DISPOSAL OF WASTE OR EXCESS HIGH EXPLOSIVES

MASON & HANGER - SILAS MASON CO., INC.
PANTEX ERDA PLANT

DEVELOPMENT DIVISION

PROGRESS REPORT
APRIL - JUNE 1976

For
U.S. Energy Research and Development Administration
Albuquerque Operations Office
Albuquerque, New Mexico

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ABSTRACT

The evaluation of the closed-pit, batch-type, full scale test incinerator at the ERDA Pantex Plant is continuing. The use of sand as a filter media gives only a slight reduction in NO_x and CO effluents with the present gas-production conditions (454 kg of granulated LX-04). Attempts to alter the gas-production parameters within the incinerator is discussed as future work.

I. INTRODUCTION

The present research and development effort for the disposal of high explosives (HE) is being conducted for ERDA/ALO by the Mason & Hanger - Silas Mason Co., Inc. The project began January 1971. The objectives of this effort have been: (1) to assess the magnitude of the problem which will exist at ERDA facilities in meeting the new environmental regulations, (2) to determine methods of disposal and (3) to select the best methods and develop pilot-scale processes. This effort has been conducted at the Burlington and Pantex ERDA Plants.

Previous progress reports(1,2) have summarized the quantities and types of waste HE generated at ERDA facilities. Disposal methods—including open burning, detonation, incineration, deep-well injection, ocean dumping, biochemical decomposition and chemical recovery—were surveyed(2). Detonation and combustion products of HE were measured and preliminary results have been presented in previous reports(2,3,4, 5,6,7,8). These investigations indicated low concentration levels of primary air pollutants.

Further progress in developing new disposal methods and measuring air pollutants from burning HE have been reported in nine progress reports (3,4,5,6,7,8,9,10,11). After reviewing all methods, incineration has been selected as the best presently known method of disposal, and biodegradation was selected as the most feasible long-range recycle method. A development effort is continuing at Pantex on a closed-pit, batch-type incinerator. A final report has been issued on the Burlington investigation of a rotary incinerator(12).

II. CLOSED-PIT, BATCH-TYPE, FULL-SCALE TEST INCINERATOR

A. GENERAL DISCUSSION

The full-scale test (FST) facility, Fig. 1, was completed in July 1974. The facility is, in essence, an enclosure in which HE can be burned. The present closed-pit incinerator concept is shown in Fig. 2. The facility is located in a remote area (Zone 5) at the Pantex Plant and uses Firing Site No. 21 as the control-point.

The purpose of the facility is to provide design data for the proposed construction of an incinerator complex at Pantex. This incinerator complex must be capable of processing as much as 250,000 kg (1/2-million lbs) of HE and HE-contaminated material per year. The waste material will consist of a variety of sizes, shapes and types of explosives. In the present plans, construction of the incinerator complex is scheduled to begin in December 1978.

Fig. 1. Full-Scale Test Facility

Fig. 2. Closed-Pit, Batch-Type Incinerator Concept

The closed-pit incinerator developmental program consists of four phases. The definition of each phase and the respective time schedule are shown in Fig. 3. This schedule reflects the difficulties already encountered in Phase III. Problems with instrumentation were discussed in the last quarterly report, and during this past quarter additional delays occurred. The net result is (Fig. 3) a delay of three months for Phase III and a delay of six months for Phase IV. It is felt that this schedule gives ample time to gather the necessary data, in view of the target date for construction of December 1978.

Phase II was a study of temperature and pressure effects caused by large mass flow-rates developed during burning. The temperature and pressure also depend on the thickness of sand used in the overhead filter. In Phase II a systematic variation of both mass flow-rate of HE gases and thickness of sand was conducted. The important design data obtained from Phase II were air temperatures and pressures, overhead I-beam temperatures, air flow requirements, flame containment, wall temperature and I-beam deflection. The data were obtained using thermocouples, temperature sensitive pellets(13) and pressure transducers(14). The location of each thermocouple is shown in Fig. 4. Flame containment was evaluated from 16 mm film records.

The information obtained from Phase II was presented in a previous report(15). Essentially, these findings show that the closed-pit, batch-type incinerator concept is feasible and that the present design, with minor modification, can meet the requirements of the proposed HE waste disposal program at the Pantex Plant.

