(49)

(2.5)

MARYVILLE WASTEWATER TREATMENT PLANT SEWAGE SLUDGE INCINERATOR EMISSION TEST REPORT

PREPARED FOR:

Mr. Rex Ogle
MARYVILLE UTILITIES BOARD
Water and Wastewater Division
P.O. Box 667
Maryville, Tennessee 37801

PREPARED BY:

ENVIRO-MEASURE, INC.
P.O. Box 2511 (37901)
3028 Magnolia Avenue
Knoxville, TN 37914

October 20, 1982

TABLE OF CONTENTS

PERSONNEL DATA

Date of Source Test:	September 28, 1982
Location of Source Test:	Maryville Wastewater Treatment Plant Maryville, Tennessee
Person In Charge:	Tony Babb
Personnel Conducting Sampling:	Mike Mowery Tony Babb
Personnel Conducting Laboratory Analysis:	Mike Mowery
Personnel Conducting Visible Emission Evaluations:	V.N. Malichis
Personnel Observing Test Team:	Tom Isaacs
Personnel Observing Process:	Al Lewis

INTRODUCTION

On September 28, 1982, Enviro-Measure, Inc. performed an EPA Method 5 source emission test at MARYVILLE UTILITIES BOARD's Wastewater Treatment Plant in Maryville, Tennessee.

The objective of this test was to determine the degree of compliance of a multiple hearth sewage sludge incinerator followed by a venturi scrubber. This facility was tested in compliance in December, 1977 with natural gas as the fuel. Modifications have been made to allow the incinerator to be fueled with waste oil. This test was conducted with waste oil as the fuel.

Conditions of the permit for this facility state that particulate emissions to the atmosphere shall not exceed 1.3 lbs. per ton of dry sludge charged or 0.61 lbs. per hour which ever is more stringent.

SUMMARY OF RESULTS

Table 1 presents the results of the EPA Method 5 test conducted on MARYVILLE WASTEWATER TREATMENT PLANT's sewage sludge incineration system fueled with waste oil. The average dry sludge charge rate during testing was 0.32 tons/hr. The test results show an average grain loading of 0.0535 gr/dscf and an average emission rate of 3.61 lbs./hr or 11.2 lbs./ton of dry sludge. The average emision rate of 11.2 lbs./ton of dry sludge is greater than the allowable emission rate of 1.3 lbs./ton of dry sludge and the average emission rate of 3.61 lbs./hr is greater than the allowable emission rate of 0.61 lbs./hr. This indicates that this source was not in compliance with conditions stated in the permit during this test.

TABLE 1

MARYVILLE SEWAGE SLUDGE INCINERATION SYSTEM

METHOD 5 TEST RESULTS

	TEST 1	TEST 2	TEST 3	AVERAGE
Date	9-28-82	9-28-82	9-28-82	
Time	8:53-10:05	11:15-12:25	12:58-2:04	
Net Test Time (min.)	60	60	60	
Volume of Gas Sampled at STP (ft)	56.36	35.81	34.21	
Stack Gas Temperature (F)	105	95	98	99
Moisture Content (% Vol.)	5.2	5.0	5.5	5.2
O_2 (% Vol.)	18.1	18.5	18.2	18.3
CO_2 (% Vol.)	2.6	2.4	2.7	2.6
Stack Diameter (in.)	22	22	22	
Gas Flow Rate (acfm)	8941	9206	9037	9061
Gas Flow Rate (dscfm)	7736	8126	7892	7918
Percent Idokinetic	94	100	99	
Sludge Charge Rate wet (lbs./hr.)	3870	3594	3823	3762
Sludge Charge Rate-Dry (lbs./hr.)	668	584	659	637
Waste Oil Fuel Rate (gal./hr.)	53.5	67.4	61.7	60.9
Particulate Concentration (gr/dscf)	0.0547	0.0388	0.0669	0.0535
Particulate Mass Emission Rate (lbs./ton dry sludge)	10.8	9.2	13.7	11.2

PROCESS DESCRIPTION

MARYVILLE WASTEWATER TREATMENT PLANT utilizes a multiple hearth incinerator to burn sludge. During testing the incinerator was fueled with waste oil. The design volume rate of sludge to be charged on a dry basis is 977 lbs./hr. A 24" Merrick Model L440DS-1 digital single idler Weightometer is used to meter sludge to the incinerator. Exhaust gases from the incinerator are scrubbed with a Sly two stage size 230 Impinjet scrubber with venturi and pre-coolerbefore being exhausted to the atmosphere.

SAMPLING AND ANALYTICAL PROCEDURES

The sewage sludge incineration system at the MARYVILLE WASTEWATER TREATMENT PLANT was tested in accordance with EPA Method 5. Enviro-Measure utilized a sampling train manufactured by Research Appliance Corporation, Inc. (RAC). This equipment has the approval of and meets the standards of calibration accuracy set by EPA.

The RAC stack sampler consists of three main units: the pump, control units, and sampling box. The pump is a Gast^{R} lubricated fiber van rotary pump altered for leak-free operation. The pump is connected to the control unit which contains a Rockwell dry gas meter, dual manometers, dial temperatures indicators, probe and oven temperature controllers, and a calibrated orifice system designed to enable isokinetic sampling. The sampling box is connected to the control unit by means of a flexible umbilical cord, and contains the impinger case and filter oven.

The probe used was constructed of stainaless steel wrapped with a heating element and incased in a 304 stainless steel tube. The heating element maintains probe temperatures above gaseous dew points to prevent condensation. The probe was rigidly mounted to the sampling box and connected directly to the filter holder inside the sampling box oven. An "S" type

pitot tube mounted to the probe was used for velocity measurements at the sampling points.

The nozzles used were constructed of stainless steel and average nozzle diameter was measured on site immediately before and after testing.

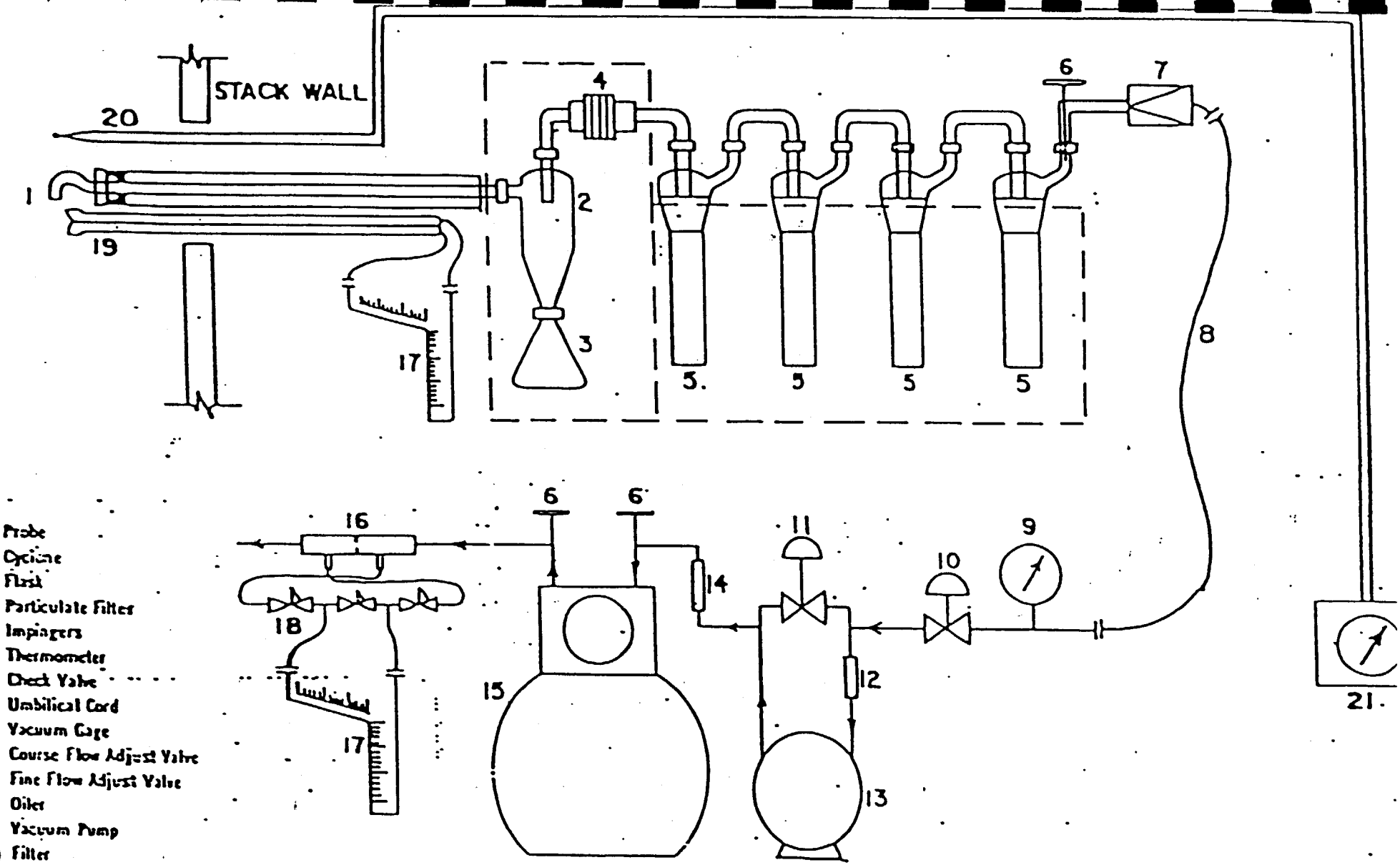
Four ball-topped impingers in an ice bath were used in this system to remove moisture from stack gas samples. The first two impingers contained 100 milliliters (ml) of deionized distilled water, the third was empty, and the fourth contained a preweighed volume of silica gel desiccant. All fittings in the system were rigid ground glass to glass or speically machined steel to prevent leakage.

Figure 1 is a schematic of the RAC sampling train. Figure 2 is a schematic of the sampling points used for testing the scrubber.

The stack gas sample was drawn isokinetically through the nozzle, the heated probe, and into the heated filter assembly where the particulate matter was collected on a preweighed glass fiber filter. The filtered gas then passed through an umbilical cord to the dry gas meter, orifice, and pump.

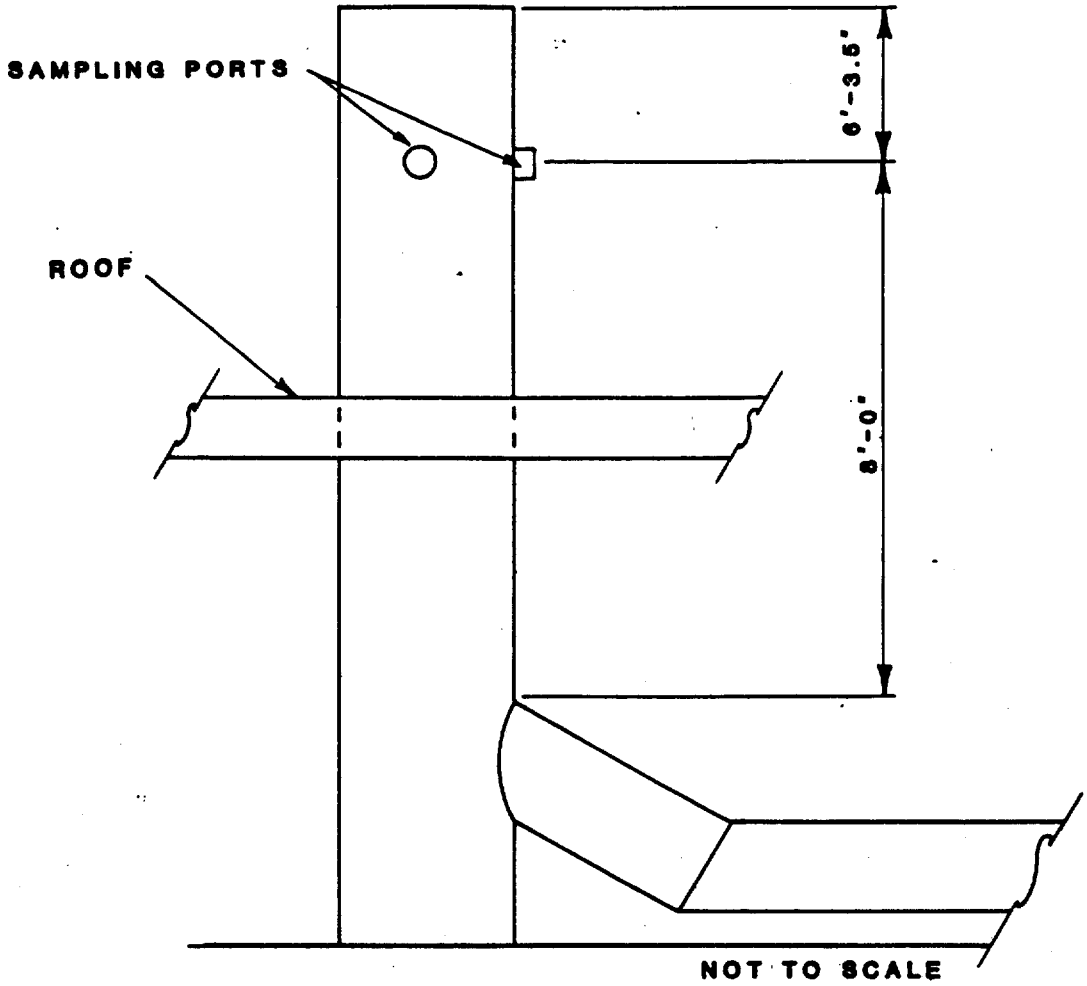
Velocity pressure and temperature were monitored at each sampling point to insure that isokinetic sampling conditions were maintained. On-site leak checks were performed across the entire sampling train to insure that the system met the 0.02 cfm allowable leakage rate as specified by the EPA. This criterion was met. The pitot tube system was also checked for leaks.

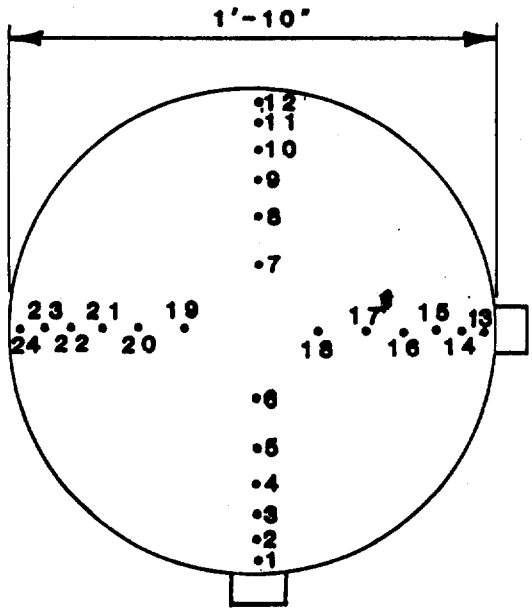
A flue gas sample was collected through a stainless steel tube mounted on the sampling probe. An integrated grab sample was collected by using a hand pump to extract a gas sample at each sampling point during testing and thereby filling one 5-liter Tedlar bag. This gas sample was then analyzed for CO_2 and O_2 using a Fisher Orsat Analyzer.



1) Probe
2) Cyclone
3) Flask
4) Particulate Filter
5) Impingers
6) Thermometer
7) Check Valve
8) Umbilical Cord
9) Vacuum Gage
10) Course Flow Adjust Valve
11) Fine Flow Adjust Valve
12) Oiler
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Pyrometer

FIGURE 1. SCHEMATIC OF THE RAC SAMPLING TRAIN





TRAVERSE POINTS

1/13	- 1.00
2/14	- 1.47
3/15	- 2.59
4/16	- 3.89
5/17	- 5.50
6/18	- 7.81
7/19	- 14.19
8/20	- 16.50
9/21	- 18.11
10/22	- 19.40
11/23	- 20.53
12/24	- 21.00

FIGURE 2. SCHEMATIC OF THE STACK AND SAMPLING POINTS.

At the conclusion of each particulate test, a clean-up was conducted on the sampling train. Care was taken to insure no sample was lost and no particulate matter other than the sample itself was allowed in the sample to be analyzed.

The nozzle and probe were washed with acetone, and the probe was cleaned with a teflon bore brush. The washings were placed in polyethylene sample bottles. The filter holder and impingers were transported to the lab for subsequent analysis.

The filter was removed from the filter holder and transferred to a petri dish. The front half of the filter holder was washed with acetone and this wash added to the nozzle and probe wash. The liquid in impingers 1, 2, and 3 were measured with a graduated cylinder. The silica gel in impinger 4 was removed and weighed to the nearest 0.5 gm.

The filters were subsequently desiccated for 24 hours before weighing to a constant weight. The net weight of the captured particulate was determined to the nearest 0.10 mg.

The contents of the wash samples were transferred to tared beakers and evaporated to dryness at ambient temperature and pressure. The beakers were then desiccated for 24 hours to a constant weight. The net weight of the captured particulate was then determined to the nearest 0.10 mg.

All volumes and weights were recorded on laboratory sheets.

EQUATIONS
and
NOMENCLATURE

SAMPLE EPA METHOD 5 CALCULATIONS

CLIENT _____

TEST NO. _____

Volume of Water Collected

$V_{wstd} = (V I_q)\ (0.0474\ \frac{ft.^3}{ml})$

=

V_{wstd} =

Volume of Gas Metered, Standard Conditions

$V_{mstd}\ ((17.71)\ (Vm)\ (Pb + \frac{\Delta H}{13.6})\ (\gamma))/\ T_m$

=

V_{mstd} =

Moisture Content

$$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$$

=

B_{wo} =

Molecular Weight of Dry Gas Stream

$M_d = (.44)\ (\%CO_2) + (.32)\ (\%O_2) + (.28)\ (\%CO + \%N_2)$

=

M_d =

Molecular Weight of Stack Gas

$M_s = M_d(1-B_{ow}) + 18(B_{wo})$

=

M_s =

Velocity of Stack Gas

$$Vs = 174\ Cp\sqrt{\overline{\Delta p}}\ \sqrt{Ts \times \frac{29.92}{Ps} \times \frac{28.96}{Ms}}$$

=

Vs =

Total Flow of Stack Gas

Qa = As x Vs

=

Qa =

$$Qs = Qa \times \frac{530}{TsR} \times \frac{Ps}{29.92}$$

=

Qs =

Qstd = Qs (1-Bwo)

=

Qstd =

Particulate Concentration

$$Cs = \frac{(15.43)\ (Mn)}{Vmstd}$$

=

Cs =

Particulate Mass Rate

$$PMR = \frac{(Mn)\ (Qstd)\ (60)}{(Vmstd)\ (454)}$$

=

PMR =

Percent Isokinetic of Test

$$Is = \frac{Vmstd}{An\ (\theta)\ (Vs_{std})}$$

=

Is =

NOMENCLATURE

An – Cross sectional area of nozzle, square feet.

As – Cross section area of stack, square feet.

Bwo – Proportion by volume of water vapor in gas stream, %.

Ca – Concentration of particulate matter in stack gas, Gr./Acf.

Cp – Pitot tube coefficient, dimensionless.

Cs – Concentration of particulate matter in stack gas, Gr./DSCF.

C_{12} – Emission rate corrected to 12% CO_2, lb/hour.

$\overline{\Delta H}$ – Average pressure drop across the orifice, inches H_2O.

$\overline{\sqrt{\Delta p}}$ – Average velocity head of stack gas, inches H_2O.

%I – Percent of isokinetic sampling (acceptable: $90 \leq I \leq 110\%$).

Kp – 85.48 ft./sec.: constant $\left[\frac{\text{lb.}}{\text{lb. mole R}}\right]^{1/2}$

Md – Dry molecular weight of stack gas, lb/lb. mole.

