

ANH/EMO/SUMM-93615
CONF-971125--11-Summ.

Argonne National Laboratory's Photo-Oxidation Organic Mixed Waste Treatment
System - Installation and Startup Testing

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This paper described the installation and startup testing of the Argonne National Laboratory (ANL-E) Photo-Oxidation Organic Mixed Waste Treatment System. This system will treat organic mixed (i.e., radioactive and hazardous) waste by oxidizing the organics to carbon dioxide and inorganic salts in an aqueous media. The residue will be treated in the existing radwaste evaporators. The system is installed in the Waste Management Facility at the ANL-E site in Argonne, Illinois.

The Photo-Oxidation Organic Mixed Waste Treatment System uses hydrogen peroxide, Fenton's Reagent (ferrous sulfate), and ultraviolet light to produce OH radicals which react with the organic. The design processing rate is 0.67 kg of toluene per hour. A diagram of the system is shown in Figure 1. The waste is metered from the Waste Feed Tank to the Process Batch Tank at a rate that matches the total organic carbon (TOC) destruction rate. The Process Batch Tank has an initial inventory of 4.6 m³ (1200 gallons) of water and is recirculated through the ultraviolet reactor (30 kW lamp) and a heat exchanger at approximately 0.19 m³/min (50 gal/min). Hydrogen peroxide (30 wt%) is continuously metered into the Process Batch Tank. Sulfuric acid (30 wt%) and sodium hydroxide (35 wt%) are added to control the pH and the Fenton's Reagent is added at the start of a batch and as needed. The hydrogen peroxide and iron are monitored by sampling and using test strips to measure the concentrations; the hydrogen peroxide feed rate is adjusted as necessary. The cooling water flow through

the heat exchanger is automatically controlled by solenoid valves to maintain the temperature. The normal operating parameters for the system are:

pH	2.7 to 3.3
Temperature	122 °C to 125 °C (140 to 145 °F)
Peroxide	200 to 400 ppm
Ferrous	~ 100 ppm
Organic	Less than solubility limit (some much less)

A series of pre-delivery performance tests were performed on simulated wastes using the deliverable hardware, and after the system was installed the functional tests were performed.

The results of the pre-delivery performance tests are summarized below:

Waste	Time to destroy 1 kg	Time to polish residue to 0.1 ppm
Toluene	1 hr	12 to 16 hrs
Isopropyl alcohol*	3	4 to 5
1, 4 dioxane	2.5	6 to 10
Dichloromethane	3	6 to 8
Tributyl phosphate	2.5	6 to 12
1,2,4 Trichlorobenzene	2.5	5 to 8
Hexane	3	4 to 6

Ultima Gold (scintillation media)	3	10 to 20
Ethylene glycol	3	4 to 6

* Decomposes rapidly into acetone

The functional tests which were performed after installation included:

Hydrostatic leak test at 150 psig

Metering pump functional test and flow rate measurements

Recirculation pump functional tests

Level switch checkouts

Instrument functional test

Lamp startup and operational test

System heat up and cool down rate test

Performance test with 1 liter of isopropyl alcohol

The pre-delivery performance tests demonstrated the system would perform as expected and PLC programming errors to be identified and corrected before the system was delivered. The functional checkouts facilitated the identification and correction of wiring errors and changes in performance characteristics of the chemical addition metering pumps and chemical tank level sensors due to changes in the configuration of the equipment. ANL-E completed the stimulated waste testing in June 1997 and the system is operational under RCRA Part A.

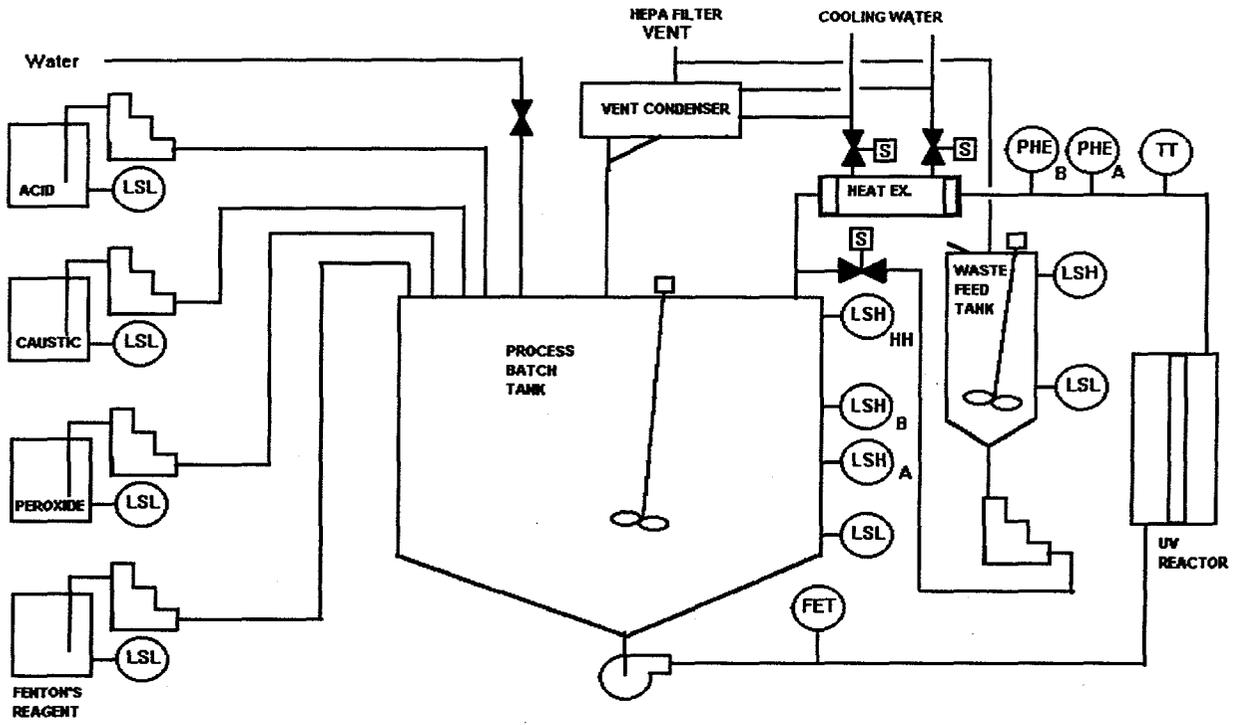


Figure 1 - ANLE Photo-Oxidation Organic Mixed Waste Treatment System