United States
Environmental Protection
Agency

EPA/540/MR-94/504
March 1994

SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION

Demonstration Bulletin

The ECO Logic Thermal - Desorption Unit

Middleground Landfill - Bay City, MI - ELI ECO Logic International, Inc.

Technology Description: Eco Logic has developed a thermal desorption unit (TDU) for the treatment of soils contaminated with hazardous organic contaminants. This TDU has been designed to be used in conjunction with Eco Logic's patented gas-phase chemical reduction reactor. The Eco Logic reactor is the subject of an independent SITE Demonstration (see SITE Bulletin: EPA/540/MR-93/522, September 1993).

The TDU (see Figure 1) consists of an externally-heated bath of molten tin metal, blanketed in a hydrogen gas atmosphere. Eco Logic offers several reasons for using tin: tin and hydrogen are nonreactive; tin's density allows soils to float on the surface of the molten bath; tin's low vapor pressure prevents evaporation of the tin into the hydrogen; molten tin is a good fluid for heat transfer; tin is non-toxic as a soil contaminant; and tin has been used as a bath medium in the manufacture of plate glass for many years.

Contaminated soil is conveyed into a hopper where an auger feeds the soil into the TDU. The screw feeder provides a gas seal between the outside air and the hydrogen atmosphere inside the TDU. The auger's variable speed drive provides feedrate control. Soil inside the TDU floats on top of the molten tin and is heated to 600°C, vaporizing the water and organic material. Decontaminated soil is removed from the tin bath into a water-filled quench tank. The water in the quench tank provides a gas seal between the TDU's hydrogen atmosphere and the outside air. A scraper mechanism removes desorbed soil from the quench tank into drums.

After desorption from the soil, the organic contaminants are swept into the companion reactor where they undergo gas-phase reduction reactions with the hydrogen at elevated temperatures. This gas-phase reduction reaction takes place within Eco Logic's specially-designed reactor: a cylindrical vessel with a hollow ceramic tube and electric glo-bar heaters. The reactor operates in a hydrogen atmosphere. Desorbed organics from the TDU enter the reactor and swirl between the reactor's side wall and the ceramic tube. By the time the mixture enters the central tube, it has been heated to at least 850°C. The reduction reactions take place as the gas travels up the central tube to the scrubber.

The scrubber removes hydrogen chloride, heat, water, and fine particulate matter from the gas stream. When processing low organic wastes, approximately 95% of the hydrogen-rich gas recirculates back into the reactor, while the remaining 5% is used as supplementary fuel for the system's propane-fired boiler. Pro-