Mn – Total amount of particulate matter collected, mg.

Ms – Molecular weight of stack gas (wet basis), lb/lb. mole.

Pb – Barometric pressure, inches Hg.

Ps – Absolute stack gas pressure, inches Hg.

Pstd – Pressure at standard conditions.

PMR – Particulate mass rate, lbs/hr.

Qa – Volumetric flow rate, actual conditions.

Qs – Volumetric flow rate at standard conditions.

Qstd – Volumetric flow rate at standard conditions, (dry basis).

$\overline{Tm}$ – Average dry gas meter temperature, °R or °F.

$\overline{Ts}$ – Average stack temperature, °R or °F.

Tstd – Absolute temperature at standard conditions, 530°R.

θ —Total sampling time, minutes

V_{lo} —Total volume of liquid collected in impingers and silica gel, ml.

V_m —Volume of gas sample through the dry gas meter (meter conditions), cubic feet.

V_{mstd} —Volume of gas sample through the dry gas meter at standard conditions.

V_{wstd} —Volume of water collected at 29.92" Hg. and 70° cubic feet.

$\overline{V_s}$ —Stack gas velocity, feet per minute.

V_{Pc} —Vapor pressure of metered gas at condenser temperature, in. Hg.

Standard Conditions, 29.92" Hg. and 70° F.

γ —Dry meter calibration factor.

DATA SHEETS
and
CALCULATIONS

EPA SHEET

PARAMETER	TEST 1	TEST 2	TEST 3
$\overline{\Delta h}$	3.85	1.43	1.38
$\overline{\sqrt{\Delta p}}$	0.955	0.992	0.971
Pb	29.15	29.15	29.15
Ps	29.11	29.11	29.11
Tm	543.8	553.	556.
Tsr	565.0	555.	558.
Vm	58.91	36.96	36.79
Vmstd	56.36	35.81	34.21
Vlo	64.5	39.5	41.8
Vwstd	3.06	1.87	1.98
Bwo	0.052	0.050	0.055
Md	29.14	29.12	29.16
Ms	28.56	28.56	28.55
Vs	3387.	3487.	3423.
Qa	9841.	9206.	9037.
Qstd	7736.	8126.	7892.
Mn	0.1998	0.0901	0.1483
Cs	0.0547	0.0388	0.0669
%I	94.0	100.0	99.0
As	2.64	2.64	2.64
Cp	0.84	0.84	0.84
0	60	60	60
H@	2.056	2.056	2.056
An	0.000341	0.000193	0.000193
$\%CO_2$	2.6	2.4	2.7
$\%O_2$	18.1	18.5	18.2
PMR	3.62	2.70	4.52

RT. 4 BOX 283
LOUISVILLE, TN 37777
615/970-2313

DENNIS WEETER ASSOCIATES

CONSULTING ENGINEERS

October 1, 1982

Mr. Al Lewis
Air Pollution Control Division - TDPH
5th Floor Terra Bldg.
150 9th Ave. N.
Nashville, TN 37203

RE: Operating Data - MUB Test of 9/28/82 (APCD #05-00116)

Dear Al:

Please find enclosed Table I and Table II which summarize the operating data from the MUB September 28, 1982 test.

We will forward the test results as soon as they are received from EMI (air test) and Kenwill (Hg analysis).

Sincerely yours,

D. W. Weeter, P.E.

spw

cc: T. Babbs - EMI
D. Carver - APCD
V. Malichis - APCD Knoxville
R. Ogle - MUB
T. S. Reddy - APCD

MUB Air Test
APCD #05-00116
9/28/82

TABLE I

	Time	Sludge Cake % Solids	Oil Sludge % Moisture	Sludge W+ lbs/hr
	5 am	-	-	3663
	6 am	-	-	2741
	7 am	18%	-	3057
	8 am	-	-	3032
Run #1	9 am	17.5%	-	3870
Run #1	10:05 am	17%	25%	-
Run #2	11:20 am	17.5%	25%	3594
Run #2	12:05 pm	15%	-	-
Run #2	12:25 pm	-	-	-
Run #3	1:00 pm	-	-	3823
Run #3	1:40 pm	17%	25%	-
Run #3	2:10 pm	17.5%	-	-

Fuel Use

No Natural Gas Used

Oil

Test 1 (9:00 am - 10:05 am) - 58 gallons
Test 2 (11:20 am - 12:25 pm) - 73 gallons
Test 3 (1:00 pm - 2:10 pm) - 72 gallons

MUB Air Test
APCD #05-00116
9/28/82

TABLE II

TIME	Temperature °F									% O_2	Scrubber Diff. Inches	Scrubber Flow gpm @ 10
	H-1	H-2	H-3	H-4	H-5	H-6	Cooling Air	Scrub Inlet	Scrub Outlet			
MN	700	1040	1120	1280	860	200	260	120	120	off	off	off
5 am	770	1040	1110	1250	850	180	260	120	120	off	off	off
6 am	680	1120	1270	1540	1080	200	210	120	140	3.0	4.0	280
7 am	670	1110	1280	1620	1180	210	260	110	140	4.5	4.0	275
8 am	630	1090	1200	1610	1140	230	280	190	150	5.0	5.0	275
9 am	720	1400	1610	1620	1260	260	280	200	160	5.5	4.75	275
10:05 am	600	1110	1210	1550	1200	220	290	310	130	6.6	4.25	280
11:20 am	570	1020	1130	1540	1190	220	280	190	140	2.8	4.0	280
12:25 am	560	1000	1080	1540	1190	240	260	240	140	7.5	4.0	275
1:00 pm	520	980	1060	1520	1180	200	240	180	140	7.0	4.0	275
2:10 pm	560	1060	1140	1610	1200	240	280	140	140	1.7	4.25	280
3:00 pm	580	1080	1190	1630	1260	240	260	120	140	2.0	4.25	280

EPA SOURCE SAMPLING PARTICULATE WEIGHT DATA SHEET

Company Maryville Utilities

Process Waste Treatment Incinerator

Test Date 9-28-82

Analysis Date 9-29-82

FILTER

Test #1

Filter No. 904

Initial Wt. 0.3528

Final Wt. 0.4938

Particulate Wt. 0.1410

Test #2

Filter No. 902

Initial Wt. 0.3562

Final Wt. 0.4378

Particulate Wt. 0.0820

Test #3

Filter No. 903

Initial Wt. 0.3586

Final Wt. 0.4386

Particulate Wt. 0.0800

PROBE WASH

Acetone Blank

Initial Wt. 9.1276

Final Wt. 9.1276

Calibration Factor -0-

Test #1

Initial Wt. 9.0926

Final Wt. 9.1514

Particulate Wt. 0.0588

Test #2

Initial Wt. 9.1565

Final Wt. 9.1646

Particulate Wt. 0.0081

Test #3

Initial Wt. 9.1307

Final Wt. 9.1990

Particulate Wt. 0.0683

Signature of person responsible Michael Mowery Date 9-29-82

CLIENT Maryville Waste Treatment SOURCE Waste Incinerator

RUN NO. 1
DATE 7-29-97
OPERATORS [illegible]
METER BOX NO. [illegible]
SAMPLE BOX NO. 1
FILTER NO. [illegible]
PROBE HEATER SETTING [illegible]

BAROMETRIC PRESSURE 29.15
STATIC PRESSURE -0.55
AMBIENT TEMPERATURE [illegible]
PROBE LENGTH 3'
PROBE LINER S.S.
PORT LENGTH 2 3/4"
PORT DIAMETER 3"

SCHEMATIC OF STACK

TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	VELOCITY HEAD (ΔP) in.	(√ΔP)	ORIFICE METER (ΔH) in. H2O ACTUAL	DESIRED	GAS SAMPLE TEMP. AT DRY GAS METER INLET (Tm)°F	OUTLET (Tm)°F	PUMP VACUUM GAUGE in. Hg	SAMPLE BOX TEMP. °F	TEMP. OF GAS LEAVING LAST IMPINGER °F	GAS SAMPLE VOLUME (Vm) ft³	S T
1	1:53	[illegible]	.72		2.0	3.0	69	66	1.5	265	50	160.00	11
2		5.5	.81		3.6	3.6	72	67	3.0	265	50	162.10	12
3		5.0	.95		4.0	4.0	83	68	3.5	260	50	164.57	11
4		7.5	.95		4.0	4.0	87	69	4.0	260	50	167.00	12
5		10.0	.93		3.9	3.9	89	70	5.0	255	50	169.40	11
6		12.5	.86		3.6	3.6	91	71	4.5	250	60	171.90	12
7		15.0	.92		3.85	3.85	93	71	5.0	265	60	174.40	11
8		17.5	.92		3.85	3.85	94	72	5.0	265	65	176.85	12
9		20.0	.98		4.05	4.05	95	73	6.0	260	65	179.30	9
10		22.5	1.05		4.40	4.40	96	73	7.0	265	65	181.80	9
11		25.0	1.20		5.0	5.0	97	74	9.0	260	70	184.50	10
12		27.5	1.10		4.6	4.6	100	75	9.0	265	70	187.30	9
13		30.0	.59		2.45	2.45	81	73	3.0	265	55	189.44	9
14		32.5	.64		2.70	2.70	89	75	4.0	265	55	192.00	10
15		35.0	.68		2.85	2.85	93	75	4.5	270	60	194.10	9
16		37.5	.65		2.75	2.75	97	76	4.5	265	60	196.30	10
17		40.0	.70		2.90	2.90	97	77	5.0	260	60	198.45	9
18		42.5	.70		2.90	2.90	99	77	5.0	265	65	200.60	9
19		45.0	.91		3.80	3.80	99	78	8.0	265	65	202.70	9
20		47.5	1.0		4.10	4.10	101	78	9.0	260	65	205.15	9
21		50.0	1.20		5.0	5.0	103	79	12.0	260	65	207.70	9
22		52.5	1.25		5.20	5.20	105	79	14.0	265	65	210.40	9
23		55.0	1.20		5.0	5.0	105	80	14.0	265	65	213.30	9
24		57.5	1.20		5.0	5.0	105	80	15.0	260	70	216.20	10
	10:05	60.0										218.91	
TOTAL					92.5								
AVERAGE				0.955	3.85			83.8					105

STATIC PITOT LEAK-CHECK @ 15 sec.	[illegible]
IMPACT PITOT LEAK-CHECK @ 15 sec.	OK
TRAIN LEAK RATE @ 60 sec:	0.0 cf @ 12 in.
TRAIN LEAK RATE @ 60 sec:	0.0 cf @ 15 in.

STACK GAS ANALYSIS

TIME	CO2	O2	CO	N2
11:15	2.6	18.1		

NOZZLE CALIBRATION I.D. NO. 785

PRETEST	POST-TEST
DIA. 1	DIA. 1
DIA. 2	DIA. 2
DIA. 3	DIA. 3
AVERAGE .25	AVERAGE 0.25

ENVIRO - MEASURE, INC.
3028 MAGNOLIA AVE.
P. O. BOX 2511
KNOXVILLE, TN 37901

Consultants in Air Pollution

SIGNATURE Michael D Mauldin

SOURCE SAMPLING EPA PARTICULATE TEST LAB DATA SHEET

COMPANY Maryville Utilities Waste Treatment DATE 9-28-82
SOURCE Incinerator BOX NO. 1 RUN NO. 1

CONDENSATION

IMPINGER NO.	INITIAL VOL., ml	FINAL VOL., ml	NET GAIN, ml
1.	100	114	14
2.	100	121	21
3.	-0-	6	6
4.	200 ,g	223.5 ,g	23.5 ,g
TOTAL	400		64.5

PARTICULATE

COMPONENT I.D. NO.	INITIAL WT., g	FINAL WT., g	NET WT., g
PROBE WASH	9.0926	9.1514	0.0588
ACETONE BLANK	9.1276	9.1276	-0-
PROBE WASH (-Blank)			0.0588
CYCLONE	———	———	———
FILTER #904	0.3528	0.4938	0.1410
IMPINGERS	———	———	———

PARTICULATE COLLECTED (excluding impinger catch) =	0.1998	,g
PARTICULATE COLLECTED (including impinger catch) =	———	,g

COMMENTS: ———

SIGNATURE OF PERSON RESPONSIBLE Mickal Mowery DATE 9-29-82

MARYVILLE UTILITIES BOARD
SEWAGE SLUDGE INCINERATOR
9/28/82
TEST # 1

SAMPLE EPA CALCULATIONS

Volume of Water Collected

$V_{wstd} = (VI_q)\ (0.0474\ ft.^3/ml)$

$= (64.5)(0.0474)$

$V_{wstd} = 3.06$

Volume of Gas Metered, Standard Conditions

$V_{mstd} = ((17.71)\ (Vm)\ (Pb + \frac{\Delta H}{13.6})\ (Y))/\ Tm$

$= ((17.71)(58.91)(29.15 + \frac{3.85}{13.6})(998))/543.8$

$V_{mstd} = 56.36$

Moisture Content

$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$

$= \frac{3.06}{56.36 + 3.06}$

$B_{wo} = 0.052$

Molecular Weight of Dry Gas Stream

$M_d = (.44)\ (\%CO_2) + (.32)\ (\%O_2) + (.28)\ (\%CO + \%N_2)$

$= (.44)(2.6) + (.32)(18.1) + (.28)(79.3)$

$M_d = 29.14$

Molecular Weight of Stack Gas

$M_s = M_d(1 - B_{ow}) + 18(B_{wo})$

$= 29.14(1 - 0.052) + 18(0.052)$

$M_s = 28.56$

$29.15 - \frac{0.55}{13.6}$

Velocity of Stack Gas

$$Vs = 174\ Cp\sqrt{\overline{\Delta p}}\ \sqrt{Ts \times \frac{29.92}{Ps} \times \frac{28.96}{Ms}}$$

$$= 174(.84)(0.955)\sqrt{.565 \times \frac{29.92}{29.11} \times \frac{28.96}{28.56}}$$

$$Vs = 3,387$$

Total Flow of Stack Gas

$$Qa = As \times Vs$$

$$= 2.64 \times 3387$$

$$Qa = 8,941.$$

$$Qs = Qa \times \frac{530}{TsR} \times \frac{Ps}{29.92}$$

$$= 8,941 \times \frac{530}{565} \times \frac{29.11}{29.92}$$

$$Qs = 8160$$

$$Qstd = Qs\ (1 - Bwo)$$

$$= 8160(1 - 0.052)$$

$$Qstd = 7736$$

Particulate Concentration

$$Cs = \frac{(15.43)\ (Mn)}{Vmstd}$$

$$= \frac{(15.43)(0.1998)}{56.36}$$

$$Cs = 0.0547$$

Particulate Mass Rate

$$PMR = \frac{(Mn)\ (Qstd)\ (60)}{(Vmstd)\ (454)}$$

$$= \frac{(0.1998)(7736)(60)}{(56.36)(454)}$$

$$PMR = 3.62$$

Percent Isokinetic of Test

$$Is = \frac{Vmstd}{An\ (\theta)\ (Vs_{std})}$$

$$= \frac{56.36}{(0.000341)(60)(2930)}$$

$$Is = 0.94$$

CLIENT Maryville Utilities SOURCE Sludge Incinerator

RUN NO. 2
DATE 8-12-97
OPERATORS [illegible]
METER BOX NO. [illegible]
SAMPLE BOX NO. 2
FILTER NO. [illegible]
PROBE HEATER SETTING [illegible]

BAROMETRIC PRESSURE
STATIC PRESSURE
AMBIENT TEMPERATURE
PROBE LENGTH 3'
PROBE LINER S
PORT LENGTH [illegible]
PORT DIAMETER 3

SCHEMATIC OF STACK

TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	VELOCITY HEAD (ΔPs)	VELOCITY HEAD (√ΔPs)	ORIFICE METER (ΔH) in. H2O ACTUAL	ORIFICE METER (ΔH) in. H2O DESIRED	GAS SAMPLE TEMP. AT DRY GAS METER INLET (Tm) °F	GAS SAMPLE TEMP. AT DRY GAS METER OUTLET (Tm) °F	PUMP VACUUM GAUGE in. Hg	SAMPLE BOX TEMP. °F	TEMP. OF GAS LEAVING LAST IMPINGER °F	GAS SAMPLE VOLUME (Vm), ft³	STACK TEMP. (Ts) °F
1	11:15	0.0	1.0		1.45	1.45	83	79	0.0	225	55	219.70	96
2		2.5	1.10		1.55	1.55	91	82	0.0	230	55	220.[illegible]	96
3		5.0	1.05		1.50	1.50	95	82	0.0	235	55	222.40	95
4		7.5	1.0		1.45	1.45	98	83	0.0	235	55	224.00	96
5		10.0	1.0		1.45	1.45	100	83	0.0	235	55	225.60	95
6		12.5	.94		1.35	1.35	100	84	0.0	240	55	227.20	95
7		15.0	.95		1.35	1.35	100	85	0.0	245	55	228.70	96
8		17.5	.99		1.40	1.40	101	85	0.0	230	55	230.20	95
9		20.0	1.05		1.50	1.50	101	86	0.0	240	55	231.80	95
10		22.5	1.10		1.55	1.55	102	87	0.0	245	55	233.40	95
11		25.0	1.20		1.70	1.70	103	87	0.0	250	60	235.06	94
12		27.5	1.160		2.30	2.30	104	97	0.0	255	60	236.60	95
13		30.0	.55		0.79	0.79	97	87	0.0	255	60	238.50	94
14		32.5	.64		0.97	0.97	98	88	0.0	265	60	239.70	96
15		35.0	.66		0.96	0.96	99	88	0.0	250	65	240.90	95
16		37.5	.64		0.92	0.92	100	89	0.0	250	65	242.30	94
17		40.0	.67		0.98	0.98	100	89	0.0	265	65	243.50	96
18		42.5	.70		1.0	1.0	101	89	0.0	265	65	—	95
19		45.0	.93		1.30	1.30	101	89	0.0	265	65	246.20	94
20		47.5	1.10		1.55	1.55	101	89	1.0	265	65	247.70	96
21		50.0	1.20		1.70	1.70	103	89	2.0	265	65	249.20	94
22		52.5	1.10		1.55	1.55	103	90	1.5	265	65	251.00	95
23		55.0	1.40		1.85	1.85	103	90	1.5	265	65	252.60	96
24		57.5	1.50		2.15	2.15	103.	90	2.0	250	65	254.30	95
		60.0										256.16	
TOTAL													
AVERAGE				0.992	1.926			93				36.96	95

STATIC PITOT LEAK-CHECK @ 15 sec. OK	
IMPACT PITOT LEAK-CHECK @ 15 sec. OK	
TRAIN LEAK RATE @ 60 sec: 0.0 cf @ 15 in.	
TRAIN LEAK RATE @ 60 sec: 0.0 cf @ 7 in.	

