Nsm 2.4 BR 66

South Coast
AIR QUALITY MANAGEMENT DISTRICT
9150 FLAIR DRIVE, EL MONTE, CA 91731 (818) 572-6200

PENROSE, 2/88

EFD
100

SOURCE TEST REPORT

88-0075

CONDUCTED AT

Pacific Lighting Energy Systems
Penrose Landfill
8301 Tujunga
Sun Valley, California

EMISSIONS FROM AN INTERNAL COMBUSTION ENGINE FUELED BY LANDFILL GAS

TESTED: February 24, 1988

ISSUED: JUN 01 1988

REPORTED BY: Victor Espinosa
Air Quality Engineer I

REVIEWED BY:

E. Ramirez, Senior AQ Engineer

SOURCE TESTING AND MONITORING BRANCH
JOHN HIGUCHI, MANAGER

SANFORD M. WEISS
DIRECTOR, TECHNICAL SERVICES

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

Test No. 88-0075 -2- Date 2-24-88

INTRODUCTION

a. Firm Tested.....Pacific Lighting Energy System Penrose Landfill

b. Test Location.....8301 Tujunga, Sun Valley, CA

c. Unit Tested.....ICE #3

d. Test Requested by.....V. Espinosa

e. Reason for Test Request.....Information

f. Date of Test.....February 24, 1988

g. Source Test Performed by.....V. Espinosa, E. Ramirez

h. Test Arrangements Made Through.....Ezra Abraham Pacific Lighting Energy System

i. Source Test Observed by..... -

j. Company I.D. No.....043536

k. Permit No..... -

l. Application No..... -

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

Test No. 88-0075 -3- Date 2-24-88

SUMMARY OF RESULTS

Contaminant	Emissions Measured	Emissions Allowed	Applicable Rule
Sulfur Compounds as H_2S	153 ppm	800 ppm	431.1 (b)(4)
Heating Value of Landfill Gas	540 BTU/scf	Information	Information
Carbon Monoxide	12.7 lb/hr	26 lb/hr	Permit Cond.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

INTRODUCTION

On February 24, 1988, source test engineers from the South Coast Air Quality Management District (SCAQMD) conducted a source test at Pacific Lighting Energy System's power generating station at Penrose Landfill. Engine No. 5 was tested to determine compliance with District rules and as part of an on-going program to monitor landfill gas composition and concentrations.

EQUIPMENT AND PROCESS DESCRIPTION

Penrose Landfill, owned by Los Angeles By-Products Co., is an inactive Class II site covering approximately 70 acres and contains 14 million cubic yards of refuse. Pacific Lighting Energy System utilizes the landfill gas from Penrose Landfill as fuel for its power station.

Landfill gas, generated by the biochemical decomposition of buried organic refuse, is collected by a system of gas collection wells. The wells are manifolded together and connected to compressors which pull a vacuum on the system and deliver the gas to the power station.

Moisture is removed from the gas which is then delivered to five Cooper Superior Internal Combustion Engines. Each engine drives a 1.875 megawatt generator. The power produced is sold to a local utility.

SAMPLING AND ANALYTICAL PROCEDURES

INLET FLOW RATE

834 per engine

The inlet flow rate, 4170 dscfm, was obtained from the operator of the power station. The value is for all five engines and the flow to each engine is assumed to be equal.

EXHAUST FLOW RATE

The dry volumetric flow rate of the engine exhaust was calculated from a carbon balance based upon the total combustion analysis data and the inlet gas flow rate.

GAS SAMPLE

The landfill gas was sampled at two points on the inlet side of the engine. The raw landfill gas sample was obtained at the header line from the landfill gas wells, the dehumidified sample was obtained after the gas was compressed and the moisture removed. The samples were obtained with a battery operated teflon pump, teflon tubing and tedlar bags.

The engine exhaust was sampled with the apparatus shown in Figure 1. It consists of a stainless steel probe, teflon tubing, a battery operated teflon pump and a tedlar bag.

An expanding aluminum pole was used to reach the top of the stack and a thermocouple and Omega potentiometer were used to measure the temperature of the exhaust during sampling.