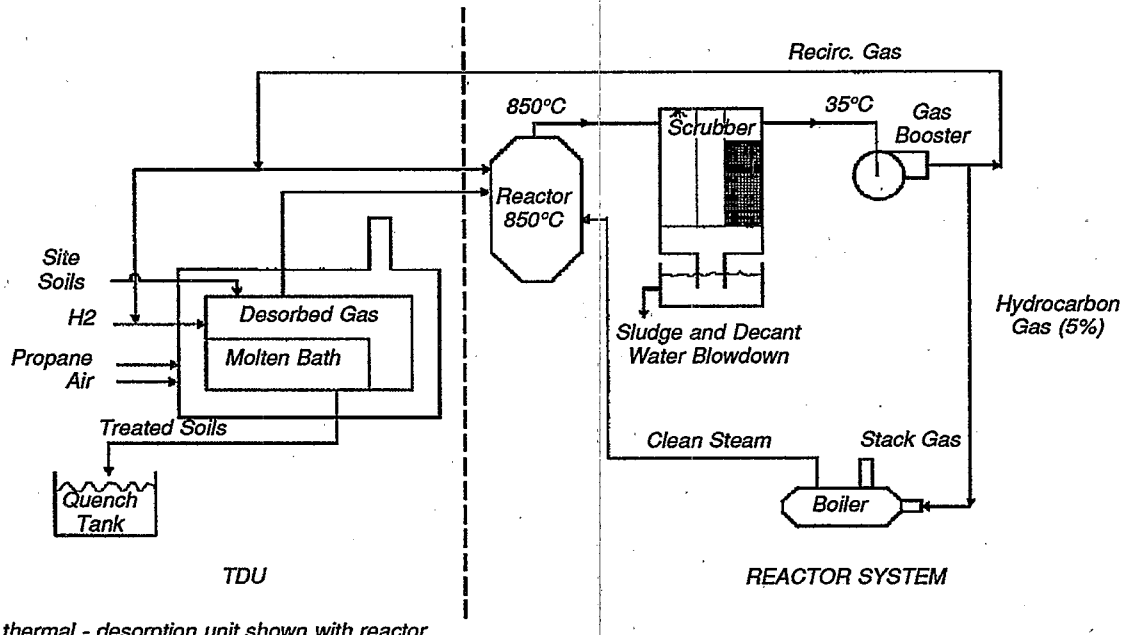

Figure 1. ECO logic thermal - desorption unit shown with reactor.

cessing waste streams with a high organic content produces much more excess gas, which can be compressed, stored, and analyzed before use as a supplementary fuel.

The TDU can be transported on a single, standard flatbed trailer. The companion reactor, scrubber, boiler, and auxiliary equipment are mounted on two standard, drop-deck highway trailers.

Waste Applicability: The TDU, when coupled with it's companion reactor, is suitable for many wastes including polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), chlorinated dioxins and dibenzofurans, chlorinated solvents, chlorbenzenes, and chlorophenols. The TDU is designed to treat most soil and sludge wastes, including those with a high water content.

Demonstration Results: The U.S. EPA's Superfund Innovative Technology Evaluation (SITE) Program, in cooperation with Environment Canada, the Ontario Ministry of the Environment, and the City of Bay City sponsored a demonstration of the Eco Logic TDU in conjunction with the Eco Logic reactor system at the Middleground Landfill in Bay City, Michigan during November and December 1992. Previous tests of the reactor system conducted during October 1992 demonstrated 99.9999% destruction and removal efficiency on PCB-contaminated water (approximately 4000 ppm PCBs) and oil (24.5% PCBs).

The TDU test plan called for three analytical test runs on soils excavated from the landfill. The soils contained approximately 1000 ppm PCBs. Tests were conducted under a TSCA R&D permit. Run 1, hampered by shakedown and materials handling problems, caused Eco Logic to make modifications to the system prior to Run 2. Run 2 was conducted with a reduced feed throughput in order to increase soil residence time on the tin bath to adequately heat clumps of soil that formed in the system. Run 3 was cancelled due to TSCA permit time constraints.

The demonstration achieved the following:

- PCB destruction and removal efficiencies (DREs) for the TDU and reactor system combined were 99.9999% for Run 1. Run 2 results were impacted by sampling and analytical problems.
- PCB concentrations in the cleaned soil ranged between 8 and 30 ppm.
- Destruction efficiencies (DEs) for hexachlorobenzene (added as a surrogate waste) ranged from 72% for Run 1 to 99.99% for Run 2.
- Throughput was 180 lb/hr for Run 1 and 55 lb/hr for Run 2.

Eco Logic plans to modify the materials handling capabilities of the TDU to eliminate clump formation and increase throughput.

The final report will address other test results, including an analysis of process inputs, intermediates, and outputs. System reliability, mass balances, costs, and safety will also be addressed.

For Further Information Contact:

SITE Project Manager:
Gordon M. Evans
U.S. EPA
Risk Reduction Engineering Laboratory
26 W. Martin L. King Dr.
Cincinnati, OH 45268
(513)-569-7684

*U.S. Government Printing Office: 1994 — 550-067/80235

United States
Environmental Protection Agency
Center for Environmental Research Information
Cincinnati, OH 45268

Official Business
Penalty for Private Use
$300

EPA/540/MR-94/504