STACK GAS ANALYSIS

TIME	CO2	O2	CO	N2
1:00	2.4	18.5		

NOZZLE CALIBRATION I.D. NO. 138

PRETEST	POST-TEST
DIA. 1	DIA. 1
DIA. 2	DIA. 2
DIA. 3	DIA. 3
AVERAGE .188	AVERAGE 0.188

ENVIRO-MEASURE, INC.
3028 MAGNOLIA AVE.
P. O. BOX 2511
KNOXVILLE, TN 37901

Consultants in Air Pollution

SIGNATURE [signature] TEST TEAM LEADER

CLIENT Maryville Utilities SOURCE Sludge Incinerator

RUN NO. 2
DATE 1-12-94
OPERATORS [illegible]
METER BOX NO. [illegible]
SAMPLE BOX NO. 2
FILTER NO. [illegible]
PROBE HEATER SETTING [illegible]

BAROMETRIC PRESSURE
STATIC PRESSURE
AMBIENT TEMPERATURE
PROBE LENGTH 31
PROBE LINER
PORT LENGTH
PORT DIAMETER 3

SCHEMATIC OF STACK

TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	VELOCITY HEAD (Δ Psi)	VELOCITY HEAD (√Δ Psi)	ORIFICE METER (ΔH) in. H2O ACTUAL	ORIFICE METER (ΔH) in. H2O DESIRED	GAS SAMPLE TEMP. AT DRY GAS METER INLET (Tm_in) °F	GAS SAMPLE TEMP. AT DRY GAS METER OUTLET (Tm_out) °F	PUMP VACUUM GAUGE in. Hg	SAMPLE BOX TEMP. °F	TEMP. OF GAS LEAVING LAST IMPINGER °F	GAS SAMPLE VOLUME (Vm) ft³	STAC TEMP (Ts) °
1	11:15	0.0	1.0		1.45	1.45	83	79	0.0	225	55	219.70	96
2		2.5	1.10		1.55	1.55	91	82	0.0	230	55	222.40	95
3		5.0	1.05		1.50	1.50	95	82	0.0	235	55	224.00	96
4		7.5	1.0		1.45	1.45	98	83	0.0	235	55	225.60	95
5		10.0	1.0		1.45	1.45	100	83	0.0	235	55	227.20	95
6		12.5	.94		1.35	1.35	100	84	0.0	240	55	228.70	96
7		15.0	.95		1.35	1.35	100	85	0.0	245	55	230.20	95
8		17.5	.99		1.40	1.40	101	85	0.0	230	55	231.80	95
9		20.0	1.05		1.50	1.50	101	86	0.0	240	55	233.40	95
10		22.5	1.10		1.55	1.55	102	87	0.0	245	55	235.06	94
11		25.0	1.20		1.70	1.70	103	87	0.0	250	60	236.60	95
12		27.5	1.60		2.30	2.30	104	87	0.0	255	60	238.50	94
13		30.0	.55		0.79	0.79	97	87	0.0	255	60	239.70	96
14		32.5	.64		0.92	0.92	98	88	0.0	265	60	240.90	95
15		35.0	.66		0.96	0.96	99	88	0.0	250	65	242.30	94
16		37.5	.64		0.92	0.92	100	89	0.0	250	65	243.50	96
17		40.0	.67		0.98	0.98	100	89	0.0	265	65	—	95
18		42.5	.70		1.0	1.0	101	89	0.0	265	65	246.20	94
19		45.0	.93		1.30	1.30	101	89	0.0	265	65	247.70	96
20		47.5	1.10		1.55	1.55	101	89	1.0	265	65	249.20	94
21		50.0	1.20		1.70	1.70	103	89	2.0	265	65	251.00	95
22		52.5	1.10		1.55	1.55	103	90	1.5	265	65	252.60	96
23		55.0	1.40		1.85	1.85	103	90	1.5	265	65	254.30	95
24		57.5	1.50		2.15	2.15	103.	90	2.0	250	65	256.16	
		60.0											
TOTAL								93				36.96	9
AVERAGE				0.992	1.426								

STATIC PITOT LEAK-CHECK @ 15 sec. OK
IMPACT PITOT LEAK-CHECK @ 15 sec. OK
TRAIN LEAK RATE @ 60 sec: 0.0 cf @ 15 in.
TRAIN LEAK RATE @ 60 sec: 0.0 cf @ 7 in.

STACK GAS ANALYSIS

TIME	CO2	O2	CO	N2
1:00	2.4	18.5		

NOZZLE CALIBRATION I.D. NO. 138

PRETEST	POST-TEST
DIA. 1	DIA. 1
DIA. 2	DIA. 2
DIA. 3	DIA. 3
AVERAGE .188	AVERAGE 0.188

ENVIRO-MEASURE, INC.
3028 MAGNOLIA AVE.
P. O. BOX 2511
KNOXVILLE, TN 37901

SIGNATURE Michael Mowery

SOURCE SAMPLING EPA PARTICULATE TEST LAB DATA SHEET

COMPANY Maryville Utilities Waste Treatment DATE 9-28-92

SOURCE Incinerator BOX NO. 2 RUN NO. 2

CONDENSATION

IMPINGER NO.	INITIAL VOL., ml	FINAL VOL., ml	NET GAIN, ml
1.	100	116	16
2.	100	112	12
3.	-0-	1	1
4.	200 ,g	310.5 ,g	10.5 ,g
TOTAL	400		

PARTICULATE

COMPONENT I.D. NO.	INITIAL WT., g	FINAL WT., g	NET WT., g
PROBE WASH	9.1565	9.1646	0.0081
ACETONE BLANK	9.1276	9.1276	-0-
PROBE WASH (-Blank)			0.0081
CYCLONE	———	———	———
FILTER # 902	0.3562	0.4378	0.0820
IMPINGERS	———	———	———

PARTICULATE COLLECTED (excluding impinger catch) =	0.0901 ,g
PARTICULATE COLLECTED (including impinger catch) =	——— ,g

COMMENTS: _____

SIGNATURE OF PERSON RESPONSIBLE Michael D Mauney DATE 9-29-92

SAMPLE EPA CALCULATIONS

Test #2

Volume of Water Collected

$V_{wstd} = (VI_q)\ (0.0474\ ft.^3)^{MI}$

$= (39.5)(0.0474)$

$V_{wstd} = 1.87$

Volume of Gas Metered, Standard Conditions

$V_{mstd} = ((17.71)\ (Vm)\ (Pb + \frac{\Delta H}{13.6})\ (Y))/\ T_m$

$= ((17.71)(36.96)(29.15 + \frac{1.426}{13.6})(.998))/553$

$V_{mstd} = 35.81$

Moisture Content

$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$

$= \frac{1.87}{35.81 + 1.87}$

$B_{wo} = 0.050$

Molecular Weight of Dry Gas Stream

$M_d = (.44)\ (\%CO_2) + (.32)\ (\%O_2) + (.28)\ (\%CO + \%N_2)$

$= (.44)(2.4) + (.32)(18.5) + (.28)(79.1)$

$M_d = 29.12$

Molecular Weight of Stack Gas

$M_s = Md(1-Bow)\ 18(Bwo)$

$= 29.12(1-0.05) + 18(0.05)$

$M_s = 28.56$

Velocity of Stack Gas

$$Vs = 174\ Cp\sqrt{\overline{\Delta p}}\ \sqrt{Ts \times \frac{29.92}{Ps} \times \frac{28.96}{Ms}}$$

$$= 174(.84)(.992)\left(\sqrt{555 \times \frac{29.92}{29.11} \times \frac{28.96}{28.56}}\right.$$

$$Vs = 3487$$

Total Flow of Stack Gas

$$Qa = As \times Vs$$

$$= 2.64 \times 3487$$

$$Qa = 9206$$

$$Qs = Qa \times \frac{530}{TsR} \times \frac{Ps}{29.92}$$

$$= 9206 \times \frac{530}{555} \times \frac{29.11}{29.92}$$

$$Qs = 8,553$$

$$Qstd = Qs\ (1 - Bwo)$$

$$= 8,553(1 - 0.05)$$

$$Qstd = 8126$$

Percent Isokinetic of Test

$$Is = \frac{Vmstd}{An\ (\theta)\ (Vs_{std})}$$

$$= \frac{35.81}{(0.000193)(60)(3078)}$$

$$Is = 1.00$$

Particulate Concentration

$$Cs = \frac{(15.43)\ (Mn)}{Vmstd}$$

$$= \frac{(0.0901)(15.43)}{35.81}$$

$$Cs = 0.0388$$

Particulate Mass Rate

$$PMR = \frac{(Mn)\ (Qstd)\ (60)}{(Vmstd)\ (454)}$$

$$= \frac{(0.0901)(8126)(60)}{(35.81)(454)}$$

$$PMR = 2.70$$

CLIENT Maryville Utilities SOURCE Waste Incinerator

RUN NO. 3
DATE 9-29-92
OPERATORS M. Sm. / TD.
METER BOX NO. 04
SAMPLE BOX NO. 3
FILTER NO. 902
PROBE HEATER SETTING 0-4

BAROMETRIC PRESSURE
STATIC PRESSURE .155
AMBIENT TEMPERATURE
PROBE LENGTH 3
PROBE LINER 3S
PORT LENGTH 2½
PORT DIAMETER 3

SCHEMATIC OF STACK
Flue Gas Sample Before Scru
* 1 CO_2 - 4.4 O_2 - 17.1
* 2 CO_2 - 4.8 O_2 - 16.9

TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	VELOCITY HEAD (ΔPs)	VELOCITY HEAD (√ΔPs)	ORIFICE METER (ΔH) in. H2O ACTUAL	ORIFICE METER (ΔH) in. H2O DESIRED	GAS SAMPLE TEMP. AT DRY GAS METER INLET (Tm) °F	GAS SAMPLE TEMP. AT DRY GAS METER OUTLET (Tm) °F	PUMP VACUUM GAUGE in. Hg	SAMPLE BOX TEMP. °F	TEMP. OF GAS LEAVING LAST IMPINGER °F	GAS SAMPLE VOLUME (Vm), ft³	S TE (T
1		0.0	.89		1.25	1.25	87	85	0.0	245	70	256.33	9
2		2.5	.96		1.40	1.40	93	87	0.0	250	65	257.90	9
3		5.0	.90		1.40	1.40	97	87	0.0	255	65	259.30	9
4		7.5	1.0		1.45	1.45	99	88	0.0	260	60	260.90	9
5		10.0	1.0		1.45	1.45	100	89	0.0	265	60	262.50	9
6		12.5	.94		1.35	1.35	101	89	0.0	270	65	264.00	9
7		15.0	.87		1.25	1.25	102	86	0.0	240	65	265.60	9
8		17.5	.98		1.40	1.40	102	89	0.0	245	65	267.10	9
9		20.0	.98		1.40	1.40	103	90	0.0	260	65	268.60	9
10		22.5	1.05		1.50	1.50	103	91	0.0	260	65	270.40	9
11		25.0	1.10		1.60	1.60	105	91	0.0	275	65	271.80	9
12		27.5	1.10		1.60	1.60	105	91	0.0	240	65	273.50	9
13		30.0	.58		.84	.84	99	91	0.0	270	70	275.20	9
14		32.5	.64		.92	.92	102	92	0.0	240	70	276.40	9
15		35.0	.64		.92	.92	103	93	0.0	255	70	277.70	9
16		37.5	.65		.94	.94	103	93	0.0	265	70	279.00	9
17		40.0	.65		.94	.94	103	93	0.0	270	70	280.30	9
18		42.5	.70		1.0	1.0	104	94	0.0	235	70	281.60	10
19		45.0	.89		1.30	1.30	105	94	1.0	240	70	282.90	9
20		47.5	.96		1.40	1.40	105	94	1.0	260	70	284.40	9
21		50.0	1.20		1.70	1.70	106	94	2.5	265	70	285.90	9
22		52.5	1.40		2.0	2.0	106	94	3.5	265	70	287.60	10
23		55.0	1.40		2.0	2.0	106	94	3.5	265	70	289.40	9
24	2:04	57.5	1.45		2.10	2.10	107	95	4.0	275	70	291.30	9
		60.0										293.12	
TOTAL													
AVERAGE				0.971	1.38			96				36.79	

STATIC PITOT LEAK-CHECK @ 15 sec.	OK
IMPACT PITOT LEAK-CHECK @ 15 sec.	OK
TRAIN LEAK RATE @ 60 sec:	0.0 cf @ 12 in.
TRAIN LEAK RATE @ 60 sec:	0.0 cf @ 9 in.

STACK GAS ANALYSIS

TIME	CO_2	O_2	CO	N_2
2:15	2.7	18.2		

NOZZLE CALIBRATION-I.D. NO. 138

PRETEST	POST-TEST
DIA. 1	DIA. 1
DIA. 2	DIA. 2
DIA. 3	DIA. 3
AVERAGE 0.188	AVERAGE 0.18

ENVIRO - MEASURE, INC.
3028 MAGNOLIA AVE.
P. O. BOX 2511
KNOXVILLE, TN 37901

SIGNATURE

SOURCE SAMPLING EPA PARTICULATE TEST LAB DATA SHEET

COMPANY Maryville Utilities Waste Treatment DATE 9-29-92

SOURCE Incinerator BOX NO. 3 RUN NO. 3

CONDENSATION

IMPINGER NO.	INITIAL VOL., ml	FINAL VOL., ml	NET GAIN, ml
1.	100	122	22
2.	100	108	8
3.	-0-	1	1
4.	200 ,g	210.8 ,g	10.8 ,g
TOTAL	400	441.8	41.8

PARTICULATE

COMPONENT I.D. NO.	INITIAL WT., g	FINAL WT., g	NET WT., g
PROBE WASH	9.1307	9.1990	0.0683
ACETONE BLANK	9.1276	9.1276	-0-
PROBE WASH (-Blank)			0.0093
CYCLONE	———	———	———
FILTER #903	0.3586	0.4386	0.0800
IMPINGERS	———	———	———

PARTICULATE COLLECTED (excluding impinger catch) =	0.1493 ,g
PARTICULATE COLLECTED (including impinger catch) =	——— ,g

COMMENTS: ———

SIGNATURE OF PERSON RESPONSIBLE Michael Murray DATE 9-29-92

SAMPLE EPA CALCULATIONS

Test = 3

Volume of Water Collected

$V_{wstd} = (VI_q)\ (0.0474\ ft.^3/ml)$

$= 41.8\ (0.0474)$

$V_{wstd} = 1.98$

Volume of Gas Metered, Standard Conditions

$V_{mstd} = ((17.71)\ (Vm)\ (Pb + \frac{\Delta H}{13.6})\ (\gamma))/\ Tm$

$= ((17.71)(36.79)(29.15 + \frac{1.38}{13.6})(.998))/556$

$V_{mstd} = 34.21$

Moisture Content

$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$

$= \frac{1.98}{34.21 + 1.98}$

$B_{wo} = 0.055$

Molecular Weight of Dry Gas Stream

$M_d = (.44)\ (\%CO_2) + (.32)\ (\%O_2) + (.28)\ (\%CO + \%N_2)$

$= (.44)(2.7) + (.32)(18.2) + (.28)(79.1)$

$M_d = 29.16$

Molecular Weight of Stack Gas

$M_s = M_d(1-B_{ow})\ 18(B_{wo})$

$= 29.16(1-0.055) + 18(0.055)$

$M_s = 28.55$

Velocity of Stack Gas

$$Vs = 174\ Cp\sqrt{\overline{\Delta p}}\ \sqrt{Ts \times \frac{29.92}{Ps} \times \frac{28.96}{Ms}}$$

$$= 174(.84)(0.971)\sqrt{558 \times \frac{29.92}{29.11} \times \frac{28.96}{28.55}}$$

$$Vs = 3423$$

Total Flow of Stack Gas

$$Qa = As \times Vs$$

$$= 2.64 \times 3423$$

$$Qa = 9037$$

$$Qs = Qa \times \frac{530}{TsR} \times \frac{Ps}{29.92}$$

$$= 9037 \times \frac{530}{558} \times \frac{29.11}{29.92}$$

$$Qs = 8351$$

$$Qstd = Qs\ (1 - Bwo)$$

$$= 8351\ (1 - 0.055)$$

$$Qstd = 7892$$

Percent Isokinetic of Test

$$Is = \frac{Vmstd}{An\ (\theta)\ (Vs_{std})}$$

$$= \frac{34.21}{(0.000193)(60)(2989)}$$

$$Is = 0.99$$

Particulate Concentration

$$Cs = \frac{(15.43)\ (Mn)}{Vmstd}$$

$$= \frac{(15.43)(0.1483)}{34.21}$$

$$Cs = 0.0669$$

Particulate Mass Rate

$$PMR = \frac{(Mn)\ (Qstd)\ (60)}{(Vmstd)\ (454)}$$

$$= \frac{(0.1483)(7892)(60)}{(34.21)(454)}$$

$$PMR = 4.52$$

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
EAST TENNESSEE REGIONAL OFFICE
ALEX B. SHIPLEY REGIONAL HEALTH CENTER
1522 CHEROKEE TRAIL
KNOXVILLE, TENNESSEE 37920

October 1, 1982

Mr. Tony Babb
Enviro-Measure, Inc.
3028 Magnolia Avenue
Knoxville, Tennessee 37915

Reference #: 05-00116

Dear Mr. Babb:

Please find attached copies of the visible emission evaluations conducted during the September 28, 1982 source tests at Maryville Wastewater Treatment Plant.

If additional information is needed, please let me know.

Sincerely,

V.N. Malichis

V. N. Malichis
Air Pollution Consultant
Enforcement Section
Tennessee Air Pollution Control

VNM:row

Attachments

Manville Wastewater Treatment Plant

ADDRESS: Wheeler Road

Rockford

COUNTY: Blount | ZIP: 37777 | PHONE: (615) 983-7161

SOURCE REFERENCE NUMBER: OS-00116

OBSERVATION DATE: 9 | 28 | 82

PROCESS EQUIPMENT: Sludge Incinerator

OPERATING MODE: Normal

CONTROL EQUIPMENT: Venturi Scrubber

OPERATING MODE: Normal

DESCRIBE EMISSION POINT: stack

HEIGHT ABOVE GROUND LEVEL: 50'

HEIGHT RELATIVE TO OBSERVER: -50'

DISTANCE FROM OBSERVER: 700'

DIRECTION FROM OBSERVER: NNE

DESCRIBE EMISSIONS: smoke

EMISSION COLOR: beige/gray

PLUME TYPE: CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT: NO ☒ YES ☐

IF YES, IS PLUME: ATTACHED ☐ DETACHED ☐

AT WHAT POINT WAS OPACITY DETERMINED: at tip of stack

DESCRIBE BACKGROUND: trees

BACKGROUND COLOR: green

SKY CONDITIONS: clear

WIND SPEED: 0-5 m.p.h.

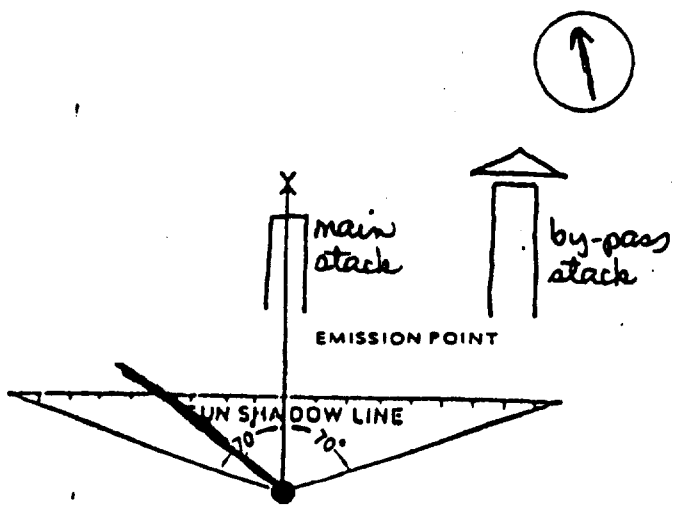
WIND DIRECTION: WSW

AMBIENT TEMP.: 76°F | REL. HUMIDITY: 54%

HRS. SINCE LAST PRECIP.: 36(+)

COMMENTS:
1. #2 test in progress
2. #1 test not observed due to fog
3. no emissions from by-pass stack

SOURCE LAYOUT SKETCH — DRAW NORTH ARROW



OBSERVER'S SIGNATURE: V.N. Malichis

WAS NOTICE OF VIOLATION ISSUED: YES [ ] NO [X]

FOR OFFICIAL USE ONLY

APPLICABLE STANDARD: Ch. 1200-3-5

(PA TO 0101 (10-77))

V.N. Malichis

ORGANIZATION: T.A.P.C.D.

