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**LSA Cyclone Incinerator
Development Program
for May 1976**

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Issued: July 16, 1976

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MONTHLY PROGRESS REPORT
May 1 through May 31, 1976

During May, the major effort was directed toward installation of the Venturi scrubber in the offgas system which is expected to be complete by mid-June.

Some incineration runs were made to collect additional particulate data and the analysis was completed on the NO_x , HCl, vinyl chloride and total hydrocarbon data from spot samples, collected earlier.

A. Venturi Scrubber Installation

Installation of a Venturi scrubber and auxiliary equipment was initiated on May 24, 1976. The Venturi scrubber was fabricated by Fisher-Klosterman, Inc., to remove 99% of the particulates from a gas stream characterized as follows:

1. Air flow 225 ACFM (actual cubic feet per minute) to 550 ACFM at 130°F saturated with moisture
2. Inlet gas 0.06 grains of particulates per actual cubic foot
3. Inlet particle size distribution (actual measured values from spray tank outlet)
 - 100% below 7 micrometers
 - 97% below 2.7 micrometers
 - 92% below 1.6 micrometers
 - 89% below 1.1 micrometers
 - 74% below 0.56 micrometers
 - 56% below 0.35 micrometers
4. Particle density 2.2 g/ml (actual particle data)

The normal operating pressure drop in the scrubber will be 40-50 inches water gage.

Installation is presently on schedule and is expected to be complete by mid-June, 1976.

B. Particulate Data

During the month, six incinerator runs were made before the shut-down for the Venturi scrubber installation. The results of these runs (two per feed type) substantiate previous data within statistical limits. The composition of the three types of feeds is defined in Table I. The efficiency of the spray tank in removing particulates generated by the three types of feed are summarized in Table II.

TABLE I

COMPOSITION OF INCINERATOR FEEDS

	<u>Type I</u> ⁽¹⁾	<u>Type II</u> ⁽¹⁾	<u>Type III</u> ⁽¹⁾
Paper	32	2	48
Plastics			
PVC	9	23	1
Polyethylene	29	9	6
Polypropylene	8	2	-
Rubber	13	3	26
Cloth	3	61	6
Leather	-	-	-
Wood	-	-	7
Metal	6	-	6

(1) Weight %

TABLE II

EFFICIENCY OF SPRAY TANK IN REMOVING PARTICULATES

	<u>All Particules</u>	<u>>1 Micron</u>	<u><1 Micron</u>
	(%)	(%)	(%)
Type I Feed	55.8	76.7	49.0
Type II Feed	40.4	58.6	34.4
Type III Feed	31.1	69.4	20.5

Samples of flue gas were taken at the outlets of the incinerator chamber, the deluge tank and the roughing filter to determine their effectiveness in removing particulates. Table III lists the total particulate emissions at the three sample stations in relation to the total waste charge burned.

TABLE III
TOTAL PARTICULATE EMISSIONS
(av g/kg Feed)

	<u>Combustion Chamber</u>	<u>Deluge Tank</u>	<u>Roughing Filter</u>
Type I Feed	10.0	4.8	1.6
Type II Feed	7.9	4.7	1.0
Type III Feed	9.0	6.2	3.7

C. Vinyl Chloride and Hydrocarbon Analysis of the Offgas Stream

Concentrations of vinyl chloride and total hydrocarbons present in the scrubber exit stream were determined with a portable gas chromatograph. The unit used was a Model 511, AID Portable Flame Ionization Detector (FID), Gas Chromatograph. By means of a hand pump, stack gas was drawn through a stainless steel probe into an automatic sampling valve. Total hydrocarbons were determined through a direct path to the FID. For the analysis of vinyl chloride (VC), however, chromatographic separation was necessary prior to introducing the sample into the flame ionization detector.

The results for nine different sample runs are given in Table IV. In the table, readings marked "greater than" (>) are for values which exceeded the instrument range setting at the time of sampling.