All samples were submitted to the District Laboratory for analysis. Vinyl chloride, benzene, and toluene detection were done by gas chromatography with a flame and photoionization detector. Chlorinated hydrocarbons were analyzed by electron capture/gas chromatography. Carbon monoxide, carbon dioxide and methane were analyzed by non-dispersive infrared/gas chromatography using the Total Combustion Analysis Method, and oxygen was obtain using thermal conductivity/gas chromatography.

TEST CRITIQUE

The test was conducted during daylight operating hours. All five engines were operational. Engine #5 was producing 1.91 megawatts of power at an inlet fuel flow rate of 830 dscfm. The fuel flow rate to all engines is assumed to be equal.

The laboratory analysis for the engine exhaust is incomplete as the Lab ran out of sample before analysing for sulfur compounds, vinyl chloride, benzene, xylene and toluene.

To determine emissions for the power station, all five engines need to be tested simultaneously.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

Test No. 88-0075 -6- Date 2-24-88

TABLE I

ORGANIC MASS FLOW RATE Inlet Flow to engine #5

Inlet Gas Flow Rate 830 dscfm

Compound	Molecular Weight	Concentration (ppm)	Mass Rate (lb/hr)
Vinyl Chloride	62.5	3.80	0.031
Benzene	78.1	1.20	0.012
Toluene	92.2	40.00	0.486
Xylene	106.2	19.00	0.266
Chloroform	119.4	<0.40	<0.006
Trichloroethylene	131.4	5.60	0.097
1,1,1-Trichloroethane	133.4	<0.09	<0.002
Carbon Tetrachloride	153.8	<0.02	<0.0004
Perchloroethylene	165.3	18.00	0.392
Hydrogen Sulfide	34.1	130.0	0.585
Methyl Mercaptan	48.1	9.2	0.058
Carbonyl Sulfide	60.1	<2.0	<0.016
Dimethyl Sulfide	62.1	10.0	0.082
Carbon Disulfide	76.1	<2.0	<0.020
Methane	16.0	432,000	911.4
TNMHC as Hexane	86.2	123,000	233.0

This is after moisture reduction

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TABLE II

ORGANIC MASS EMISSION RATE

Flare exhaust

Exhaust Gas Flow Rate 6840 dscfm

Compound	Molecular Weight	Concentration (ppm)	Mass Rate (lb/hr)
Chloroform	119.4	0.0072	0.00093
Trichloroethylene	131.4	0.0073	0.00104
1,1,1-Trichlorroethane	133.4	0.00025	0.00004
Carbon Tetrachloride	153.8	0.00006	0.00001
Perchloroethylene	165.3	0.013	0.0023
Methane	16.0	1,540	26.8
Carbon Monoxide	28.0	418	12.7
TNMHC as Hexane	86.2	40	0.6

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ORGANIC MASS FLOW/EMISSION RATE

Where: OMR = Organic Mass Flow/Emission Rate (lb/hr)

MW = Molecular Weight

FLOW = Flow Rate, DSCFM

CONC. = Concentration, ppm

OER = $(1.583X10^{-7})(MW)(FLOW)(CONC.)$

For Benzene,

OMR = $(1.583x10^{-7})(78.1)(830)(1.20)$

= 0.012 lb/hr

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
TECHNICAL SERVICES DIVISION
SOURCE TESTING AND MONITORING BRANCH
CALCULATION SHEET

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PROCESSED BY	CHECKED BY
VE	ER

FLARE EXHAUST FLOW RATE CALCULATION

Calculation based upon inlet flow rate and carbon balance form TCA data.