CERTIFICATION DATE: 5 | 11 | 82

START TIME: 11:15 a.m.

STOP TIME: 12:15 p.m.

	0	15	30	45		0	15	30	45
1	5	5	5	5	31	10	5	5	5
2	5	5	5	5	32	5	5	5	5
3	5	5	5	5	33	5	5	5	5
4	5	5	5	5	34	5	5	10	10
5	5	5	5	5	35	5	5	10	5
6	5	5	5	5	36	5	5	5	5
7	5	5	5	5	37	5	5	5	5
8	5	5	5	5	38	5	5	5	5
9	5	5	5	5	39	5	5	5	5
10	5	5	5	5	40	5	5	5	5
11	10	5	5	5	41	5	5	5	5
12	5	5	5	5	42	5	5	5	5
13	5	5	5	5	43	5	5	5	5
14	5	5	5	5	44	5	5	5	5
15	5	5	5	5	45	5	5	5	5
16	5	10	5	5	46	5	5	5	5
17	5	5	5	5	47	5	5	5	5
18	5	5	10	10	48	5	5	5	5
19	5	5	5	5	49	5	5	5	5
20	5	5	5	5	50	5	5	5	5
21	5	5	5	5	51	5	5	5	5
22	5	10	5	10	52	5	5	5	5
23	5	5	5	5	53	5	5	5	5
24	5	5	5	5	54	5	5	5	5
25	10	5	5	5	55	5	5	5	5
26	5	5	5	5	56	5	5	5	5
27	5	5	5	5	57	5	5	5	5
28	5	5	10	5	58	5	5	5	5
29	5	5	5	5	59	5	5	5	5
30	5	5	10	10	60	5	5	5	5

HIGHEST ___ MINUTE OPACITY

AVERAGE ___ %

RANGE OF OPACITY READINGS: FROM 5% TO 10%

NUMBER OF READINGS ABOVE 20 % WERE 0

TIME EMISSIONS CROSSED PROPERTY LINE: 0

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS.

SIGNATURE

TITLE

DATE

Maryville Wastewater Treatment Plant

ADDRESS: Wheeler Road

Rockford

COUNTY: Blount ZIP: 37777 PHONE: (615) 983-7161

ORGANIZATION: T.A.P.C.D.

CERTIFICATION DATE: 5 | 11 | 82

SOURCE REFERENCE NUMBER: OS-00116

OBSERVATION DATE: 9 | 28 | 82

START TIME: 12:15 P.m.

STOP TIME: 12:25 P.m.

PROCESS EQUIPMENT: Sludge Incinerator

OPERATING MODE: Normal

CONTROL EQUIPMENT: Venturi Scrubber

OPERATING MODE: Normal

DESCRIBE EMISSION POINT: stack

HEIGHT ABOVE GROUND LEVEL: 50'

HEIGHT RELATIVE TO OBSERVER: -50'

DISTANCE FROM OBSERVER: 700'

DIRECTION FROM OBSERVER: NNE

DESCRIBE EMISSIONS: smoke

EMISSION COLOR: beige / gray

PLUME TYPE: CONTINUOUS [X] FUGITIVE [ ] INTERMITTENT [ ]

WATER DROPLETS PRESENT: NO [X] YES [ ]

IF YES, IS PLUME: ATTACHED [ ] DETACHED [ ]

AT WHAT POINT WAS OPACITY DETERMINED: at top of stack

DESCRIBE BACKGROUND: trees

BACKGROUND COLOR: green

SKY CONDITIONS: clear

WIND SPEED: 0-5 m.p.h.

WIND DIRECTION: WSW

AMBIENT TEMP.: 76° F

REL. HUMIDITY: 54%

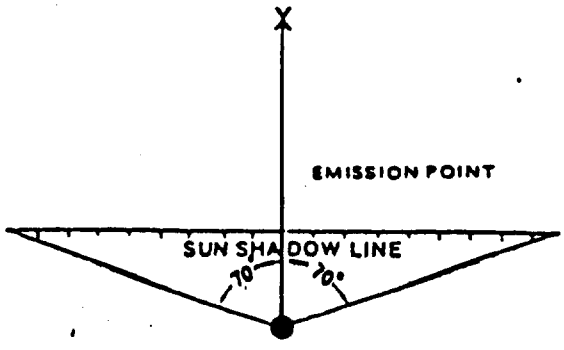
HRS. SINCE LAST PRECIP.: 36 (+)

COMMENTS:

	0	15	30	45		0	15	30	45
1	5	5	5	5	31				
2	5	5	5	5	32				
3	5	5	5	5	33				
4	5	5	5	5	34				
5	5	5	5	5	35				
6	5	5	5	5	36				
7	5	5	5	5	37				
8	5	5	5	5	38				
9	5	5	5	5	39				
10	5	5	5	5	40				
11		—			41				
12	test stopped				42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

SOURCE LAYOUT SKETCH

DRAW NORTH ARROW



HIGHEST ____ MINUTE OPACITY

AVERAGE ____ %

RANGE OF OPACITY READINGS

FROM ____ TO ____

NUMBER OF READINGS ABOVE ____ % WERE ____

TIME EMISSIONS CROSSED PROPERTY LINE

OBSERVER'S SIGNATURE: U.M. Malichis

WAS NOTICE OF VIOLATION ISSUED YES [ ] NO [X]

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS.

SIGNATURE

TITLE

DATE

FOR OFFICIAL USE ONLY

VERIFIED BY:

APPLICABLE STANDARD: Ch. 1200-3-5

EPA TP 9121 (7-81)

Manville Wastewater Treatment Plant

ADDRESS: Whiteton Road

Rockford

COUNTY: Blount ZIP: 37777 PHONE: (615) 983-7161

V. N. Malichis

ORGANIZATION: T.A.P.C.D.

CERTIFICATION DATE: 5/11/82

PAGE 1 OF 1

SOURCE REFERENCE NUMBER: OS-00116

OBSERVATION DATE: 9/28/82

START TIME: 1:25 P.M.

STOP TIME: 2:25 P.M.

PROCESS EQUIPMENT: Sludge Incinerator

OPERATING MODE: Normal

CONTROL EQUIPMENT: Venturi Scrubber

OPERATING MODE: Normal

DESCRIBE EMISSION POINT: stack

HEIGHT ABOVE GROUND LEVEL: 50'

HEIGHT RELATIVE TO OBSERVER: -50'

DISTANCE FROM OBSERVER: 700'

DIRECTION FROM OBSERVER: NNE

DESCRIBE EMISSIONS: smoke

EMISSION COLOR: beige/gray

PLUME TYPE: CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT: NO ☒ YES ☐

IF YES, IS PLUME: ATTACHED ☐ DETACHED ☐

AT WHAT POINT WAS OPACITY DETERMINED: at tip of stack

DESCRIBE BACKGROUND: trees

BACKGROUND COLOR: green

SKY CONDITIONS: clear

WIND SPEED: 0-5 m.p.h.

WIND DIRECTION: ESE

AMBIENT TEMP.: 79°F

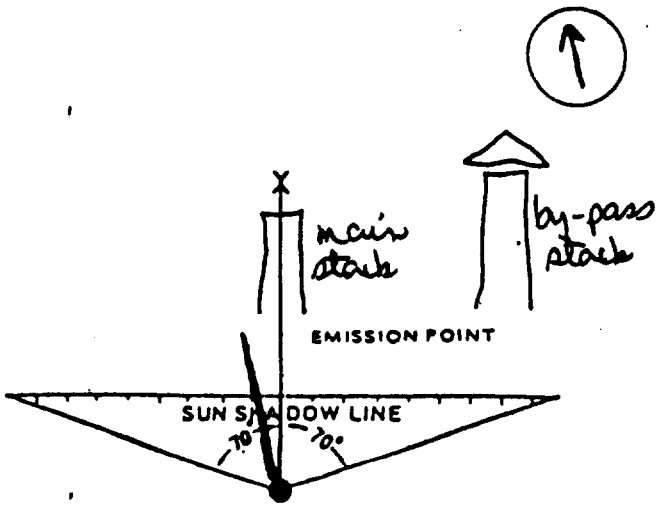
REL. HUMIDITY: 50%

HRS. SINCE LAST PRECIP.: 36(+)

COMMENTS:
① #3 test in progress
② no emissions from by-pass stack

	0	15	30	45		0	15	30	45
1	5	5	5	5	31	5	5	5	5
2	5	10	10	5	32	5	5	5	5
3	5	5	5	5	33	5	5	5	5
4	5	5	5	5	34	5	5	5	5
5	5	5	5	5	35	5	5	5	5
6	5	5	10	5	36	5	5	5	5
7	10	5	5	10	37	5	5	5	5
8	5	5	5	5	38	5	5	5	5
9	5	5	5	5	39	5	5	5	5
10	5	5	5	5	40	5	5	5	5
11	5	5	5	5	41	5	5	5	5
12	5	5	5	5	42	5	5	5	5
13	5	5	5	5	43	5	5	5	5
14	5	5	5	5	44	5	5	5	5
15	5	5	5	5	45	5	5	5	5
16	5	5	5	5	46	5	5	5	5
17	5	5	5	5	47	5	5	5	5
18	5	5	5	5	48	5	5	5	5
19	5	5	5	5	49	5	5	5	5
20	5	5	5	5	50	5	5	5	5
21	5	5	5	5	51	5	5	5	5
22	5	5	5	5	52	5	5	5	5
23	5	5	5	5	53	5	5	5	5
24	5	5	5	5	54	5	5	5	5
25	5	5	5	5	55	5	5	5	5
26	5	5	5	5	56	5	5	5	5
27	5	5	5	5	57	5	5	5	5
28	5	5	5	5	58	5	5	5	5
29	5	5	5	5	59	5	5	5	5
30	5	5	5	5	60	5	5	5	5

SOURCE LAYOUT SKETCH — DRAW NORTH ARROW



HIGHEST ____ MINUTE OPACITY

AVERAGE ____ %

RANGE OF OPACITY READINGS FROM 5% TO 10%

NUMBER OF READINGS ABOVE 20 % WERE 0

TIME EMISSIONS CROSSED PROPERTY LINE: 0

OBSERVER'S SIGNATURE: V.N. Malichis

WAS NOTICE OF VIOLATION ISSUED YES [ ] NO [X]

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS.

SIGNATURE

TITLE

DATE

FOR OFFICIAL USE ONLY

VERIFIED BY:

APPLICABLE STANDARD: Ch. 1200-3-5

EPA TP 9101 (10-80)

STAPPA/ALAPCO
2.5

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

~~DGC~~

#21 10/27/86

TENNESSEE DEPARTMENT OF PUBLIC HEALTH
Environmental Management and Quality Assurance Administration
T.E.R.R.A. BUILDING
150 NINTH AVENUE, NORTH
NASHVILLE, TENNESSEE 37203

February 28, 1983

Mr. Rex Ogle
Maryville Utilities Board
Water and Wastewater Division
P.O. Box 667
Maryville, Tennessee 37801

Re: Municipal Sewage Incinerator
Reference No. 05-0116-01
Tested 9/28/82

Dear Mr. Ogle:

The Existing Source Section has reviewed the particulate emissions test report for the above-referenced incinerator submitted by Enviromeasure Inc. for the Maryville Utilities Board. Actual emissions from the incinerator during the test were analyzed to average 3.67 pounds per hour or 11.5 pounds per ton of dry sludge, at an average dry sludge charge rate of 637 pounds per hour. The allowable emission rate for this incinerator is 0.61 pounds per hour and 1.30 pounds per ton dry sludge input, according to Rule 1200-3-16-.~~13~~15 of the Tennessee Air Pollution Control Regulations.

Therefore, based on the information provided in the report, you are to consider this letter as a formal Notice of Violation of Rule 1200-3-16-.~~13~~15, specifically, for failing to comply with condition 1.(C.) of Construction Permit No. 992673I. Please be advised that you are provided the opportunity to request that this Notice of Violation be excused in accordance with Rule 1200-3-20-.07 of the Tennessee Air Pollution Control Regulations. Please submit to this office two copies of the enclosed APC-19, Proposed Schedule for Corrective Action within 45 days of receipt of this letter.

Should you have any questions or comments, feel free to contact me at 615-741-3651.

Sincerely,

Dave P. Jarrett
Existing Source Section
Division of Air Pollution Control

DPJ/sc/1-21

cc: Quincy Styke
Regional Office

TENNESSEE DEPARTMENT OF PUBLIC HEALTH
Environmental Management and Quality Assurance Administration
T.E.R.R.A. BUILDING
150 NINTH AVENUE, NORTH
NASHVILLE, TENNESSEE 37203

NOV 26 1982

Mr. Rex Ogle
Maryville Utilities Board
Water and Wastewater Division
P. O. Box 667
Maryville, TN 37801

Ref. No. 05-00116

Dear Mr. Ogle:

The Compliance Monitoring Section of the Tennessee Division of Air Pollution Control has reviewed the particulate emissions test report submitted by Enviro-Measure, Inc. for the following source(s):

Sewage Sludge Incinerator, tested 9-28-82

The sampling data appears to be in order and the report is acceptable to this section. The section has forwarded this test report to the Engineering Program for review of operational parameters and compliance verification.

Should you have any questions on this or any other matters related to source sampling, please do not hesitate to contact this office.

Sincerely,

David G. Carson

David G. Carson
Compliance Monitoring Section
Division of Air Pollution Control

DGC/bec APC 8A

cc: Regional Office
Enviro-Measure, Inc.
Dennis Weeter Associates

Tennessee Division of Air Pollution Control

INTERNAL REVIEW
METHOD 5 PARTICULATE TEST
SECTION 1
(Review by Source Sampling)

A. GENERAL

1. Company Maryville Utilities Board Ref. No. 05-116
2. Plant Contact Rex Ogle Phone _____
3. Source(s) tested Multiple hearth sludge incinerator
4. Type Control Device Venturi scrubber
5. Source Test Performed By Enviro-measure
   Person In Charge of Test Tony Babb
   Address P.O. Box 2511, Knoxville Phone 523-2911
6. Date(s) Test(s) Actually Performed 9-28-82
7. Test Observer Thomas Isaacs Process Observer Al Lewis
8. Final Test Report Received: Date 10-28-82
9. Preliminary Review: By Thomas Isaacs Date 10-29-82
10. Requested Information Received 11-16-82 Date _____

B. EVALUATION

1. Observers Evaluation/Waiver Letter Included
   Yes ✓ No _____
2. Field Test Accepted Yes ✓ No _____
3. Visible Emissions Read Yes ✓ No _____
   If yes, attach copy of Visible Emission Evaluation
   V.E. Observer V.N. Malichis
4. Calibration Data Acceptable ✓ Unacceptable _____

5. Sampling Points

Sketch showing upstream/downstream distance from nearest flow disturbances. Yes ✓ No ____

Number of Points Required 24 Number of Points Used 24

If Different, was Deviation Authorized? Yes ____ No ____

By ____ Date ____

Method: Letter ____ Observer ____

6. Calculations Correct Yes ✓ No ____

If no, did Acceptability of Test Change? Yes ____ No ____

Person Checking Calculations Thomas Isaacs

(Complete calculation Sheet Appendix A and attach to this Report. One set for each stack tested.)

7. Summary of Results

	% Isokinetic	Concentration grams	Mass Rate
Run 1	93.24	.1998	3.64
Run 2	95.6	.0901	2.83
Run 3	98.25	.1483	4.53
Avg.	95.7	.1460	3.67

8. Acceptable Method 5 Test Yes ✓ No ____

9. If Method 5 Test unacceptable, Give Details Below:

Source Sampling Evaluation By: Thomas Isaacs

Date: 11/17/82

Approved By Section Chief By: [signature]

Date: 11/22/82

Date Letter Sent 11/26/82

INTERNAL REVIEW
METHOD 5 PARTICULATE TEST

SECTION II

(Review by Engineering Program)

A. GENERAL

1. Company _____ Ref. No. _____

2. Process Observer _____ Test Date(s) _____

B. PROCESS INFORMATION

	Run 1	Run 2	Run 3	Avg.
1. Allowable Emissions (#/hr) (#/MBTU) (#/100#)				
2. Process Weight				
3. Operating Rate Test Conditions (#/hr) (MBTU)				
a. Design Rate				
b. Percent of Design Rate				
c. Acceptable Operating Rate				

C. STATEMENT OF INSPECTION PARAMETERS:

D. PERMIT CONDITIONS:

DC/sc/5-16 8/13/82

Company Maryville Utilities Board Source Sludge Incinerator Date 10-29-82

Store	1	2	3
2	58.9	36.9	36.7
3	105/565	95/555	98/558
4	.955	.992	.971
5	3.85	1.42	1.38
6	83.8/543.8	93/553	96/555
7	2.6	2.4	2.7
8	18.1	18.5	18.2
9	79.3	79.1	79.1
0	-.55	-.55	-.55
I	.998	.998	.998
B	64.5	39.5	41.8
C	.84	.84	.84
f P> <S			
0	60	60	60

1. Volume sampled V_m ; ft^3
2. Average stack temperature, T_S; $^oF/^oR$
3. Average $\overline{\sqrt{\Delta P}}$; in water
4. Average $\overline{\Delta H}$; in. water
5. Average ~~temperature~~ of meter, T_m; $^oF/^oR$
6. Per cent CO_2
7. Per cent O_2
8. Per cent N_2 + per cent CO
9. Stack gauge pressure in. H_2O, P_S'
10. Meter correction factor MCF
11. Volume liquid collected V_{wc}; ml
12. Pitot coefficient C_p
13. Total time in minutes Θ_1

f P> <S

COMMAND			
C	29.15	29.15	29.15
D	2.64	2.64	2.64
E	.250	.188	.188

f P> <S

STORE D			
COMMAND A	.1998	.0901	.1483

14. P_{bar} (Barometric pressure); in. Hg
15. A_s (area of stack); ft^2
16. D_n (nozzle diameter); in.

ENTER CARD TWO

17. W (fuel burning); 10^6 BTU
18. M_n (part. catch); grams

Source Sampling Calculation

BY Thomas Isaacs

Approved By Section Chief

BY

1. Volume of water vapor @ 70°F, 29.92 "Hg: ft^3

   V_w gas = 0.0474 x V_{wc}

   (V_{wc} = water catch of impinger; ml)

2. Moisture in stack gas

$$\%M = \frac{100 \times V_w \text{ gas}}{V_{mstd} + V_w \text{ gas}}$$

3. Mole fraction of dry gas

$$M_d = \frac{100 - \%M}{100}$$

4. Molecular weight of dry stack gas

$$MW_d = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + (\%N_2 + \%CO)\ (28/100)$$

5. Volume of dry gas sampled at standard conditions (70°F, 29.92 in. Hg): ft^3

$$V_{mstd} = (17.7)(\frac{V_m}{T_m + 460})(P_{Bar} + \frac{\Delta H}{13.6})(MCF)$$

MCF = Meter Correction Factor

6. Molecular Weight of stack gas

$$MW = (MW_d)\ (M_d) + 18\ (1-M_d)$$

7. Stack Pressure (P_s):

$$P_s = P_{Bar} \pm \frac{P'_s}{13.6}$$

P_s = Absolute Pressure in Stack; in. Hg.

P'_s = Stack gauge pressure, in. H_2O

8. Stack velocity (stack conditions); ft/min.

$$V_s = (85.48)\ (C_p)(Avg.\sqrt{\Delta P})\sqrt{\frac{T_s+460}{(P_s)(MW)}} \times 60$$

9. Stack gas volume (70°F, 29.92 "Hg), SCFM

$$Q_s \text{ std} = \frac{(17.7)\ (V_s)\ (A_s)\ (M_d)\ (P_s)}{(T_s + 460)}$$

(A_s = area of the stack; ft^2)

0. Per cent isokinetic

$$\%I = \frac{(1032)\ (T_s + 460)\ (V_{mstd})}{(V_s)\ (\theta_1)\ (P_s)\ (M_d)\ (Dn)^2}$$

(D_n = Nozzle diameter; in.)