On-line control instrumentation is used to continuously monitor combustible gas in the offgas. Results obtained with such equipment are consistent with the spot analyses given in Table IV. The value of 19,692 ppm for run 283,

TABLE IV

SUMMARY OF TOTAL HYDROCARBON (THC)
AND VINYL CHLORIDE (VC) RESULTS

<u>Run No.</u>	<u>VC (ppm)</u>	<u>THC (ppm)</u>
277	>500	3,714
277	200	4,500
277		4,714
277		5,143
277		5,000
277		4,214
278	1,040	
278	600	
279		65
279		63
279		47
279		48
279		52
279		42
279		62
280	>156	
280	200	
281	40	
281	40	
281	24	
282	> 77	
282	>308	
282	0	
282	0	
282	148	
282	> 19	
283	19,692	48
283	0	51
283	0	>381
283		>762
283		3,429
283		3,429
284	12	> 24
284		> 24
284		4
284		23
284		22
284		24
285	17	4
285	14	3

which was obtained by spot analysis, was confirmed by the line control instrumentation. Actually, such high peaks are instantaneous in nature and occur only occasionally during runs. Therefore, the magnitude of such peaks should not be construed as being representative of the vinyl chloride content of the offgas for a given run because lack of homogeneity of feed material and fluctuation in the incineration process have a significant influence on the size of the peaks.

Although the data are limited, oxidation of the vinyl chloride appears more difficult than oxidation of butyl rubber or the polyolefins.

D. HCl Determination in Offgas Stream

The HCl offgas analyses show anomalous results (Table V) which could be caused by sampling, analytical or process problems or a combination of the three. At this time, the possible causes of these anomalies have not been fully investigated.

TABLE V
MEASUREMENT OF REMOVAL OF HCl FROM OFFGAS

<u>Run No.</u>	<u>Length of Run (Min.)</u>	<u>Type of Feed^a</u>	<u>% PVC</u>	<u>Incinerator Chamber Effluent (ppm HCl)</u>	<u>Scrubber Effluent (ppm HCl)</u>
277	30	II	23	7140	192
278	10	III	1	950	147
279	20	I	9	103	337
280	17	II	23	475	716
281	12.5	III	1	695	634
282	17	I	9	1120	534
283	24	II	23	2430	239
284	13	III	1	817	304
285	21	I	9	379	594
Average				1570	411

^aSee Table I.

The levels of HCl found do not agree with the quantity of PVC burned. Also, in three cases, the scrubber effluent has a higher indicated concentration than the incinerator chamber effluent which further beclouds the validity of the data. The average value for the HCl removal efficiency appears to be about 74%. The quantity of Na_2CO_3 used to neutralize the HCl to an acceptable pH level for different runs corroborates this average value. This value is much less than the values obtained earlier using Drager tubes. The earlier values were 10 to 20 ppm for the scrubber effluent.

Further work is being done to determine the cause of these discrepancies. Findings will be reported as they become available.

E. NO_x Analysis of the Offgas Stream

The analytical results on NO_x spot sampling of ten incinerator runs are shown in Table VI. As can be seen, the average value and some of the individual results show a higher NO_x content from the outlet of the scrubber than from the inlet. Examination of the sample timing as compared to offgas temperatures indicates that the scrubber outlet NO_x concentration relates to offgas temperatures more than to scrubber efficiency. In some cases the scrubber outlet samples were taken at a later time and a higher temperature. Therefore, higher concentrations of NO_x were present in the outlet sample than in the inlet. If the scrubber inlet and outlet samples were taken simultaneously, the outlet NO_x concentrations would not be higher than the inlet but would fluctuate with the offgas temperature. To obtain more accurate data for the NO_x content, instrumentation is being reviewed which will monitor the effluent to determine true concentration of NO_x at any point during the run.

TABLE VI
SUMMARY OF NO_x ANALYSES

Run No.	Incinerator Outlet		Scrubber Outlet	
	Sample No.	NO _x Conc. (ppm)	Sample No.	NO _x Conc. (ppm)
276	(3)	17	(1)	120
	(4)	22	(2)	34
277	(7)	24	(5)	25
	(8)	30	(6)	94
278	(11)	12	(9)	46
	(12)	30	(10)	6.6
279	(15)	9.4	(13)	5.9
	(16)	169	(14)	111
280	(19)	68	(17)	29
	(20)	47	(18)	71
281	(23)	49	(21)	17
	(24)	4.7	(22)	30
282	(27)	29	(25)	44
	(28)	22	(26)	51
283	(31)	54	(29)	55
	(32)	57	(30)	160
284	(35)	34	(33)	109
	(36)	8.8	(34)	16
285	(39)	159	(37)	216
	(40)	53	(38)	73
Average		49.4	65.7	

F. Milestone Status for May 1976

As described earlier in this report analysis of NO_x , HCl, vinyl chloride and total hydrocarbons completes the analyses of the possible significant pollutants in the offgas stream. These data in addition to those reported in MLM-2326(LD) Milestone 3 (see Milestone Chart) will be marked complete, although further work on NO_x, HCl, vinyl chloride, and total hydrocarbons will be necessary because of analysis problems and changes in equipment (addition of Venturi) mentioned earlier.

