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Project Summary

Preliminary Operation of the Fluidized-Bed Combustion Facility for Hazardous Waste Disposal Research: Test Results and Evaluation

R. Clayton, H. Dempsey, and R. Machilek

This report describes Phase I of a program to provide research data on the destruction of hazardous wastes in a fluidized-bed combustor (FBC). The report addresses three primary areas of the program: facility operation, sampling and analysis, and health and safety.

The FBC was operated at a nominal temperature of 982°C for each test run. The bed height changed somewhat from run to run, but the residence time at a temperature of about 982°C was maintained at about 0.8 sec. CO and CO_2 concentrations in the freeboard were monitored continuously, along with downstream O_2 and total hydrocarbon levels.

Operating parameters were maintained easily, but were less flexible than desired. Phase II of the program will re-evaluate and continue the research effort, based on the Phase I data and conclusions.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Discussion

As part of an interagency coordinated research program to provide technical support for EPA's hazardous waste permitting activities, EPA's Air and Energy Engineering Research Laboratory sponsored a program to incinerate surrogate wastes in a fluidized-bed combustor (FBC). A multiphased program was developed to utilize the FBC for a variety of hazardous waste incineration studies including destruction and removal efficiency (DRE) testing, sampling and analysis methods evaluation and development, and incineration and control technology development. The pilot-scale atmospheric FBC facility, at EPA's Environmental Research Center, Research Triangle Park, NC, was utilized for this study.

Phase I of the program was designed to (1) develop, test, and evaluate facility operation protocols with emphasis on facility safety and personnel health; (2) determine destruction and removal efficiencies for selected test compounds at a given set of operating conditions; and (3) test selected state-of-the-art sampling trains and analysis methods.

The 6-month Phase I program included: the development of a comprehensive test plan, including OA/OC and health and safety plans for facility operation and sampling and analysis activities; modification of the FBC to accomplish the goals of the plan; and a 3-week test burn for data collection. A post-test evaluation period was designed to analyze the results and reappraise the program's goals and direction.

Test compounds were chosen to represent a full range of volatility and ease of destruction which would allow the testing of three sampling and analysis methods including: (1) Volatile Organic Sample Train (VOST) for measuring the volatile constituents, (2) Source Assessment Sampling System with a glass XAD-2

Resin module (Glass SASS) for collecting the semivolatiles, and (3) Stack Dilution Sampling System (SDSS) for measuring the condensible organic components in the flue gas. Test compounds were chosen which were not listed as principal organic hazardous constituents in Appendix VIII of the Resource Conversion and Recovery Act (RCRA).

These surrogate wastes were mixed with No. 2 fuel oil at 1- 2 percent by weight concentrations to be injected into the fluidized bed.

The facility was modified by:

1. Extending the exhaust stack to ensure adequate dispersion of any flue gas pollutants.
2. Installing a gas-fired burner in the combustor for bed preheat and fuel oil ignition.
3. Installing a liquid-fuel feed system to safely handle and inject the fuel/waste mixtures.
4. Recasting the combustor section to a circular cross-section with more abrasive-resistant material.
5. Modifying particulate cleanup devices (cyclone, baghouse) to safely catch and dispose of potentially hazardous residues.
6. Adding and modifying facility safety controls.

A typical test run required approximately 24 hours, beginning 12 - 18 hours before data collection began. The facility draft fan, blower, and electric and gas preheater were operated to preheat the combustor, bed material, and downstream facility components.

After a clean oil start-up burn time of 3 - 6 hours, the facility was operated at a nominal bed temperature of 982°C for each fuel/waste burn. Apparent residence time at temperature was about 0.8 sec. The bed was about 25 in.* (slumped) of 0.020 - 0.050 in. spherical bauxite beads expanded to 30-35 in. After data collection was completed, the facility was operated on clean fuel for about 30 minutes before fuel shutoff and facility cooldown.

Two fuel/waste mixtures were burned—one containing the non-volatile and semivolatile compounds and the other containing the volatile compounds. The Glass SASS and SDSS methods were conducted simultaneously on three test dates. The three VOST runs were made successively on the same day.

The data provided DRE's for the six compounds in the 99.99 percent range, verifying the usefulness of the facility for hazardous waste research. Phase I of the program provided not only quantitative data but also operational data to evaluate the protocols developed for facility sampling and analysis operations with particular emphasis on OA/OC, personnel health and safety, and program goals.

To develop and evaluate a comprehensive health and safety plan, a third party was utilized to assist in the development of protocols, training of personnel, and evaluation of performance and procedures.

The facility performed satisfactorily, with only one problem affecting the test: the fuel feed nozzle plugged during operation causing a premature shutdown. All goals of the facility operations plans were met by performing the required test burns and providing the data necessary to evaluate the facility's capabilities and plan future testing.

The goals of the sampling and analysis functions of the program were also achieved. The three sampling methods were tested, and the data were analyzed to provide the DRE determinations. The operational experience with each sampling method provided the data to evaluate the methods and analytical procedures and determine the logistics necessary for data collection and analysis for hazardous waste studies using the FBC facility.

The health and safety aspects of the program were a primary focal point of the test plans to achieve the facility operation and sampling and analysis goals. The accomplishment of those goals provided the opportunity to evaluate the health and safety protocols developed for the program and the adherence to the protocols by the facility operations and sampling crews. Health- and safety-related costs were determined as part of this effort.

R. Clayton, H. Dempsey, and R. Machilekd are with Acurex Corp., Research Triangle Park, NC 27709.
***John H. Wasser** is the EPA Project Officer (see below).*
The complete report, entitled "Preliminary Operation of the Fluidized-Bed Combustion Facility for Hazardous Waste Disposal Research: Test Results and Evaluation," (Order No. PB 87-110 474/AS; Cost: $24.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Air and Energy Engineering Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

* 1 in. = 2.54 cm.

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