Stored	1	2	3	Avg.
1	3.06	1.87	1.98	2.30
2	5.17	5.19	5.48	
3	.948	.948	.945	
4	29.14	29.12	29.16	
5	56.1	34.1	34.1	
6	28.56	28.54	28.55	
7	29.109	29.109	29.109	
8	3390	3491	3426	3435
9	7736	8111	7892	7913
D	93.24	95.6	98.25	

11. Percent excess air at sampling point

$$\%EA = \frac{100\ (\%O_2)}{0.264\ (\%N_2) - \%O_2}$$

12. Total Particulate catch, M_n; grams

13. Particulate concentration, C; grains/dscf

$C = 15.4\ M_n/V_{mstd}$

14. Mass Rate of emission, A; lb/hr

$$A = \frac{(Q_s std)(60)(M_n)}{(V_{mstd})\ (454)}$$

15. Emission per million BTU, E; $lb/10^6$ BTU

$E = \frac{A}{W}$ (fuel burning)

16. Incinerator emission rate, I; lb/100 lb charged

$I = 100\ \frac{A}{W}$

17. Concentration corrected to 12% CO_2, c12; grains/dscf

$c12 = \frac{12c}{\%CO_2}$

c12 is the concentration of particulate matter corrected to twelve (12) percent CO_2

c is the concentration of particulate matter

Stored	1	2	3	Avg.
1	638.4	776.5	678.4	
A	.1998	.0901	.1483	
C	.0548	.0406	.0669	
B	3.64	2.83	4.53	3.67
E				
3				
0				

ONS
D. Carson

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
NASHVILLE 37219

AIR POLLUTION CONTROL DIVISION — ENFORCEMENT PROGRAM

INSPECTION REPORT

Date 9/28/82 Reference No. 05 - 00116

Company Name Maryville Wastewater Treatment Plant

Address Wheeler Road City Rockford

County Blount Person Contacted Mr. Robert Young

SOURCE CATEGORY

Process ____ Fuel Burning ____ Other Municipal Sludge Incinerator

REASON FOR REPORT

Site Inspection [ ] Routine [X] Requested [ ] Permit

VEE Compliance [X] In [ ] Out

Notice of Violation [ ]

Equipment Listing [ ] Inspection [ ] Increment of Progress Check [ ] # ____

Source Test Observation [ ] Initial Registration forms ____, ____, ____, ____, ____,

COMMENTS

Attached to this inspection report, you will find two (2) VEE's obtained on the main stack of this sludge incinerator. A series of stack tests were performed on 9/28/82 by Enviro-Measure, Inc. Only the #2 and #3 tests were observed by me. During the #1 test, dense fog obscured the area.

Inspection completed by ____

Maryville Wastewater Plant

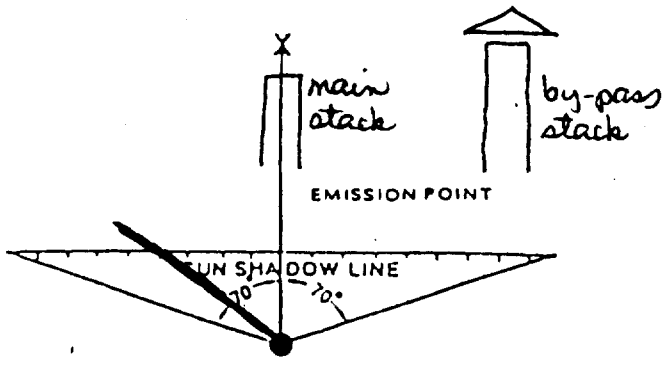
ADDRESS
Wheeler Road
Rockford

COUNTY | ZIP | PHONE
Blount | 37777 | (615) 983-7161

SOURCE REFERENCE NUMBER: OS-00116
OBSERVATION DATE: 9/28/82
PROCESS EQUIPMENT: Sludge Incinerator
OPERATING MODE: Normal
CONTROL EQUIPMENT: Venturi Scrubber
OPERATING MODE: Normal
DESCRIBE EMISSION POINT: stack
HEIGHT ABOVE GROUND LEVEL: 50'
HEIGHT RELATIVE TO OBSERVER: -50'
DISTANCE FROM OBSERVER: 700'
DIRECTION FROM OBSERVER: NNE
DESCRIBE EMISSIONS: smoke
EMISSION COLOR: beige/gray
PLUME TYPE: CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT: NO ☒ YES ☐
IF YES, IS PLUME: ATTACHED ☐ DETACHED ☐
AT WHAT POINT WAS OPACITY DETERMINED: at tip of stack
DESCRIBE BACKGROUND: trees
BACKGROUND COLOR: green
SKY CONDITIONS: clear
WIND SPEED: 0-5 m.p.h.
WIND DIRECTION: WSW
AMBIENT TEMP. | REL. HUMIDITY: 76°F | 54%
HRS. SINCE LAST PRECIP.: 36(+)

COMMENTS
1) #2 test in progress
2) #1 test not observed due to fog
3) no emissions from by-pass stack

SOURCE LAYOUT SKETCH — DRAW NORTH ARROW



OBSERVER'S SIGNATURE: D. N. Malichis
WAS NOTICE OF VIOLATION ISSUED: YES [ ] NO [X]
FOR OFFICIAL USE ONLY
VERIFIED BY:
APPLICABLE STANDARD: Ch. 1200-3-5

ORGANIZATION: T.A.P.C.D.
CERTIFICATION DATE: 5/11/82
PAGE 1 OF 2

START TIME: 11:15 a.m.
STOP TIME: 12:15 p.m.

	0	15	30	45		0	15	30	45
1	5	5	5	5	31	10	5	5	5
2	5	5	5	5	32	5	5	5	5
3	5	5	5	5	33	5	5	5	5
4	5	5	5	5	34	5	5	10	10
5	5	5	5	5	35	5	5	10	5
6	5	5	5	5	36	5	5	5	5
7	5	5	5	5	37	5	5	5	5
8	5	5	5	5	38	5	5	5	5
9	5	5	5	5	39	5	5	5	5
10	5	5	5	5	40	5	5	5	5
11	10	5	5	5	41	5	5	5	5
12	5	5	5	5	42	5	5	5	5
13	5	5	5	5	43	5	5	5	5
14	5	5	5	5	44	5	5	5	5
15	5	5	5	5	45	5	5	5	5
16	5	10	5	5	46	5	5	5	5
17	5	5	5	5	47	5	5	5	5
18	5	5	10	10	48	5	5	5	5
19	5	5	5	5	49	5	5	5	5
20	5	5	5	5	50	5	5	5	5
21	5	5	5	5	51	5	5	5	5
22	5	10	5	10	52	5	5	5	5
23	5	5	5	5	53	5	5	5	5
24	5	5	5	5	54	5	5	5	5
25	10	5	5	5	55	5	5	5	5
26	5	5	5	5	56	5	5	5	5
27	5	5	5	5	57	5	5	5	5
28	5	5	10	5	58	5	5	5	5
29	5	5	5	5	59	5	5	5	5
30	5	5	10	10	60	5	5	5	5

HIGHEST ____ MINUTE OPACITY
AVERAGE ____ %
RANGE OF OPACITY READINGS: FROM 5% TO 10%
NUMBER OF READINGS ABOVE: 20 % WERE 0
TIME EMISSIONS CROSSED PROPERTY LINE: 0

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS.
SIGNATURE
TITLE
DATE

EPA TO 9101 (10-81)

ADDRESS
Wheeler Road
Rockford

COUNTY Blount | ZIP 37777 | PHONE (615) 983-7161

SOURCE REFERENCE NUMBER: 05-00116
OBSERVATION DATE: 9/28/82

PROCESS EQUIPMENT: Sludge Incinerator
OPERATING MODE: Normal

CONTROL EQUIPMENT: Venturi Scrubber
OPERATING MODE: Normal

DESCRIBE EMISSION POINT: stack

HEIGHT ABOVE GROUND LEVEL: 50'
HEIGHT RELATIVE TO OBSERVER: -50'

DISTANCE FROM OBSERVER: 700'
DIRECTION FROM OBSERVER: NNE

DESCRIBE EMISSIONS: smoke

EMISSION COLOR: beige/gray
PLUME TYPE: CONTINUOUS [X] FUGITIVE [ ] INTERMITTENT [ ]

WATER DROPLETS PRESENT: NO [X] YES [ ]
IF YES, IS PLUME: ATTACHED [ ] DETACHED [ ]

AT WHAT POINT WAS OPACITY DETERMINED: at tip of stack

DESCRIBE BACKGROUND: trees

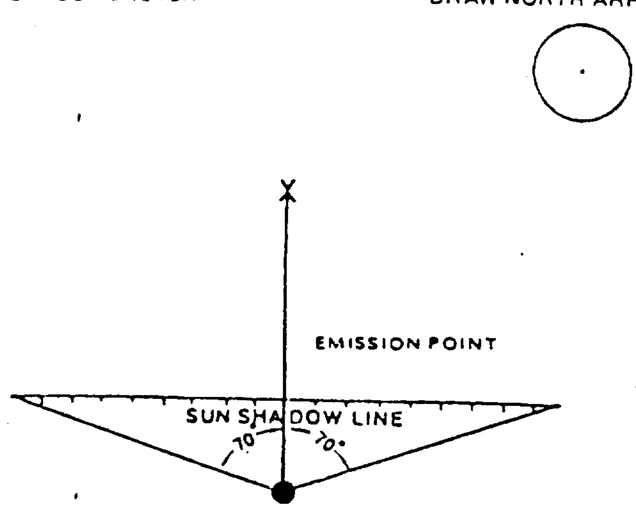
BACKGROUND COLOR: green
SKY CONDITIONS: clear

WIND SPEED: 0-5 m.p.h.
WIND DIRECTION: WSW

AMBIENT TEMP: 76°F | REL. HUMIDITY: 54% | HRS. SINCE LAST PRECIP.: 36 (+)

COMMENTS

SOURCE LAYOUT SKETCH | DRAW NORTH ARROW



OBSERVER'S SIGNATURE: U.M. Malichis
WAS NOTICE OF VIOLATION ISSUED: YES [ ] NO [X]

FOR OFFICIAL USE ONLY
VERIFIED BY:
APPLICABLE STANDARD: Ch. 1200-3-5

ORGANIZATION: T.A.P.C.D.

CERTIFICATION DATE: 5/11/82
PAGE 2 OF 2

START TIME: 12:15 p.m.
STOP TIME: 12:25 p.m.

	0	15	30	45		0	15	30	45
1	5	5	5	5	31				
2	5	5	5	5	32				
3	5	5	5	5	33				
4	5	5	5	5	34				
5	5	5	5	5	35				
6	5	5	5	5	36				
7	5	5	5	5	37				
8	5	5	5	5	38				
9	5	5	5	5	39				
10	5	5	5	5	40				
11		—			41				
12	test stopped				42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

HIGHEST ______ MINUTE OPACITY AVERAGE ______ %
RANGE OF OPACITY READINGS FROM ______ TO ______

NUMBER OF READINGS ABOVE ______ % WERE ______
TIME EMISSIONS CROSSED PROPERTY LINE

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS.

SIGNATURE
TITLE | DATE

ADDRESS
Wheeler Road
Rockford

COUNTY | ZIP | PHONE
Blount | 37777 | (615) 983-7161

ORGANIZATION
T.A.P.C.D

CERTIFICATION DATE
5/11/82

PAGE 1 OF 1

SOURCE REFERENCE NUMBER
OS-00116

OBSERVATION DATE
9/28/82

START TIME
1:25 P.M.

STOP TIME
2:25 P.M.

PROCESS EQUIPMENT
Sludge Incinerator

OPERATING MODE
normal

CONTROL EQUIPMENT
Venturi Scrubber

OPERATING MODE
Normal

DESCRIBE EMISSION POINT
stack

HEIGHT ABOVE GROUND LEVEL
50'

HEIGHT RELATIVE TO OBSERVER
-50'

DISTANCE FROM OBSERVER
700'

DIRECTION FROM OBSERVER
NNE

DESCRIBE EMISSIONS
smoke

EMISSION COLOR
beige/gray

PLUME TYPE: CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT
NO ☒ YES ☐

IF YES, IS PLUME: ATTACHED ☐ DETACHED ☐

AT WHAT POINT WAS OPACITY DETERMINED
at tip of stack

DESCRIBE BACKGROUND
trees

BACKGROUND COLOR
green

SKY CONDITIONS
clear

WIND SPEED
0-5 m.p.h.

WIND DIRECTION
ESE

AMBIENT TEMP.
79°F

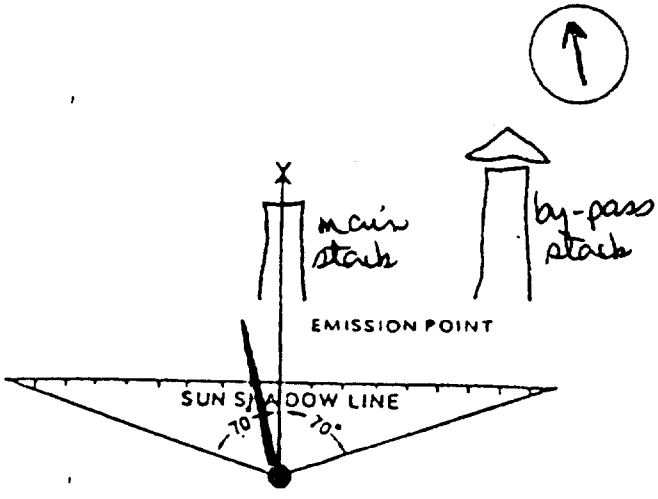
REL. HUMIDITY
50%

HRS. SINCE LAST PRECIP.
36(+)

COMMENTS
① #3 test in progress
② no emissions from by-pass stack

SOURCE LAYOUT SKETCH

DRAW NORTH ARROW



	0	15	30	45		0	15	30	45
1	5	5	5	5	31	5	5	5	5
2	5	10	10	5	32	5	5	5	5
3	5	5	5	5	33	5	5	5	5
4	5	5	5	5	34	5	5	5	5
5	5	5	5	5	35	5	5	5	5
6	5	5	10	5	36	5	5	5	5
7	10	5	5	10	37	5	5	5	5
8	5	5	5	5	38	5	5	5	5
9	5	5	5	5	39	5	5	5	5
10	5	5	5	5	40	5	5	5	5
11	5	5	5	5	41	5	5	5	5
12	5	5	5	5	42	5	5	5	5
13	5	5	5	5	43	5	5	5	5
14	5	5	5	5	44	5	5	5	5
15	5	5	5	5	45	5	5	5	5
16	5	5	5	5	46	5	5	5	5
17	5	5	5	5	47	5	5	5	5
18	5	5	5	5	48	5	5	5	5
19	5	5	5	5	49	5	5	5	5
20	5	5	5	5	50	5	5	5	5
21	5	5	5	5	51	5	5	5	5
22	5	5	5	5	52	5	5	5	5
23	5	5	5	5	53	5	5	5	5
24	5	5	5	5	54	5	5	5	5
25	5	5	5	5	55	5	5	5	5
26	5	5	5	5	56	5	5	5	5
27	5	5	5	5	57	5	5	5	5
28	5	5	5	5	58	5	5	5	5
29	5	5	5	5	59	5	5	5	5
30	5	5	5	5	60	5	5	5	5

HIGHEST ____ MINUTE OPACITY
AVERAGE ____ %
RANGE OF OPACITY READINGS
FROM 5% TO 10%

NUMBER OF READINGS ABOVE
20 % WERE 0

TIME EMISSIONS CROSSED PROPERTY LINE 0

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS.

SIGNATURE

TITLE

DATE

OBSERVER'S SIGNATURE
U.N. Malichis

WAS NOTICE OF VIOLATION ISSUED
YES [ ] NO [X]

FOR OFFICIAL USE ONLY
VERIFIED BY:

APPLICABLE STANDARD
Ch. 1200-3-5

(EPA TP 9101 (10/79))

KENWILL, INC.

2537

MINERAL EXPLORATION • MINING CONSULTANTS
LABORATORY SERVICES (COAL/WATER/GEOLOGIC)
505 E. BROADWAY • MARYVILLE, TENN. 37801
615/977-1200

October 1, 1982

Maryville Utilities Board
P.O. Box 667
Maryville, TN 37801

Attn: Mr. Don Thompson

Sample Description	Waste Oil
Date Taken & Time	9/28/82

CERTIFICATE OF ANALYSIS

(All results are reported as mg/l unless otherwise noted.)

Mercury	<0.05 ppm

KENWILL, INC.

for E. W. Kuemmerle, Jr., Ph.D.
Vice President, Laboratory Division

DGC

RT. 4 BOX 283
LOUISVILLE, TN 37777
615/970-2313

DENNIS
WEETER
& ASSOCIATES
CONSULTING ENGINEERS

RECEIVED
DATE 10-7-82

RECEIVED
DIRECTOR'S OFFICE
OCT 1982
SH
DIVISION OF AIR POLLUTION CONTROL
TENNESSEE DEPARTMENT OF PUBLIC HEALTH

October 1, 1982

Mr. Al Lewis
Air Pollution Control Division - TDPH
5th Floor Terra Bldg.
150 9th Ave. N.
Nashville, TN 37203

RE: Operating Data - MUB Test of 9/28/82 (APCD #05-00116)

Dear Al:

Please find enclosed Table I and Table II which summarize the operating data from the MUB September 28, 1982 test.

We will forward the test results as soon as they are received from EMI (air test) and Kenwill (Hg analysis).

Sincerely yours,

D. W. Weeter, P.E.

spw

cc: T. Babbs - EMI
D. ~~Carver~~ - APCD
V. Malichis - APCD Knoxville
R. Ogle - MUB
T. S. Reddy - APCD

MUB Air Test
APCD #05-00116
9/28/82

TABLE I

Time	Sludge Cake % Solids	Oil Sludge % Moisture	Sludge W+ lbs/hr
5 am	-	-	3663
6 am	-	-	2741
7 am	18%	-	3057
8 am	-	-	3032
9 am	17.5%	-	3870
10:05 am	17%	25%	-
11:20 am	17.5%	25%	3594
12:05 pm	15%	-	-
12:25 pm	-	-	-
1:00 pm	-	-	3823
1:40 pm	17%	25%	-
2:10 pm	17.5%	-	-

Fuel Use

No Natural Gas Used

Oil

Test 1 (9:00 am - 10:05 am) - 58 gallons
Test 2 (11:20 am - 12:25 pm) - 73 gallons
Test 3 (1:00 pm - 2:10 pm) - 72 gallons

MUB Air Test
APCD #05-00116
9/28/82

TABLE II

TIME	Temperature °F H-1	H-2	H-3	H-4	H-5	H-6	Cooling Air	Scrub Inlet	Scrub Outlet	% O_2	Scrubber Diff. (Inches	Scrubber Flow gpm @ 10 psi
MN	700	1040	1120	1280	860	200	260	120	120	off	off	off
5 am	770	1040	1110	1250	850	180	260	120	120	off	off	off
6 am	680	1120	1270	1540	1080	200	210	120	140	3.0	4.0	280
7 am	670	1110	1280	1620	1180	210	260	110	140	4.5	4.0	275
8 am	630	1090	1200	1610	1140	230	280	190	150	5.0	5.0	275
9 am	720	1400	1610	1620	1260	260	280	200	160	5.5	4.75	275
10:05 am	600	1110	1210	1550	1200	220	290	310	130	6.6	4.25	280
11:20 am	570	1020	1130	1540	1190	220	280	190	140	2.8	4.0	280
12:25 am	560	1000	1080	1540	1190	240	260	240	140	7.5	4.0	275
1:00 pm	520	980	1060	1520	1180	200	240	180	140	7.0	4.0	275
2:10 pm	560	1060	1140	1610	1200	240	280	140	140	1.7	4.25	280
3:00 pm	580	1080	1190	1630	1260	240	260	120	140	2.0	4.25	280

TENNESSEE AIR POLLUTION CONTROL DIVISION
SOURCE SAMPLING SECTION
Source Sampling Observation Report Sheet (Particulates)

Company Maryville Utilities Board Ref. No. 05-0116-01
Source I.D. Sewage Sludge Incinerator
Test Conducted by Enviro-Measure
Person in Charge of Test Tony Babb
Observer Thomas Isaacs
Run Number Observed 1, 2, 3

Date 9-28-82 Time Test Observed 7:45 - 2:30

THIS REPORT SHEET IS AN EVALUATION OF SAMPLING PROCEDURES CONDUCTED AT THE ABOVE MENTIONED SITE. THIS EVALUATION COVERS ONLY GENERAL ITEMS OBVIOUS TO THE OBSERVER. THIS DOES NOT IN ANY WAY IMPLY THAT ALL TEST PROCEDURES ARE ACCURATE OR THAT THE TEST REPORT WILL BE ACCEPTED BY THE TAPCD. EVEN THOUGH THE FIELD PROCEDURE MAY BE ACCEPTABLE, INFORMATION PRESENTED IN THE TEST REPORT MAY RENDER THE ENTIRE TEST UNACCEPTABLE. THIS REPORT APPLIES ONLY TO THE TESTS ACTUALLY OBSERVED BY THE TAPCD OBSERVER.