B. PHASE III - POLLUTION ABATEMENT STUDY (CONTINUED)

Phase III began in the second quarter of FY 1976. The primary objectives of Phase III are: (1) to determine what concentrations of pollutants are produced and to what degree the production of these concentrations can be minimized, and (2) to study the effectiveness of the overhead filter in reducing the effluents (NO, NO₂, CO and particulates) produced. To accomplish these, stringently, controlled conditions must be maintained.

A detailed study plan for Phase III has already been reported(16) as has a description of the sampling system, sampling procedures and data reduction procedures. Preliminary data for gases generated within the incinerator were reported in the last quarterly report(17).

The data in this report are preliminary and were gathered in view of a desire to obtain an estimate of the filter effectiveness. The original study plan was to investigate the gas-production parameters prior to evaluating the filter media. However, if there are trade-offs among the production parameters, knowledge of the filter effectiveness will prove helpful in attaining the over-all goal of reduced pollution to the environment.

	FY 75				FY 76				FY 76A	FY 77	
	Quarters				Quarters				Quarter	Quarters	
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	1st	2nd
I											
II											
III											
IV											

- Phase I Determine feasibility of burning a large quantity of explosive in a closed-pit incinerator.
- Phase II Establish basic design information for the incinerator structure, maximum number of burns per day, and limitation of burn conditions.
- Phase III Define pollution conditions and establish abatement requirements.
- Phase IV Develop burning procedures and safety requirements for the incinerator complex.

Fig. 3. Planned Development Schedule for the Closed-Pit, Batch-Type Incinerator Project

Instrumentation Legend:

- Location of I-Beam Deflection Measurement
- A1-A6 - Air Thermocouples (~ 20 cm below ceiling)
- ⊗ I1-I2 - I-Beam Thermocouples
- × Floor Thermocouples
- △ W1, W2 --- Wall Thermocouples (1/2, 1 cm deep, respectively)
- Gas Sampling Ports (Inside the Incinerator)

Fig. 4. Instrumentation Layout

1. PRELIMINARY GAS-SAMPLING ABOVE THE FILTER

The change from "inside" to "outside" sampling was accomplished by raising the nine sampling ports shown in Fig. 4 to a height that positioned each port approximately 1/2 inch below the top surface of the sand. This sampling position reduced the tendency to dilute the sample from the normally windy conditions prevailing in the Panhandle of Texas. Other than a height change the nine sampling ports were maintained in the same positions as shown in Fig. 4. As in "inside" sampling, each of the nine sampling lines merged at a manifold for mixing.

Burns numbering 66 - 75 (with the exception of burn No. 74) were conducted for the purpose of measuring the effluents (NO , NO_2 and CO) from the incinerator. As is usually the case an experimental alteration brought about unexpected results. The NO_x data (chemiluminescence detection method) were reproducible and similar to those data obtained from "inside" sampling (Fig. 13)(16). However, the CO data (dual isotope fluorescence detection method) were neither reproducible nor similar to previous results (Fig. 13 Ref. 16).

Fig. 5 shows the output of the CO analyzer as a function of time when sampling above the filter. The signal suddenly becomes negative, after which the analyzer recovers. Only one burn (Burn No. 67) gave the expected shape(16), and all other results displayed the negative signal shown in Fig. 5. The negative signal usually was produced at about the same time that CO is being converted to CO_2 in rather large quantities(17). The manufacturer of the CO -analyzer (Beckman Instruments, Inc.) concurred that excessive amounts of CO_2 will produce a negative signal on the analyzer. With this information, a water and CO_2 trap were inserted between the incinerator and the CO analyzer. The block diagram for the placement of the traps is shown in Fig. 6. Liquid nitrogen (boiling point of 77.4 K) was used to trap CO_2 (sublimation point of 194.6 K) and at the same time allow CO (boiling point of 81.6 K) to pass through to the analyzer. A desiccant was used to trap water. This arrangement did not prove satisfactory because temperature differences in the trap resulted in an effective trap temperature of only 194 K which was not cold enough to trap significant quantities of CO_2 .

Replacing the liquid nitrogen with a solution of NaOH such that the incinerator gases passed through the solution did produce significant results. The negative signal disappeared. The consensus is that there are gases being produced which interfere with the CO measurement and that a solution of NaOH is an effective trap. There are, however, several unanswered questions: what are the gases, and is the "inside" sampling - measurement affected and if so, to what degree? Hopefully, these questions can be answered.

The data for the estimate of filter effectiveness obtained thus far are summarized in Tables I and II. Each table is divided into two parts: the control data which are the values of the parameters indicating the conditions of each burn, and the gas-sampling data which are the desired results of Phase III. Table I summarizes the "inside" sampling data and Table II summarizes the "outside" sampling data.

