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SITE
SUPERFUND INNOVATIVE
TECHNOLOGY EVALUATION

Demonstration Bulletin

Gas-Phase Chemical Reduction

Eco Logic International, Inc.

Technology Description: The patented Eco Logic Process employs a gas-phase reduction reaction of hydrogen with organic and chlorinated organic compounds at elevated temperatures to convert aqueous and oily hazardous contaminants into a hydrocarbon-rich gas product. After passing through a scrubber, the gas product's primary components are hydrogen, nitrogen, methane, carbon monoxide, water vapor, and other lighter hydrocarbons. Most of this gas recirculates in the process while excess gas can be compressed and stored or used as supplementary fuel for the system's propane-fired boiler.

The gas-phase reduction reaction takes place within a specially-designed reactor. Nozzles, mounted tangentially around the top of the reactor, inject a mixture of atomized waste, steam, and hydrogen into this cylindrical vessel. As the mixture swirls down between the outer reactor wall and a central ceramic tube, it passes a series of electric glo-bar heaters. By the time the mixture enters the ports at the bottom of the ceramic tube, it has been heated to at least 850°C. The gas-phase reduction reaction takes place as the gases enter the ceramic tube and travel up toward the scrubber.

The scrubber removes hydrogen chloride, heat, water, and particulate matter from the gas stream. When processing wastes with low organic content, approximately 95 percent of the hydrogen-rich gas recirculates back to the reactor; the remaining 5 % can be used as supplementary fuel for a propane-fired boiler that produces steam to preheat the waste. Processing waste with a high-organic content produces excess gas product, which can be compressed and stored for later analysis and disposal. The reactor, scrubber, boiler, and auxiliary equipment are mounted on two standard, drop-deck, highway trailers. A computerized pro-

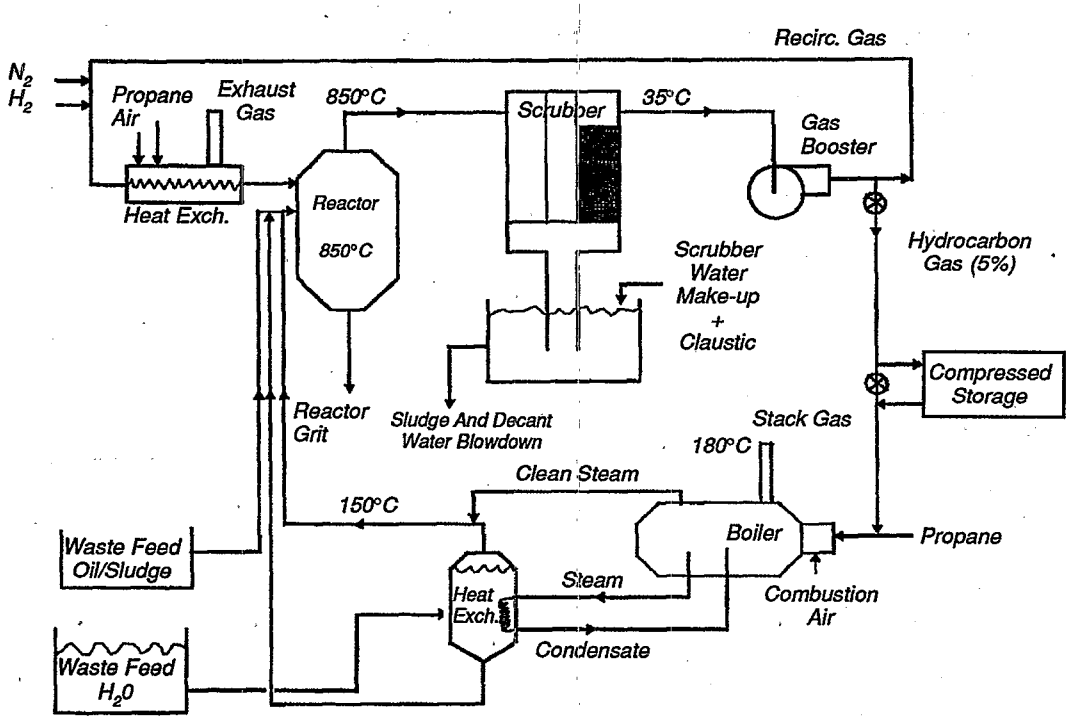

Figure 1. Reactor System Schematic

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cess control system allows the operator to monitor process variables such as temperature, pressure, hydrogen content, and oxygen levels. In addition, Eco Logic employs an on-line chemical ionization mass spectrometer (CIMS) to continuously monitor selected organic compounds.

Waste Applicability: The Eco Logic Process is designed to treat polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), chlorinated dioxins and dibenzofurans, chlorinated solvents, chlorobenzenes, and chlorophenols. The SITE Demonstration proved that the process can achieve 99.9999% destruction and removal efficiencies for PCBs in waste streams at concentrations ranging from 4600 ppm in a contaminated aqueous mixture to 24.5% in waste oils that contain chlorinated solvents and other hydrocarbons.

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 Energy, and the City of Bay City, conducted a demonstration of the Eco Logic Process at the Middleground Landfill in Bay City, Michigan during October and November 1992. This demonstration was conducted under a TSCA Research & Development permit. The formal test program consisted of two separate waste feed conditions:

- a wastewater containing an average 4600 ppm PCBs
- a waste oil containing an average 24.5% PCBs

Both feeds were tested in triplicate. In addition to the analytical test program, EPA conducted a 72-hour engineering performance test. In a companion program conducted at the Bay City site, Eco Logic demonstrated their proprietary thermal desorption unit, designed to process soils. This test is the subject of a separate set of SITE reports.

Key findings from the Eco Logic demonstration are summarized below:

- At least 99.9999% destruction and removal efficiency (DRE) for PCBs during all test runs
- A 99.99% destruction efficiency (DE) for perchloroethylene, a tracer compound, during all test runs
- Net destruction of trace feedstock dioxin and furan compounds during all test runs
- Successful completion of a 72-hour engineering performance test
- Throughput (tons/day)

	Nominal Design	*Demonstrated Rate*
Oily Waste	*4*	*2.3*
Water/Oil Waste	*10*	*7.0*

EPA will publish an Applications Analysis Report and a Technology Evaluation Report in the fall of 1993. These reports will address all tests results in detail, including a complete analysis of process inputs, intermediates, and outputs observed during the demonstration. Among the items covered will be an analysis of the products of incomplete combustion, hydrogen chloride emissions, and criteria air pollutants. System reliability, mass balances, costs, and safety will also be addressed.

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