PRELIMINARY DETERMINATIONS

- Sampling Location ✓
- Number of sample points ✓
- Velocity traverse ✓
- Method of moisture determination ✓

SAMPLING

- Leak check: pretest (specify ____) ✓
  post test (specify ____) ✓
- Probe tip orientation ✓
- Filter heated to minimum temp. ✓
- Time sampled each point ✓
- Accurately monitored train temps. ✓
- Initial readings recorded ✓
- Readings recorded if train shut down ✓
- Final readings recorded ✓
- Gas analysis (specify Multipoint Grab sample) ✓

PROCESS INFORMATION

Engineer Present (Name Al Lewis)

Pretest Agreement ____

SAMPLING TRAIN

- Basic Construction ✓
- Probe Design ✓
- Nozzle Condition ✓
- Pitot Condition ✓
- Filter ✓
- Correct amt. H_2O and Silica Gel in impingers ✓

TRAIN BREAK-DOWN

- Probe moved so as to not lose material ✓
- Probe washed and brushed ✓
- Acceptable container to store washings ✓
- Reagent grade acetone used ✓
- Blank of solutions taken ✓
- Train re-set acceptably ✓

CALIBRATION DATA

Proper calibration data available at site ✓

Observer Thomas Isaacs Team Leader Tony Babb

Original to observer; copy to team leader (to be submitted with test report)

PH-0463

APC 8/79

STACK TEST REPORT ROUTE SHEET
(Company Originated)

Company Name Maryville Utility Board (Sludge Line)
Source Sampling Log No. 412
Test Observer Tom Isaacs
VE Observer V.N. Maliekis
Process Description Included: Yes X No ____

Co. Reference No. DS-0016
Date(s) Tested 9-28-82
Process Observer Al Lewis
Pollutant(s) Tested Particulates
Visible Emissions Included: Yes X No ____

Person To	Position or Organization	Function	Date Received	Date Forwarded	Initials
DGC	Source Sampling Log-Keeper	1. Log In No. Copies Rec'd 1 Tom 2 Mark 2. Complete A-B.3. of Eval. Form 3. Forwarded 3 Copies of Report	11/19/82	11/19/82	DGC
LTI	Test Report Evaluator	1. Evaluate Test Report Acceptable X Unacceptable ____ 2. Attach Evaluation Form	10/28/82	11/17/82	LTI
DGC	Source Sampling Supervisor	1. Review Evaluation Agree X Disagree ____ 2. Write Letter	11/19/82	11/22/82	DGC
DGC	Source Sampling Log-Keeper	1. File One Copy with Orig. Eval. 2. Send 1 Copy to Reg. Office 3. Identify Company Engineer 4. Forward Report & S.S.S. Evaluation To Engineer	11/22/82	11/26/82	DGC
ASL DPJ	Engineering Section	1. Finish Engineering part of Eval. Compliance IN ____ OUT X 2. Write Letter to Company 3. Forward Letter & Report to Engineering Supervisor		12/14	dpj
ERT	Engineering Supervisor	1. Review Letter and Report Approval YES ✓ NO ____		3/1	ERT
PT	Secretary	1. Mail Letter Date ____ 2. Forward Copy of Letter to S.S.S. & Regional Office 3. Forward Report, Letters & Eval.	3/5		PT
IDK	Special Projects Staff	1. File report, eval., & letters 2. Forward route sheet to Source Sampling Section		3/7/83	IDK
DGC	Source Sampling Log-Keeper	1. Complete Log 2. File route sheet with report			

Spec. Study

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT

OFFICE CORRESPONDENCE

FROM	TO	DATE

DATE: May 9, 1984

TO: JWH, QNS

FROM: ERF

SUBJECT: Evaluation of corrective action for the sewage sludge incinerator at Maryville Utilities Board Wastewater Treatment Plant, 05-116-01-A4

I. Executive Summary

The proposed plan by the Maryville Utilities Board to upgrade their incinerator is acceptable. Basically, the venturi scrubber throat velocity will be increased from 130 ft/sec. to 370 ft/sec. and from a nominal pressure drop of 6 inches of water to 45 inches of water. A new I.D. fan will be installed for this purpose at an estimated cost of $15,000. Additionally, comparative test burns will be made with the following oil/sewage sludge ratios to ascertain an optimum fuel ratio:

1) Normal sludge/high oil rate
2) Normal sludge/low oil rate
3) High sludge/normal excess air
4) High sludge/reduced excess air

Other considerations proposed include trials of different grade for a more desirable aluminum rolling mill waste oil. This oil contains alum, sulfuric acid, and dirt grime. Laboratory analyses for metallargical components, BTU value, and other characteristics of waste oil obtained from Alcoa are being considered in pursuit of a desirable fuel.

The increased pressure drop of 45 inches is acceptable since typical incincerator scrubber pressure drops range from 15 to 50 inches of water. This pressure drop is also projected to obtain a particulate control efficiency in excess of 96% which is required to meet the NSPS standard for particulates. Venturi scrubbers represent the state of the art and this appears to be a very reasonable control method for this facility. A baghouse would cost $95,000 and an electrostatic precipitator would cost $182,000 which are much more expensive than scrubber modification. Also, the technical literature I reviewed mentions no incidences of baghouse or ESP control for sewage sludge incinerators however, these controls have been used on municipal incinerators.

The July 15, 1984 emission test schedule is acceptable. The emission tests need to be conducted with all proposed fuel combinations. Until source tests are performed using the proposed fuel mixture combinations, no further recommendations can be made at this time.

FROM	DATE

TO

II. Comments by other parties

I called Mr. Robert Young, the Wastewater Plant Superintendent, at 615-983-7161 on May 8, 1984, and the following information was conveyed:

1) The waste oil atomizes well by the compressed air. It is not as thick as some waste oils. In fact in warmer months it is quite fluid. Thus, typical nozzle problems of viscous waste oil atomization are not problems at this facility.

2) Laboaratory analysis indicated no PCB's. Alcoa will furnish quarterly lab analyses of the waste oil to the utility board.

3) During a part source test, a bucket elevator was broken and could have caused ash reentrainment biasing particulate emissions against Maryville.

4) The facility has been able to save 95% of their fuel costs over the previous natural gas usage.

5) The I.D. fan was going to fail soon. They are pleased they can now purchase a new replacement fan with increased capacity.

6) Maryville expects the new fan to arrive in the early summer.

7) Aluminum particles and dirt are known to be in the waste oil. Perhaps, the dirt grime is part of the particulate problem.

I talked to John Carson, author of the February 10, 1984 Enviro-Measure Inc. consultant report prepared for the Maryville Utilities Board. His phone number is 615-523-2911. Mr. Carson believes the scrubber pressure drop determined according to scrubber theory allows very good scrubber performance with a 45 inch pressure drop. No comparisons on fuel ratios or other modifications will be made until the new I.D. fan arrives. At the venturi throat the temperature was 157^{o}F. According to Barry Stephens, good water - gas throat mixing in scrubbers has occurred at temperatures between 120 - 140^{o}F. The 157^{o}F is somewhat near this value. Mr. Carson also thinks since the incincerator gases must be cooled, the use of a scrubber is the most practical control technique. Current considerations show it to be the most cost effective method.

ERF/ca 3-11 ERF

III. Attachments

PROPOSED SCHEDULE OF CORRECTIVE ACTION

TENNESSEE DEPARTMENT OF PUBLIC HEALTH
AIR POLLUTION CONTROL DIVISION
256 CAPITOL HILL BUILDING
NASHVILLE, TENNESSEE 37219

TO:

DO NOT WRITE IN THIS SPACE

COMPANY NO. 05-116-01-F

EMISSION POINT NO. _____

SIC CODE _____

REVIEWER _____

DATE _____

JCTIONS:

RETURN TWO COPIES OF COMPLETED FORM FOR EACH SOURCE TO THE ABOVE ADDRESS ON OR BEFORE Not Specified.

COMPLETE BOTH SIDES OF THIS FORM AND SIGN AT THE BOTTOM OF THE REVERSE SIDE.

FOR TECHNICAL ASSISTANCE TO COMPLETE THIS FORM CALL

David Jarrett PHONE 615-741-3651

LLOWING STATEMENT OF CORRECTIVE ACTION IS SUBMITTED TO EXPLAIN AND DESCRIBE ACTION WHICH WILL BE TAKEN TO CONTROL EMISSIONS RE NOT NOW IN COMPLIANCE WITH THE REGULATIONS OR OTHER APPLICABLE REQUIREMENTS OF THE TENNESSEE DIVISION OF AIR POLLUTION L. THE DIVISION DIRECTOR IS REQUESTED TO CONSIDER THIS SCHEDULE IN DETERMINING ACTION WITH REGARD TO SUCH EMISSIONS.

ESS NAME Maryville Utilities Board

DDRESS P.O. Box 667

Maryville, TN ZIP CODE 37803-0667 PHONE 615-984-7900

SS OF OPERATION Wheeler Road - Maryville Regional Wastewater Plant

Louisville, TN ZIP CODE 37777 COUNTY Blount PHONE 983-7161

E OF BUSINESS Incineration of Sewage Sludge/Treatment of Wastewater SOURCE SIC CODE _____

IPTION AND DETAILS OF OPERATION AND EMISSIONS

MUB incinerates, via multiple hearth incineration, 5-8 dry tons per day of dewatered (18%) sewage sludge. Until April 1982, natural gas was used as supplemental fuel. At that time, a non toxic, non hazardous, waste oil sludge produced at the Aluminum Co. of America (ALCOA) became the supplemental fuel. An air test conducted on 9/28/82 indicated that emissions wer 3.67 #/hr. (11.5 #/ton) when the standard is 0.61 #/hr. (1.3 #/ton). MUB has been petitioni EPA-Atlanta since Feb. 1983 to have the standards become ESPS. A recent EPA rating says the standards will be NSPS.

120

APC-19

DESCRIBE THE EMISSION AND PROPOSED METHOD FOR CONTROLLING IT. THE DESCRIPTION SHOULD BE SUFFICIENT IN DETAIL TO ENABLE THE CONTROL AGENCY TO EVALUATE THE SITUATION. INCLUDE THE EFFICIENCY OF EACH PIECE OF CONTROL EQUIPMENT TO BE USED.

Emission is particulate. Present control system is Venturi Spray scrubber and mist eliminator. Efficiency of existing scrubber is projected to need to be $\geq$ 96.4%. Oil fume emission has MMD of 0.6 microns with STD DEV of 2.3. Sludge has a MMD = 5 micron with STD DEV of 2.0.

STATUS

DESCRIBE WHAT ACTION YOU HAVE ALREADY TAKEN, IF ANY TO CORRECT THIS SITUATION. (INCLUDE NAMES OF SERVICES AND EQUIPMENT).

Completed study by Enviro-Measure, Inc. (report attached). MUB authorized implementation of the recommendations.

COMPLIANCE SCHEDULE

NOTE: THIS SCHEDULE WILL NOT BE CONSIDERED FOR APPROVAL UNLESS THE INFORMATION REQUESTED IN THIS SECTION IS SUPPLIED.

		FINAL DATE MONTH AND YEAR
(1)	LETTING OF CONTRACTS	April 24, 1984
(2)	INITIATION OF CONSTRUCTION	May 7, 1984
(3)	COMPLETION & START-UP	July 15, 1984
(4)	PERFORMANCE TESTS	July 15-Aug.15, 19
(5)	SUBMITTAL OF TEST ANALYSIS AND RESULTS	Sept. 15, 1984

REMARKS:

Robert Young WW Plant Superintend 615-993-7161
EMI Consult. John Carson wrote report 615-523-2911

SIGNATURE J. Ray Ogle DATE SIGNED 3/9/84

FOR OFFICE USE ONLY

CONTROL NUMBER _____ REVIEWER _____

PROPOSED METHOD, EQUIPMENT AND COMPLIANCE SCHEDULE ACCEPTABLE DATE _____

PROPOSED COMPLIANCE SCHEDULE NOT ACCEPTABLE. RECOMMENDED SCHEDULE: 1. _____

2. _____

3. _____

4. _____

PROPOSED METHOD AND EQUIPMENT NOT ACCEPTABLE. RECOMMENDED METHOD AND EQUIPMENT: _____

EVALUATION OF SLUDGE INCINERATOR AIR POLLUTION CONTROL SYSTEM AT MARYVILLE REGIONAL WASTEWATER TREATMENT PLANT

05-116-01-A4

SUBMITTED TO:

Mr. Andy Jordan
Director of Public Services
MARYVILLE UTILITY BOARD
Maryville, TN

SUBMITTED BY:

EMI CONSULTANTS
P.O. Box 2511
Knoxville, TN 37901

615-523-2911

February 10, 1984

INTRODUCTION

Exhaust gases from the MARYVILLE REGIONAL WASTEWATER TREATMENT PLANT (MRWTP) sludge incinerator exceeded the allowable particulate matter emission rate when tested on September 28, 1982. This was after the incinerator fuel was switched from natural gas to "waste oil". EMI Consultants were contracted to determine how the incinerator can most economically be brought into compliance with air pollution regulations. This report summarizes our findings and recommends appropriate actions.

EMI personnel Tony Babb and John Carson performed tests on the venturi scrubber/impingment plate January 9 and January 19, 1984. These tests were designed to determine if the particulate removal performance of the system could be improved. The testing was coordinated by Robert Young and Robin Hetzel.

MAIN OBJECTIVES

a) Inspect scrubber venturi and impingment sections.

b) Measure the particulate emission rate and other variables at the conditions at which the incinerator usually operates.

c) Determine how system grain loading is effected by varying the venturi throat velocity and pressure drop.

d) Based on the test results and scrubber theory, recommend the most cost effective procedures for reducing air emissions to establish compliance.

EXECUTIVE SUMMARY

Cleaning the stack and changing the type of waste oil burned reduced air emissions from the incinerator considerably. The emission rate during the September 28, 1982 compliance test was 11.2 lbs/ton of dry sludge and the emission rate during the baseline test of January 9, 1984 was 2.1 lbs/dry ton.

The results of the venturi throat velocity tests indicate that increasing the throat velocity from 130 ft/sec to 370 ft/sec will reduce the emission rate to 1.3 lbs/dry ton. This will require a pressure drop across the venturi of 45 in.w.c. The existing fan cannot do this. Installing a new fan is the single most cost effective modification that can be made.

The incinerator conditions vary from day to day and from operator to operator. These variations effect air emissions. For example, at a venturi pressure drop of 6-7 in.w.c. and a wet sewage sludge rate of 3100-3300 lbs/hr, the scrubber grain loading was about 35% higher on January 19 compared with January 9. The incinerator should be operated so that air emissions are minimized.

RECOMMENDATIONS

a) Replace existing fan with a similar, but larger, model. Minimum fan specifications are:

- Flow rate = 5000 acfm at inlet conditions
- Static pressure = -50 in.w.c. at inlet
- Gas density = 0.060 lb/ft^3 at inlet
- Construct of 316 ELC stainless steel where in contact with gas stream
- Inlet/outlet flanges should be drilled
- Include OSHA guard
- Include drain
- Include motor and drive
- Factory assemble
- Noise level 85 dB maximum

b) Adjust venturi throat damper to obtain maximum throat velocity.

c) Repair damper on by pass stack so that it will close completely.

d) Install working pressure gages on all nozzles.

e) Perform 1 or 2 days of preliminary testing after new fan is installed to insure that incinerator operation does not adversely effect scrubber performance. Specifically, the emission rate should be determined at:

1) Normal sludge rate • high oil rate • normal excess air
2) Normal sludge rate • low oil rate (reduced excess air)
3) High sludge rate • normal excess air
4) High sludge rate • reduced excess air

DISCUSSION

An inspection of the scrubber system was conducted on December 14, 1983. At this time the system was down for repairs to the incinerator and cleaning of the scrubber. The impingement plate section of the scrubber had been disassembled and cleaned. Discussion with plant personnel indicated that there was relatively no fouling of the plates but there was a build up of material downstream of the fan in the base of the stack just below the inlet from the fan. It is possible for this material build up to cause re-entrainment in the gas stream resulting in higher emissions. The venturi section of the scrubber system is all welded construction preventing visual inspection. Static pressure taps in the system were located upstream and downstream of the impingement plate section. Plant personnel were requested to install a static pressure tap upstream of the venturi section to enable measurement of pressure drop across the venturi. The inspection was completed by reviewing all available drawings and specification on the system.

The average emission rate during the compliance test of September 28, 1982 was 11.2 lbs/ton of dry sludge incinerated (3.61 lbs/hr). As shown in Table 1, the average emission rate during the baseline test of January 9, 1984 was 2.1 lbs/ton of dry sludge (0.9 lbs/hr). Two actions were taken between these tests that apparently caused this reduction. Firstly, the stack and stack drain were cleaned; and secondly, a different "waste oil" was used to fire the incinerator.

On January 9, 1984, the sludge feeder was stopped, the sludge was allowed to completely burn out, and the emission rate of particulate matter from just the oil sludge was determined. As shown in Table 1, this mass rate (2.6 lb/hr) was higher than the mass rate from the combined burning of oil and sewage (0.9 lb/hr). This indicates that some of the oil sludge particles were removed by the sewage sludge, and there may be an optimum oil/sewage ratio for reducing air pollution emissions.

The venturi scrubber throat (see Figure 1) contains an adjustable damper. As this damper is moved toward the closed position, the throat velocity and pressure drop increase. On January 19, the venturi throat damper was adjusted to produce 3 different test conditions. The throat velocity ranged from 130 to 231 ft/sec at pressure drops across the venturi of 5.9 to 18.8 in.w.c. (see Table 1). The pressure drop across the impingement section was constant at about 4 in.w.c. The draft control damper was adjusted to maintain a constant draft (0.6 in.w.c.) at the venturi inlet. This draft was not sufficient to prevent some leakage through the by pass stack.