Inlet Flow Rate = 830 dscfm

Inlet Carbon Conc. (conc. of CO_2, CO, CH_4, NMHC): 948,000

Exhaust Carbon Conc. (Conc. of CO_2, CO, CH_4, NMHC): 114, 998

$$\text{Exhaust Flow} = \frac{(\text{Inlet Flow})(\text{Inlet Carbon Conc.})}{(\text{Exhaust Carbon Conc.})}$$

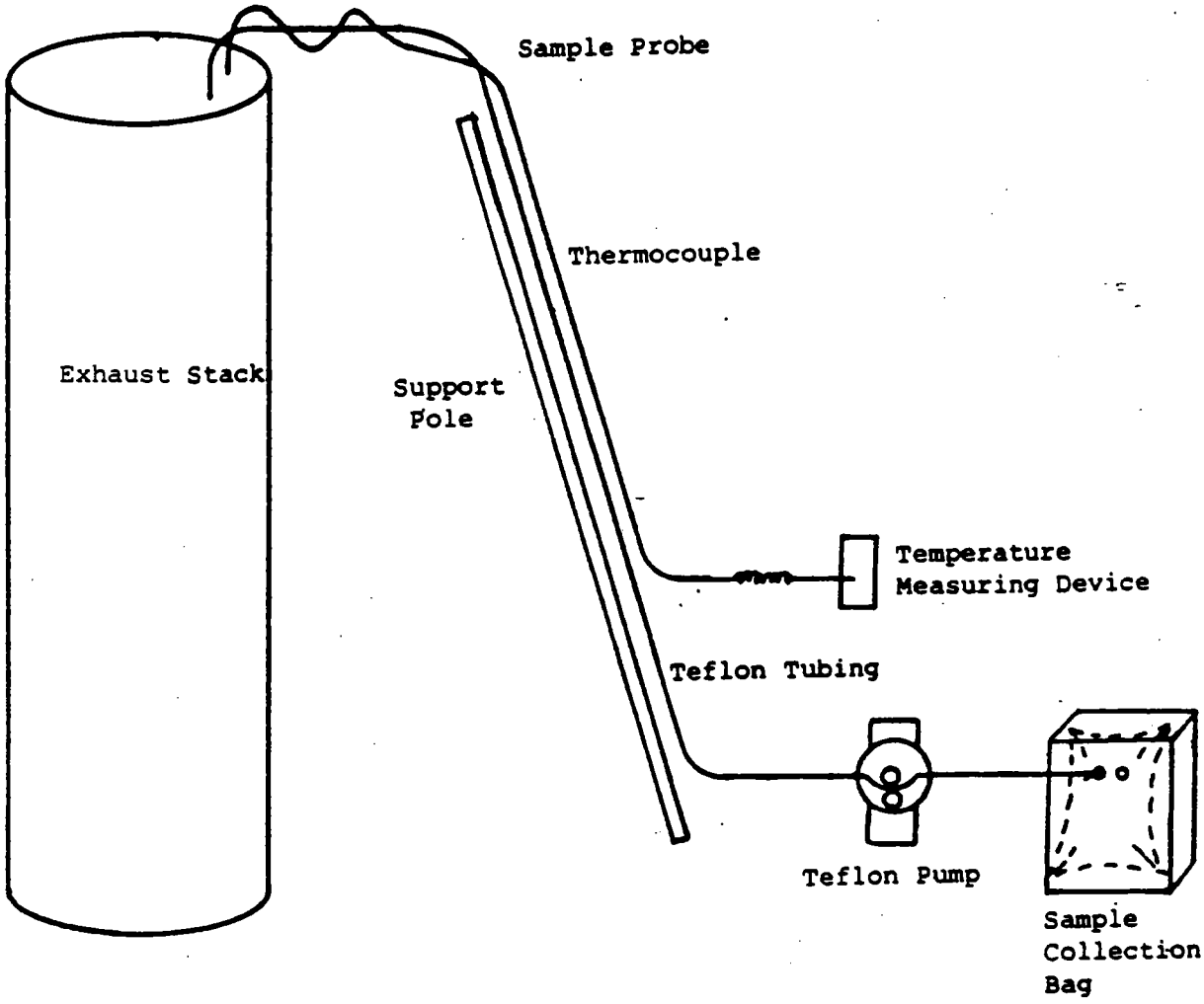
$$= \frac{(830)(948,000)}{(114,998)}$$

$$= 6840 \text{ dscfm}$$

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

Test No. 88-0075 -10- Date 2-24-88

FIGURE 1



Exhaust Gas Collection System

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

RELEASED
MAR 8 1988
LAB BRANCH

TECHNICAL SERVICES DIVISION
LABORATORY SERVICES BRANCH
REPORT FOR SOURCE TEST

TO: John Higuchi, Manager
Source Testing & Monitoring

COMPANY: Pacific Lighting (Penrose
CITY: Landfill)

CITY: Sun Valley

PROCESS
EQUIPMENT: Landfill Gas Collection

CONTROL
EQUIPMENT: I.C.E.