The utility requirements for the total incineration system will be included in the final report which will conclude the planned investigations for FY-1976.

CYCLONE INCINERATOR PROJECT

FISCAL YEAR 1976

	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE
07-31-75	■ 1A	□ 1B	□ 1C	□ 1D □ 1E □ 1F	□ 1G	□ 1H	○	□ 2A □ 3A	□ 2B □ 3B □ 4A □ 3C	□ 4B	○	○ 5A ○ 6A ○ 7A
08-30-75		■	□	□ □ □	□	□	○	□ □	□ □ □ □ □	□	○	□ ○ ○
09-30-75			■	□ □ □	□	□	○	□ □	□ □ □ □ □	□	○	□ ○ ○
10-27-75				■ ■ ■	□	□	○	□ □	□ □ □ □ □	□	○	□ ○ ○
11-27-75					■	■	○	□ □	□ □ □ □ □	□	○	□ ○ ○
01-02-76						●		□ □	□ □ □ □ □	□	○	□ ○ ○
01-31-76								□ □	□ □ □ □ □	□	○	□ ○ ○
02-29-76								■ ■	□ □ □ □ □	□	○	□ ○ ○ △
03-31-76									■ ■ □ □ □	□	○	□ ○ ○ △
04-30-76										■	●	■ ● ○ △
05-31-76												○ ▲ ○

Legend: Milestone Target ○, Revised Target △, Terminated or Deferred X, Projected Activity Status □, Actual Completed Activity ■, Completed Milestone ●

1. Install Instrumentation and Optimize Incineration (12/31/75)
 - A. Installation of impactor (08/01/75)
 - B. Installation of new exhauster (08/15/75)
 - C. Installation of recycle water, chiller and flow meter (09/15/75)
 - D. Add wetting agent to all spray nozzles (10-10-75)
 - E. Optimize burning for reduction of particulate in offgas (10/15/75)
 - a. Vary air flow and oxygen content
 - b. Install oxygen stream to exhaust at chamber and test for use on after burner
 - c. Final decision on use of cyclone, catalytic oxidizer or other type after burner for particulate reduction in exhaust stream (05/15/76)
 - F. Install and test more efficient roughing filter (10/20/75)
 - G. Determine effectiveness of spray tank and improve if necessary (10/30/75)
 - H. Install instrumentation for determining operating parameters (pressure drops, temperature profiles, O₂ and CO₂ content, etc. (11/15/75)
2. Determine temperature and pressure profiles of system (03/15/75)
 - A. Temperature profile of system (02/01/76)
 - a. Incinerator inlet air
 - b. Combustion chamber walls
 - c. Combustion chamber offgas
 - d. Spray catcher offgas
 - e. Mist eliminator offgas
 - f. Recycle tank liquor
 - g. Scrub liquor after cooling
 - h. Cooling water inlet
 - i. Cooling water outlet
 - j. Process water
 - B. Pressure drops (03/01/76)
 - a. Incinerator chamber
 - b. Spray catcher
 - c. Mist eliminator
 - d. Roughing filter
 - e. Total system
3. Gaseous Effluent Tests (04/01/76)
 - A. Particulate (02/15/76)
 - a. Size
 - b. Amount/distribution
 - B. Condensables (03/10/76)
 - a. Identify (water, organic, hydrocarbon, i.e., aldehydes, acids, alcohol, ketones, etc.)
 - b. Amount
 - C. Noncondensables (03/25/76)
 - a. Identify (CO₂, CO, hydrocarbons, HCN, HCOH, SO₂, NO_x, H₂, O₂, ClO₂, HF, etc.)
 - b. Amount
4. Identify and measure liquid and solid waste generated (05/01/76)
 - A. Identify and measure total solid waste generated per unit volume of feed (03/18/76)
 - a. Liquid filter
 - b. Filter cake from liquid filter
 - c. Roughing filter
 - d. Mist eliminator filter media
 - B. Identify and measure total liquid waste generated per unit volume of feed (04/15/76)
 - a. Recycle water
5. Determine Efficiency of waste volume reduction (06/01/76)
 - A. Determine volume of ash per unit volume of feed (06/01/76)
6. Determine utility requirements (06/15/76)
 - A. Total electric consumption
 - a. Exhauster
 - b. Water mist pump
 - c. Water chiller
7. Final Program Report (07/01/76)