achieved in 11 of 12 runs using naphthalene as a semivolatile POHC.
- Average concentrations for critical pollutants in treated soils were 0.066 mg/kg, BTEX; 12.4 mg/kg, PAHs; and 5.4 mg/kg total cyanide.
- Comparison of the dry weight basis concentration of pollutants in the feed and treated soil showed the following average removal efficiencies: 99.8 percent, BTEX; 98.6 percent, PAHs; and 97.4 percent total cyanides.
- The CBI TDS showed good operating stability during the Demonstration with only a minor amount of down time.

An Innovative Technology Evaluation Report describing the complete Demonstration will be available in the Fall of 1994.

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