LAB REPORT DATE: MARCH 8, 1988

LABORATORY NO. 80558-5

REFERENCE NO. TSB-2-13, JLC-4-54
MJS-11-48, KK-14-102

TEST NO. 88-0075

SOURCE TEST DATE: 2-24-88

DATE SAMPLE RECEIVED: 2-24-88

REQUESTED BY: V. Espinosa

SAMPLE DESCRIPTION: Three each Tedlar Bags

ANALYSIS REQUESTED: Vinyl chloride, benzene, toluene, xylenes, chlorinated hydrocarbons, sulfur compounds

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ANALYTICAL WORK PERFORMED, METHOD OF ANALYSIS, AND RESULTS

Vinyl chloride by FID/GC, aromatics by PID/GC, chlorinated hydrocarbons by ECD/GC, sulfur compounds by FPD/GC.

See Attached Results.

ISD RECEIVED
MAR 10 1988
ST. BRANCH

Approved By: [signature]
Margil W. Wadley, Ph.D.
Manager of Laboratory Services

Done

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive, El Monte, California 91731

RELEASED
APR 8 1988
LAB BRANCH

TECHNICAL SERVICES DIVISION
LABORATORY SERVICES BRANCH
REPORT FOR SOURCE TEST

TO: John Higuchi, Manager
Source Testing & Monitoring

COMPANY: Pacific Lighting
(Penrose Landfill)

CITY: Sun Valley

PROCESS EQUIPMENT: Landfill Gas Collection

CONTROL EQUIPMENT: Internal combustion engine.

LAB REPORT DATE: April 8, 1988

LABORATORY NO. 80558-4S

REFERENCE NO. JI-14-47

TEST NO. 88-0075

SOURCE TEST DATE: 2-24-88

DATE SAMPLE RECEIVED: 2-24-88

REQUESTED BY: V. Espinosa

SAMPLE DESCRIPTION: One ten-liter bag

ANALYSIS REQUESTED: Heating Value

ANALYTICAL WORK PERFORMED, METHOD OF ANALYSIS, AND RESULTS

Heating value by estimation from analytical results obtained by gas chromatography.

Sample	Heating Value, Btu/cu. ft.
Bag #2, Raw landfill gas after moisture reduction.	540

SD RECEIVED
APR 13 1988
ST BRANCH

Approved By: Joan P Wadley
Margil W. Wadley, Ph.D.
Manager of Laboratory Services

LN 80558-5

PACIFIC LIGHTING (PENROSE LANDFILL)

Component	Bag #1	Bag #2	Bag #3
Benzene, ppb	1300	1200	*
Toluene, ppb	41000	40000	*
Xylenes, ppb	20000	19000	*
Chloroethene (vinyl chloride), ppb	4200	3800	*
Trichloromethane (chloroform), ppb	<400	<400	7.2
1,1,1-trichloroethane (methyl chloroform), ppb	<90	<90	0.25
Tetrachloromethane (carbon tetrachloride), ppb	<20	<20	0.062
Trichloroethylene, ppb	5500	5600	7.3
Tetrachloroethene (perchloroethylene), ppb	18000	18000	13
Hydrogen sulfide, ppm	130	130	*
Carbonyl sulfide, ppm	<2	<2	*
Methyl mercaptan, ppm	9.6	9.2	*
Dimethyl sulfide, ppm	10	10	*
Carbon disulfide, ppm	<2	<2	*

* Not Analyzed - No Sample