The concentration of particulate material in the scrubber outlet gas stream (grain loading) was plotted as a function of throat velocity in Figure 2. This type of plot (semi-logarithmic) was selected based on venturi scrubber theory. A line was drawn through the data from the January 19 tests to predict

TABLE 1. AVERAGE TEST RESULTS
MARYVILLE REGIONAL WASTEWATER TREATMENT PLANT INCINERATOR

	1/9/84		1/19/84		
	Baseline	Oil Only	Test #1	Test #2	Test #3
Gas Temperature (°F)	164	178	178	186	180
Moisture (% By Volume)	4	1	2	2	2
CO_2 (% dry basis)	3.85	1.5	3.0	2.8	3.4
O_2 (% dry basis)	16.0	18.5	16.6	16.9	16.0
Velocity (ft/min)	2817	3039	2371	2437	2442
Gas Flow acfm	7436	8022	6259	6433	6448
scfm	6170	6510	5088	5165	5225
dscfm	5923	6445	4986	5061	5121
Particulate Concentration (grain/dscf)	0.018	0.047	0.013	0.020 [a]	0.027 [a]
Mass Rate (lb/hr)	0.90	2.62	0.57 [a]	0.85 [a]	1.17 [a]
Sludge Rate (lbs/hr)	3300	0	3100	3100	3100
Oil Rate (gal/hr) [b]	44	44	44	44	44
Furnace Draft (in.w.c.)	1.2-1.5	—	0.6	0.6	0.6
Impingement Plate ΔP (in.w.c.)	5.1	—	3.9	4.0	4.0
Venturi ΔP (in.w.c.)	6.8	—	18.8	10.4	5.9
Sewage Sludge Rate (tons/hr)(17%solids)	0.28	0	0.26	0.26	0.26
Oil Sludge Rate (tons/hr) (45 gal/hr @20% moisture)	0.15	0.15	0.15 [a]	0.15 [a]	0.15 [a]
Emission Rate (lbs/dry ton)	2.1	17	1.4 [a]	2.1 [a]	2.9 [a]
Scrubber dscfm	3898	—	2579	3296	3705
Scrubber acfm (saturated @157°F 30% H_2O)	6480	—	4290	5480 [b]	6160
Throat Velocity (ft/sec)	137	—	231	172 [b]	130
Throat Area (ft^2)	0.79	—	0.31	0.53 [b]	0.79
Grain Loading Scrubber Outlet (grains/acf)	0.016	—	0.016	0.018	0.022
% Excess Air	169	—	161	232	202

[a] some leakage through by pass stack.
[b] estimated.

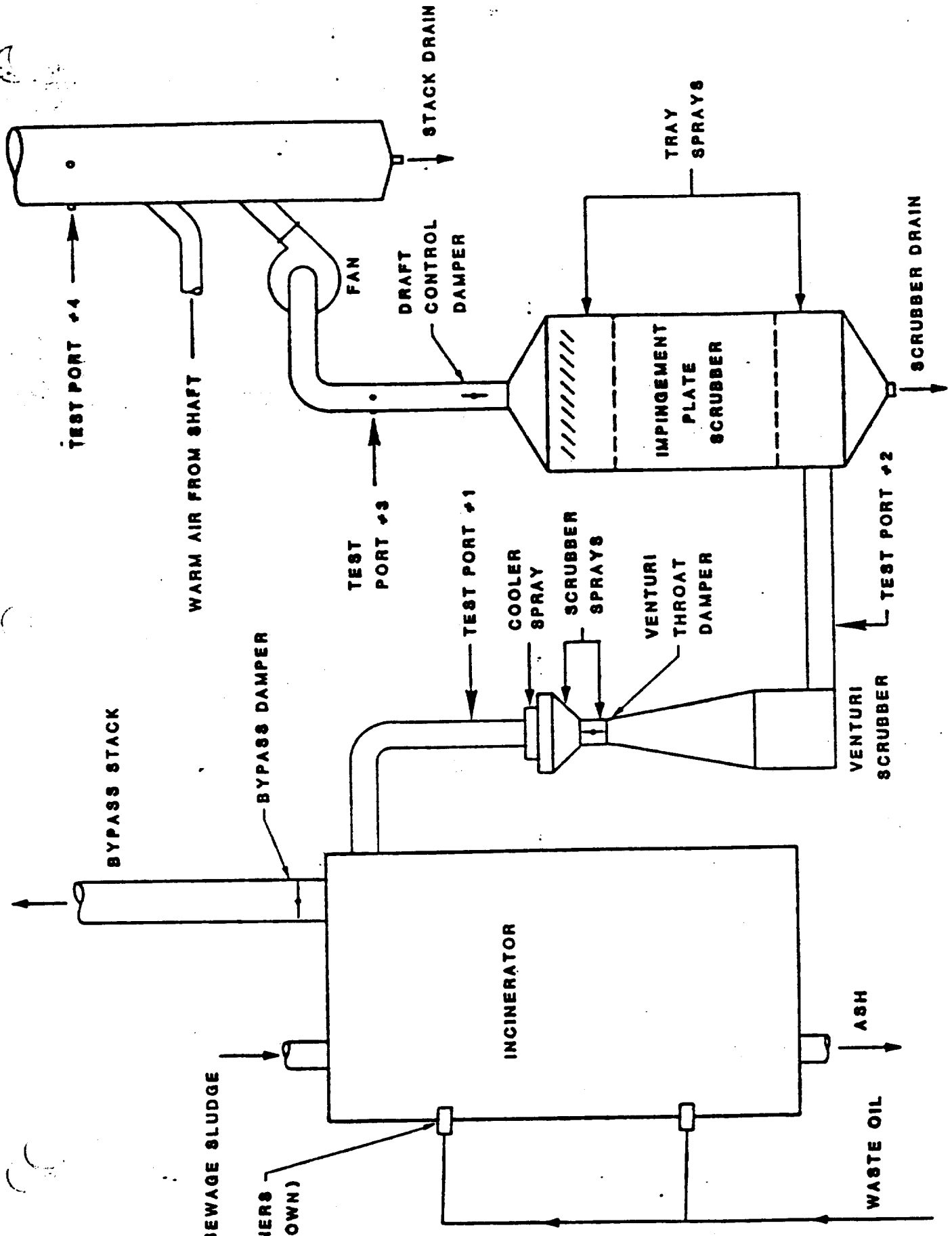


FIG. 1. MARYVILLE SLUDGE INCINERATOR SCHEMATIC.

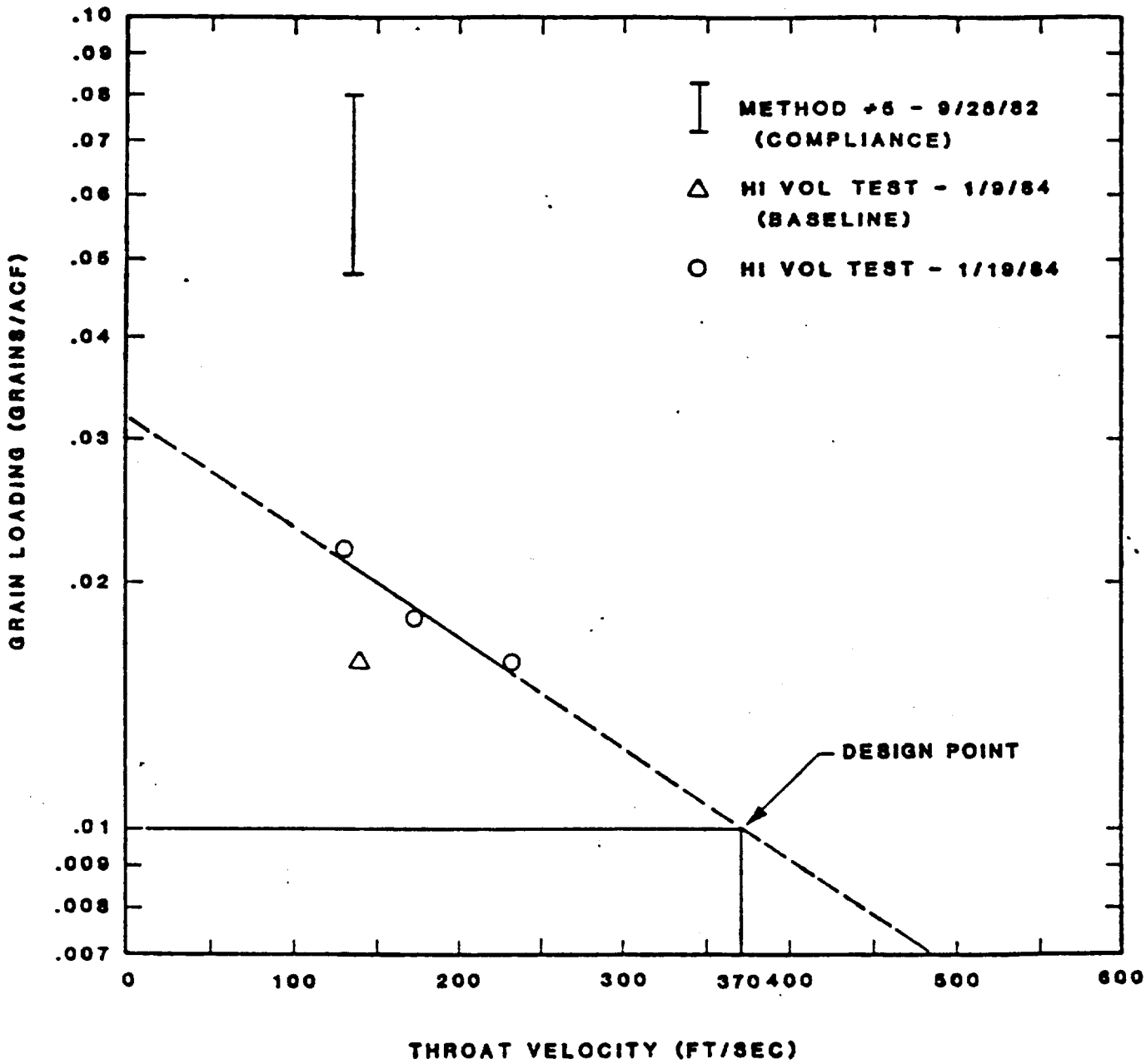


FIGURE 2. SCRUBBER OUTLET LOADING VERSUS THROAT VELOCITY.

grain loadings at other throat velocities. In Figure 3, venturi pressure drop was plotted as a function of throat velocity (again, from theory) and a line was drawn through the data to predict pressure drop at other throat velocities.

The scrubber grain loading varied considerably between the tests on January 9 and January 19. For example, at a pressure drop of 6-7 in.w.c., the scrubber grain loading ranged from 0.016 to 0.022 grains/acf on the 2 test days. This indicates that the incinerator can be operated to minimize air emissions.

Based on measurements at the baseline condition (1/9/84) and the results of the venturi throat velocity tests (1/19/84) particulate emissions from the scrubber can be reduced to the allowable rate with the modifications indicated below:

System Variable	Design Condition	Modification
Dry sludge rate	0.43 tons/hr	None
Air emission rate (1.3 lbs/dry ton)	0.56 lbs/hr	None
Venturi gas flow rate	3900 dscfm	None
Venturi gas flow rate	6500 acfm	None
Required grain loading	0.01 grains/acf	-
Required throat velocity (from Figure 2)	370 ft/sec	adjust venturi throat damper
Required Venturi pressure drop (from Figure 3)	45 in.w.c.	replace fan

The replacement fan should be larger than the existing one to deliver this gas flow and develop adequate static pressure.

Alternatives to replacing the fan would be to install a very high efficiency device such as an electrostatic precipitator (ESP) or a baghouse on the system.

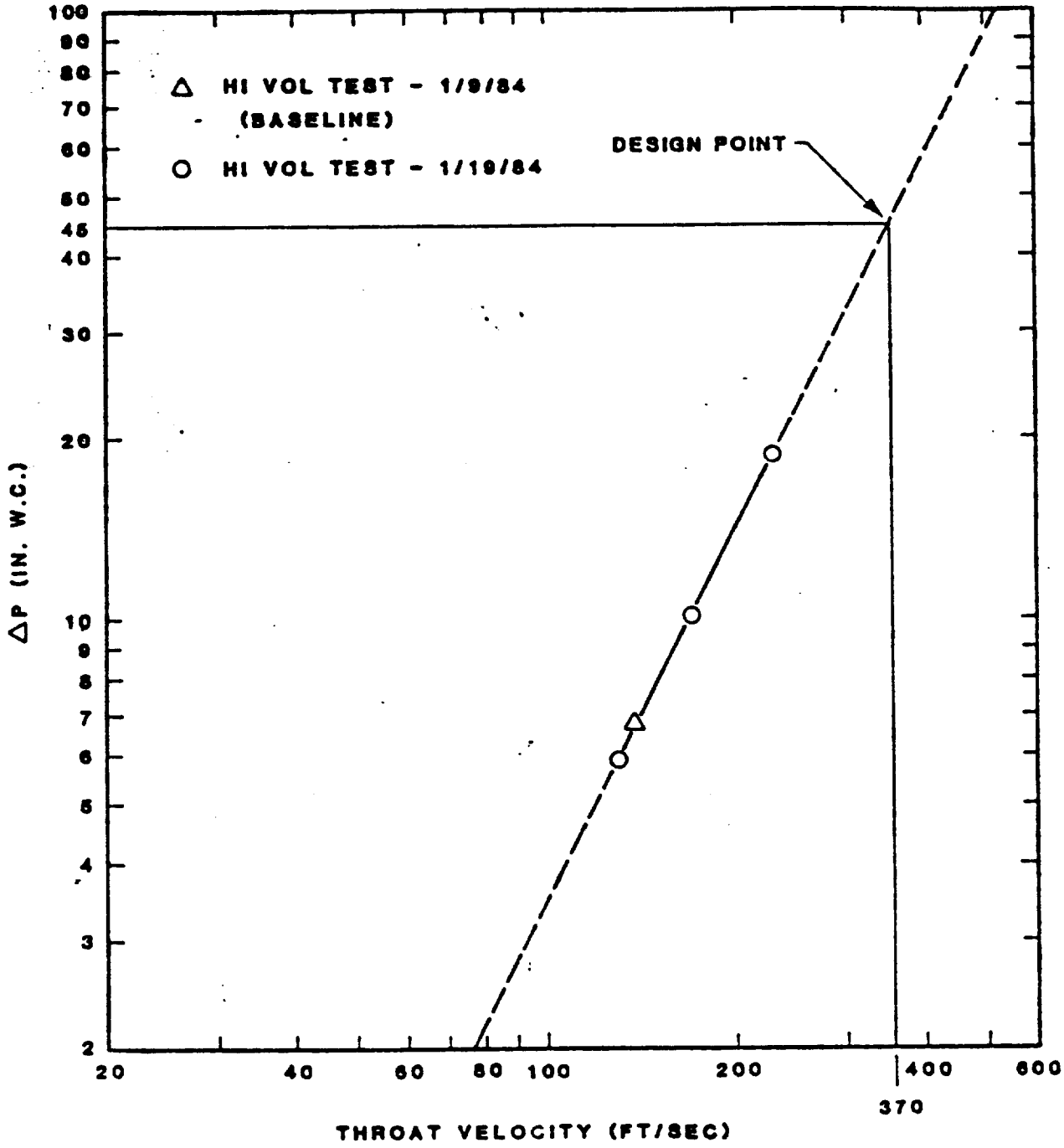


FIGURE 3. SCRUBBER PRESSURE DROP VERSUS THROAT VELOCITY.

However, these would be much more expensive options. For example, an insulated baghouse for this system could cost $95,000 and an ESP could cost $182,000. These figures are based on published chemical industry air pollution control costs (see Appendix) and do not include installation. The cost of an appropriate size fan constructed of 316 L stainless steel would range from $10,000 to $15,000.

ADDITIONAL MODIFICATIONS

The most cost effective first step in reducing air emissions to the required level would be fan replacement. Note that there are additional steps than do not appear to be necessary at this time that can help reduce emissions even further. These steps should be evaluated if further emission reductions are required:

a) oil blending
b) mixed oil/gas firing
c) finer oil filtration
d) reduce sludge cake moisture
e) automatic control
f) use clean water in cooler section
g) use clean water in scrubber section

SAMPLING AND ANALYTICAL PROCEDURES

The total gas volumetric flow rate measurements were made at test port #4 (see Figure 1)using an S-type pitot tube and an inclined manometer. The particulate concentrations were also determined at this port with a high volume type sampler. The test results listed in Table 1 represent averages of 2 or 3 runs. Bag samples were obtained at test ports 1, 3, and 4 and analyzed with an Orsat analyzer for CO_2 and O_2. The flow rate through the scrubber was calculated from the total flow rate out the stack by performing a CO_2 balance

on the gas streams. Static pressure measurements at ports 1, 2, 3, and 4 were made with magnahelic gages. Temperature measurements were made with a K-type thermocouple or a mercury thermometer. Moisture was determined from wet bulb/dry bulb temperatures and a psychrometric chart.

APPENDIX

ENVIRO-MEASURE, INC.
DESIGN CALCULATIONS

DESCRIPTION			DATE
PROJECT NO.	MADE BY	CHECKED BY	SHEET NO 1 OF 2

Electrostatic Precipitator: Cost Estimate *

$$E = 1 - e^{-w(A/Q)}$$

where E = collection efficiency, w = drift velocity, ft/s; A = plate area, ft²
and Q = flowrate, actual ft³/s. Q = 9300 acfm, E = 99%, w = 0.12 ft/s

$$A = -Q[\ln(1-E)]/w$$

$$A = -\frac{9300}{60}[\ln(1-.99)]/0.12$$

$$A \cong 6000 \text{ ft}^2$$

Cost estimate of dry-type, uninsulated electrostatic precipitator with plate area of 6000 ft² is $120,000. (1977 dollars)
Adjusted to 1983 dollars the cost is:

$$\$120{,}000\left(\frac{764.7}{505.4}\right) = \$182{,}000$$

Baghouse: Cost estimate **

Design conditions: 9300 acfm, 425°F
- reverse air cleaning
- 2:1 air to cloth ratio
- fiberglass bags

Costs are based on net cloth area, which is calculated by dividing gas volume entering the baghouse by the required air-to-cloth ratio.

$$A_n = 9300/2 \cong 5000 \text{ ft}^2$$

For a standard, continuous, pressure, reverse-air baghouse the cost

$$C = 25.68(1000) + 3.0\,A_n$$

$$C = \$40{,}680 \text{ (1977 dollars)}$$

ENVIRO-MEASURE, INC.
DESIGN CALCULATIONS

DESCRIPTION			DATE
PROJECT NO.	MADE BY	CHECKED BY	SHEET NO 2 OF 2

The add-on cost for an insulated baghouse is:

$$C = 11.2(1000) + 1.66A_h$$

$C = \$19,500$ (1977 dollars)

Unit cost of fiberglass filter bags is 0.45 $/ft²

$C = (5000)(.45) = \$2250$ (1977 dollars)

Total cost of insulated baghouse and bags is

$C = \$40,680 + \$19,500 + \$2250$

$C = \$62,430$ (1977 dollars)

Adjusted to 1983 dollars the total cost is:

$C = \$62430 \left(\frac{764.7}{505.4}\right) = \$94,500$

* Vatavuk, W.M. and R.B. Neveril, Part IX: Costs of Electrostatic Precipitators, Chem. Eng., Sept. 7, 1981.