Fig. 5. CO-Analyzer Read-Out Burn No. 69 (Uncorrected)

Air Dilution(16)

Fig. 6. Block Diagram Showing Placement of the Traps in the CO-Sampling Line

Table I. Preliminary Summary for Phase III-A (Gas Sampling Within the Incinerator)

	<u>HE</u>	<u>Control Data</u>				<u>Gas-Sampling Data</u>		
		<u>Amount of HE (kg)</u>	<u>Burn Time (min)</u>	<u>Maximum Pressure (Pa)</u>	<u>Average Air Temp. (K)</u>	<u>NO_x (a) 24 Hr. Avg. (ppm)</u>	<u>NO (b) 24 Hr. Avg. (ppm)</u>	<u>CO (c) 8 Hr. Avg. (ppm)</u>
Value	Granulated LX-04	463	1.4	580	1300	0.45	0.41	100
Maximum Deviation (±)	-	-	0.1	80	30	+ 0.27 - 0.18	0.05	+ 40 - 60

(a) Average for 3 Burns

(b) Average for 3 Burns

(c) Average for 6 Burns

Table II. Preliminary Summary for Phase III-B (Gas Sampling Above the Filter)

	<u>HE</u>	<u>Control Data</u>				<u>Gas-Sampling Data</u>		
		<u>Amount of HE (kg)</u>	<u>Burn Time (min)</u>	<u>Maximum Pressure (Pa)</u>	<u>Average Air Temp. (K)</u>	<u>NO_x (a) 24 Hr. Avg. (ppm)</u>	<u>NO (b) 24 Hr. Avg. (ppm)</u>	<u>CO (c) 8 Hr. Avg. (ppm)</u>
Value	Granulated LX-04	463	1.3	570	1270	0.35	-	65
Maximum Deviation (±)	-	-	0.1	140	60	0.09	-	-

(a) Average for 8 Burns (EPA Maximum Allowable Level is 0.05 ppm)

(b) Average for 0 Burns (EPA Maximum Allowable Level is 0.05 ppm)

(c) Average for 1 Burn (EPA Maximum Allowable Level is 35 ppm)

The control data show how well the burning conditions are reproduced. However, due to the difficulties previously mentioned, only one burn of the series produced quantitative results for CO, using "outside" sampling. These results are tentative in that they will be re-evaluated for the interaction of other gases with the measuring equipment.

2. DISCUSSION

A preliminary estimate can be made for the filter effectiveness. There seems to be a slight decrease in NO_x as the gases pass through the sand. The main component of NO_x is NO which has been shown earlier(18) to be relatively unreactive with a filter media such as sand.

The data are not as conclusive for CO and more information is necessary to define the CO concentration changes through the filter. However, a slight decrease in CO may exist.

The goal of this past quarter has been to obtain an estimate of the filter effectiveness. However, it must be realized that filter effectiveness depends to a large extent on the production parameters. If, for example, CO could be reduced by increasing NO_x and at the same time NO_2 could be made the dominant component in NO_x , then the filter would bring about a sizable reduction in emissions (via moisture in the filter). This will be one of the goals during the investigation of production parameters.

III. SUMMARY AND FUTURE WORK

The HE waste disposal project at the ERDA Pantex Plant has evolved over the past few years into an in-depth investigation of disposal-by-incineration. An incinerator concept (Fig. 2) and a full-scale test facility (Fig. 1) have evolved and test data have been gathered for the past two years. The data are being channeled into an "incinerator complex" design. The construction of this project is planned to begin in December 1978.

The findings, thus far, are that this incinerator concept and the full-scale test facility can adequately form the basis of the proposed incinerator complex at Pantex, and in so doing, Pantex will comply with the requirements by the state of Texas for enclosed burning. In addition, the data indicate that particulate emissions will be within maximum allowable levels.

The present concentration levels of NO_x and CO within the incinerator are appreciably above the maximum allowable emission levels established by the EPA. Preliminary estimates of the emission levels as measured above the sand filter this quarter indicate that a slight decrease in these values can be expected. It must be mentioned, however, that the effectiveness of the filter will depend on the types of gases and the individual amounts passing through the filter. This relates directly back to the dependence of emission levels on the gas products produced within the incinerator.

Work for next quarter will include the investigation of production parameters within the incinerator by varying the supply of oxygen and by varying the dwell-time of burning. Pollution as a function of the amount of explosive burned will also be examined.

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