** ———, Part XI: Estimate the Size and Cost of Baghouses, Chem. Eng., March 22, 1982.

TENNESSEE AIR POLLUTION CONTROL BOARD
NASHVILLE, TENNESSEE 37219

Permit to Construct or Modify an Air Contaminant Source Issued Pursuant to Tennessee Air Quality Act

Date Issued: DEC 09 1981

Permit Number: 9926731

Date Expires: May 31, 1982

Issued To:
Maryville Utilities Board

Installation Address:
Wheeler Road
Louisville, TN

Installation Description:
Municipal sewage incinerator
977 # sewage per hour
120 gallons waste oil/hr
venturi scrubber and 2 tray impingent scrubbers

Emission Source Reference No:
05-0116-01

The holder of this permit shall comply with the conditions contained in this permit as well as all applicable provisions of the Tennessee Air Pollution Control Regulations.
This is not a permit to operate.

CONDITIONS:

1. This permit does not cover any air contaminant source that does not conform to the conditions of this permit and the information given in the approved application. This includes compliance with the following operating parameters:

   a. Capacity shall not exceed 977 pounds dry weight of sewage and 120 gallons of waste oil per hour.

   b. Mercury emitted from this source shall not exceed 3200 grams per 24-hour period.

   c. Particulate matter emitted from this source shall not exceed 0.61 pounds per hour and 1.30 pounds per ton dry sludge input.

   d. Visible emissions shall not exceed 20% opacity as read by Method 9.

2. Within sixty (60) days after initial startup of the operation of this air contaminant source the owner or operator shall have applied for an operating permit from the Technical Secretary.

3. The Technical Secretary shall be notified at least ten (10) days prior to start-up of the source.

(Continue on next page)

Original Signed by
HAROLD E. HODGES

HAROLD E. HODGES, P. E.
TECHNICAL SECRETARY

No Authority is Granted by this Permit to Operate, Construct, or Maintain any Installation in Violation of any Law, Statute, Code, Ordinance, Rule or Regulation of the State of Tennessee or any of its Political divisions.

NON TRANSFERABLE

POST AT INSTALLATION ADDRESS

PH-0515 APC 1/78

4. This permit does not cover construction which commences after one year of the date of issuance of this permit or the first construction permit which was issued for this source.

5. Progress reports must be filed annually for construction projects extending over a one year duration. As a minimum, these reports must specify the percentage of the project completed and give an estimated completion date. The first progress report will be due one year after this permit is issued and every year thereafter until construction is completed.

6. This source must be provided with sampling ports and platforms in accordance with the document, "Guide for Preparation of Stack Sampling Site by Source Owner and Operator." Deviations from the specifications given in this document are permissible if plans and specifications are submitted and approved by the Technical Secretary. All such deviations shall be submitted at least thirty (30) days prior to erection of the control equipment.

7. Within 60 days after achieving the maximum production rate at which the facility will be operated, but no later than 180 days after initial startup, the owner or operator shall conduct an emissions performance test for the pollutants listed below and furnish the Technical Secretary a written report of the results of such test. The performance test shall be conducted and data reduced in accordance with methods and procedures specified in Chapter 1200-3-16-.01(5) of the Tennessee Air Pollution Control Regulations.

   a. Particulates

8. Within 60 days after achieving the maximum production rate at which the facility will be operated, but no later than 90 days after initial startup, the owner or operator shall conduct an emissions performance test for mercury and furnish the Technical Secretary a written report of the results of such test. The performance test shall be conducted and data reduced in accordance with methods and procedures specified in Chapter 1200-3-11-.04(4) of the Tennessee Air Pollution Control Regulations.

9. At least thirty (30) days prior to conducting the source test, the Technical Secretary shall be given notice of the test in order to afford him the opportunity to have an observer present.

10. The issuance of this permit does not exempt the permittee from any requirements of the Environmental Protection Agency pertaining to the emissions from the operation of this new source.

...ew X Modification X Renewal ✓ Expansion ____

EMISSION SUMMARY 9926731

Air Pollutant		(#/HR) (#/MMBtu)	Tons/Yr	(Gr/Scf) (Ppm)	Applicable Standard	Date Data Estimated	Source of Data
Particulate	Est.	0.61	1.34			10-2-80	1
	All.	0.61	2.617		3-16-.13		
Sulfur Dioxide	Est.	2.4	5.4			10-2-80	4
	All.	2.4	10.8		3-14-.05		
Oxides of Nitrogen	Est.	2.45	5.37			10-2-80	4
	All.						
Carbon Monoxide	Est.	0.6	1.3			10-2-80	4
	All.						
Hydrocarbons	Est.	0.37	0.81			10-2-80	4
	All.						
Hydrogen Flouride	Est.						
Mercury	All.	3200 grams/day			3-11-.04(3)		

ENGINEERING COMMENTS: Vic Malichis confirmed the Utilities Board request for a renewal 10/28/81.

Reviewer AJL MHB Date 10-2-80 10-27-81

TECHNICAL SERVICES REVIEW:
Compounds Modeled: (Specify) _____
Dispersion Model _____ Plume Rise Equation _____
Conditions _____

Concentration Estimates

Maximum For _____ Average For _____
Location _____ Location _____
Met Conditions _____ Met Conditions _____
Other: _____

Reviewer _____ Date _____
FINAL PERMIT APPROVAL: Engineering Program ~~ASP~~ Date ~~10/30/81~~ 10/29/81
ajp

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

TENNESSEE DEPARTMENT OF PUBLIC HEALTH
Environmental Management and Quality Assurance Administration
T.E.R.R.A. BUILDING
150 NINTH AVENUE, NORTH
NASHVILLE, TENNESSEE 37203

February 28, 1983

Mr. Rex Ogle
Maryville Utilities Board
Water and Wastewater Division
P.O. Box 667
Maryville, Tennessee 37801

Re: Municipal Sewage Incinerator
Reference No. 05-0116-01 - A3

Dear Mr. Ogle:

The Existing Source Section has reviewed the particulate emissions test report for the above-referenced incinerator submitted by Enviromeasure Inc. for the Maryville Utilities Board. Actual emissions from the incinerator during the test were analyzed to average 3.67 pounds per hour or 11.5 pounds per ton of dry sludge, at an average dry sludge charge rate of 637 pounds per hour. The allowable emission rate for this incinerator is 0.61 pounds per hour and 1.30 pounds per ton dry sludge input, according to Rule 1200-3-16-.13 of the Tennessee Air Pollution Control Regulations.

Therefore, based on the information provided in the report, you are to consider this letter as a formal Notice of Violation of Rule 1200-3-16-.13, specifically, for failing to comply with condition 1.(C.) of Construction Permit No. 992673I. Please be advised that you are provided the opportunity to request that this Notice of Violation be excused in accordance with Rule 1200-3-20-.07 of the Tennessee Air Pollution Control Regulations. Please submit to this office two copies of the enclosed APC-19, Proposed Schedule for Corrective Action within 45 days of receipt of this letter.

Should you have any questions or comments, feel free to contact me at 615-741-3651.

Sincerely,

Dave P. Jarrett
Existing Source Section
Division of Air Pollution Control

DPJ/sc/1-21

cc: Quincy Styles

SOURCE EMISSION DATA — NON-PROCESS - FUEL BURNING — APC - 24

MAIL TO: TENNESSEE DEPARTMENT OF PUBLIC HEALTH
DIVISION OF AIR POLLUTION CONTROL
256 CAPITOL HILL BUILDING
NASHVILLE, TENNESSEE 37219

DO NOT WRITE IN THIS SPACE
COMPANY NO. 95-001/1/6
PERMIT NO. [ ]
EMISSION POINT NO. [ ]
REVIEWER [ ]
DATE [ ]

FILL OUT A SEPARATE SHEET FOR EACH STACK OR EMISSION POINT. SUBMIT TWO COPIES OF THIS FORM AND TWO COPIES OF PERMIT APPLICATION, APC-20.

1. COMPANY NAME Maryville Utilities Board 2. STACK NUMBER 001
3. GIVE BOILER DATA BELOW. USE A SEPARATE LINE FOR EACH BOILER DISCHARGING FLUE GAS TO THIS STACK.

BOILER NO.	TYPE FIRING*	RATED CAPACITY 10^6 BTU/HR	TYPE FUEL	ANNUAL QUANTITY	MAXIMUM HOURLY DESIGN RATE	UNITS	SULFUR[1] CONTENT (PERCENT)	ASH[1] % IF COAL	BTU VALUE OF FUEL
001	Incinerator	$8x10^6$	Waste Oil	500,000 gal/yr. Max.	120 gal. per hour	1	0.19%	1.3%	60,000 80,000 BTU per ga

* CYCLONE SPREADER (WITH OR WITHOUT REINJECTION), PULVERIZED (WET OR DRY BOTTOM, WITH OR WITHOUT REINJECTION OTHER STOKER, SPECIFY TYPE, HAND FIRED, OR OTHER TYPE (DESCRIBE).
1 IF NOT AVAILABLE, GIVE NAME AND ADDRESS OF YOUR FUEL SUPPLIER.

4. IF A STANDBY OR INTERRUPTIBLE FUEL IS USED, GIVE TYPE OF FUEL, ANNUAL QUANTITY USED, AND THE SCHEDULE OR PROGRAM FOR USE
Natural gas, $12x10^6$ cu. ft/yr., will be used as back-up to waste oil

SULFUR CONTENT OF STANDBY FUEL = 0 % IF COAL, SHOW ASH CONTENT ____ %

5. AIR POLLUTION CONTROL EQUIPMENT
Venturi Wet Scrubber followed by 2 tray impingent scrubber

AIR CONTAMINANT CONTROLLED	YEAR INSTALLED	TYPE[2]	EFFICIENCY
PARTICULATE	1976	001 High 90's	
SULFUR DIOXIDE			
OXIDES OF NITROGEN			
HYDROCARBONS			
CARBON MONOXIDE			

2 ABBREVIATIONS AS SHOWN ON BACK OF APC-20.

ID CONSTRUCTION OF THIS PROCESS BEGIN ON OR BEFORE AUGUST 9, 1969? YES ☐ NO ☒
ON OR BEFORE APRIL 3, 1972? YES ☐ NO ☒

TDPH-APC
B-222

6. IS AN EMISSION MONITORING AND RECORDING INSTRUMENT ATTACHED TO THIS STACK OR EMISSION POINT?

YES [ ] NO [X] SMOKE DETECTOR? YES [ ] NO [X] SO_2 MONITOR? YES [ ] NO [X]

NO_X MONITOR? YES [ ] NO [X] OTHER (DESCRIBE) _____

7. INDICATE STACK HEIGHT ABOVE GRADE 41 FT. 8. INSIDE DIAMETER OF STACK AT TOP 2.5 FT.

9. NORMAL DESIGN EXIT GAS TEMP. 187 °F. 10. EXIT DESIGN GAS VELOCITY 31 FPS.

11. EXIT DESIGN GAS VOLUME 4502 ACFM @ 187° [redacted].

12. SHOW MOISTURE CONTENT 898 ACFM F Dry Gas (~~GRAINS/CU. FT. DRY GAS AT 70°F~~) AND _____ (GRAINS/ CU. FT. GAS AT STACK CONDITIONS) (882#/hr)-187°F

13. SHOW DISTANCE FROM RELEASE POINT TO NEAREST PROPERTY LINE 230 FT.

14. PERCENT OF HEAT USED FOR SPACE HEATING 0 %.

15. OPERATIONAL SCHEDULE OF NON PROCESS EMISSION SOURCE:

A. HOURS PER DAY 24

B. DAYS PER WEEK 3.5

C. WEEKS PER YEAR 52

D. INDICATE IF OPERATION VARIES BY SEASON AND TELL HOW (ATTACH ADDITIONAL SHEET IF NECESSARY)

16. % ANNUAL FUEL BURNED IN EACH PERIOD BELOW

DEC - FEB	MARCH - MAY	JUNE - AUGUST	SEPT- NOV
25%	25%	25%	25%

17. SHOW AIR CONTAMINAN DATA FOR THIS EMISSION POINT:

LUTANT	ABSENT	PRESENT	CONCENTRATION			AVERAGE EMISSIONS		BASIS OF ESTIMATE (SPECIFY) *
			QUANTITY	UNITS	%EXCESS AIR	LBS/HR	TONS/YR	
PARTICULATES		X		GR/SCF		0.61		See DWA Report p.
SULFUR DIOXIDE		X		PPM		4		See DWA Report p.
OXIDES OF NITROGEN				PPM				
HYDROCARBONS				PPM				
CARBON MONOXIDE				PPM				
SHOW OTHERS:								

*PLEASE ATTACH A COPY OF THE TEST PROCEDURE, PROCESS MATERIAL BALANCE STUDY OR OTHER BASIS USED AS METHOD OF MEASUREMENT.

FOR OFFICE USE ONLY

[ ] NEW FUEL BURNING INSTALLATION FILING IS AUTHORIZED BY _____ DATE _____

[ ] EMISSION POINT IS NOT IN COMPLIANCE WITH PARTICULATE EMISSION STANDARD AND ALLOWABLE EMISSIONS OF _____ #/h

[ ] EMISSION POINT IS NOT IN COMPLIANCE WITH SULFUR DIOXIDE STANDARD OF 620 PPM CORRECTED TO 15% EXCESS AIR

[ ] EMISSION POINT IS NOT IN COMPLIANCE WITH GASEOUS EMISSION STANDARD. INDENTIFY GAS _____

[ ] CONTINUOUS MONITOR (S) FOR (1) _____; (2) _____; (3) _____ RECOMMENDED.

[ ] METHOD OF MEASUREMENT IS ACCEPTABLE [ ] METHOD OF MEASUREMENT IS NOT ACCEPTABLE

EXPLAIN _____

ALLOWABLE EMISSIONS - (TONS/YEAR) PARTICULATES _____ SULFUR DIOXIDE _____ HYDROCARBONS _____

CARBON MONOXIDE _____ OXIDES OF NITROGEN _____

TEPH-APC

LOUISVILLE, TN 37777
615/970-2313

DENNIS WEETER ASSOCIATES

CONSULTING ENGINEERS

October 1, 1982

Mr. Al Lewis
Air Pollution Control Division - TDPH
5th Floor Terra Bldg.
150 9th Ave. N.
Nashville, TN 37203

RE: Operating Data - MUB Test of 9/28/82 (APCD #05-00116)

Dear Al:

Please find enclosed Table I and Table II which summarize the operating data from the MUB September 28, 1982 test.

We will forward the test results as soon as they are received from EMI (air test) and Kenwill (Hg analysis).

Sincerely yours,

D. W. Weeter, P.E.

spw

cc: T. Babbs - EMI
D. Carver - APCD
V. Malichis - APCD Knoxville
R. Ogle - MUB
T. S. Reddy - APCD

TABLE I

	Time	Sludge Cake % Solids	Oil Sludge % Moisture	Sludge W+ lbs/hr
	5 am	-	-	3663
	6 am	-	-	2741
	7 am	18%	-	3057
	8 am	-	-	3032
Run #1	9 am	17.5%	-	3870
Run #1	10:05 am	17%	25%	-
Run #2	11:20 am	17.5%	25%	3594
Run #2	12:05 pm	15%	-	-
Run #2	12:25 pm	-	-	-
Run #3	1:00 pm	-	-	3823
Run #3	1:40 pm	17%	25%	-
Run #3	2:10 pm	17.5%	-	-

Fuel Use

No Natural Gas Used

Oil

Test 1 (9:00 am - 10:05 am) - 58 gallons
Test 2 (11:20 am - 12:25 pm) - 73 gallons
Test 3 (1:00 pm - 2:10 pm) - 72 gallons

MUB Air Test
APCD #05-00116
9/28/82

TABLE II

TIME	Temperature °F									% O_2	Scrubber Diff. Inches	Scrubbe Flow gpm @ 10
	H-1	H-2	H-3	H-4	H-5	H-6	Cooling Air	Scrub Inlet	Scrub Outlet			
MN	700	1040	1120	1280	860	200	260	120	120	off	off	off
5 am	770	1040	1110	1250	850	180	260	120	120	off	off	off
6 am	680	1120	1270	1540	1080	200	210	120	140	3.0	4.0	280
7 am	670	1110	1280	1620	1180	210	260	110	140	4.5	4.0	275
8 am	630	1090	1200	1610	1140	230	280	190	150	5.0	5.0	275
9 am	720	1400	1610	1620	1260	260	280	200	160	5.5	4.75	275
10:05 am	600	1110	1210	1550	1200	220	290	310	130	6.6	4.25	280
11:20 am	570	1020	1130	1540	1190	220	280	190	140	2.8	4.0	280
12:25 am	560	1000	1080	1540	1190	240	260	240	140	7.5	4.0	275
1:00 pm	520	980	1060	1520	1180	200	240	180	140	7.0	4.0	275
2:10 pm	560	1060	1140	1610	1200	240	280	140	140	1.7	4.25	280
3:00 pm	580	1080	1190	1630	1260	240	260	120	140	2.0	4.25	280

KENWILL, INC.

2537

MINERAL EXPLORATION • MINING CONSULTANTS
LABORATORY SERVICES (COAL/WATER/GEOLOGIC)
505 E. BROADWAY • MARYVILLE, TENN. 37801
615/977-1200

October 1, 1982

Maryville Utilities Board
P.O. Box 667
Maryville, TN 37801

Attn: Mr. Don Thompson

Sample Description	Waste Oil
Date Taken & Time	9/28/82

CERTIFICATE OF ANALYSIS

(All results are reported as mg/l unless otherwise noted.)

Mercury	<0.05 ppm

KENWILL, INC.

for Wm. J. Carter, III

E. W. Kuemmerle, Jr., Ph.D.
Vice President, Laboratory Division

INTRODUCTION

On September 28, 1982, Enviro-Measure, Inc. performed an EPA Method 5 source emission test at MARYVILLE UTILITIES BOARD's Wastewater Treatment Plant in Maryville, Tennessee.

The objective of this test was to determine the degree of compliance of a multiple hearth sewage sludge incinerator followed by a venturi scrubber. This facility was tested in compliance in December, 1977 with natural gas as the fuel. Modifications have been made to allow the incinerator to be fueled with waste oil. This test was conducted with waste oil as the fuel.

Conditions of the permit for this facility state that particulate emissions to the atmosphere shall not exceed 1.3 lbs. per ton of dry sludge charged or 0.61 lbs. per hour which ever is more stringent.

SUMMARY OF RESULTS

Table 1 presents the results of the EPA Method 5 test conducted on MARYVILLE WASTEWATER TREATMENT PLANT's sewage sludge incineration system fueled with waste oil. The average dry sludge charge rate during testing was 0.32 tons/hr. The test results show an average grain loading of 0.0535 gr/dscf and an average emission rate of 3.61 lbs./hr or 11.2 lbs./ton of dry sludge. The average emision rate of 11.2 lbs./ton of dry sludge is greater than the allowable emission rate of 1.3 lbs./ton of dry sludge and the average emission rate of 3.61 lbs./hr is greater than the allowable emission rate of 0.61 lbs./hr. This indicates that this source was not in compliance with conditions stated in the permit during this test.

From Sewage Sludge Incinerators

3.0 PROCESS DESCRIPTION, ATMOSPHERIC EMISSIONS, AND EMISSION CONTROL METHODS

Although widely varying types of sewage sludge incinerators exist, only the multiple-hearth furnace discussed in Section 3.1 is used extensively. Other types include traveling-grate furnaces, rotary kiln furnaces, fluidized-bed units, wet-oxidation units, and atomized spray units; these incinerators are discussed in Reference 1. Atmospheric emissions and control methods for sludge incinerators are discussed in Sections 3.2 and 3.3.

3.1 PROCESS DESCRIPTION

The sludge incineration process involves three steps: preliminary dewatering, drying, and combustion. Figure 3.1 is a generalized schematic of a sludge treatment system. The dewatering operation reduces the moisture content of the sludge from its original 90-plus percent to about 30 to 50 percent. Vacuum filtration, pressure filtration, and centrifugation are some of the dewatering methods used.

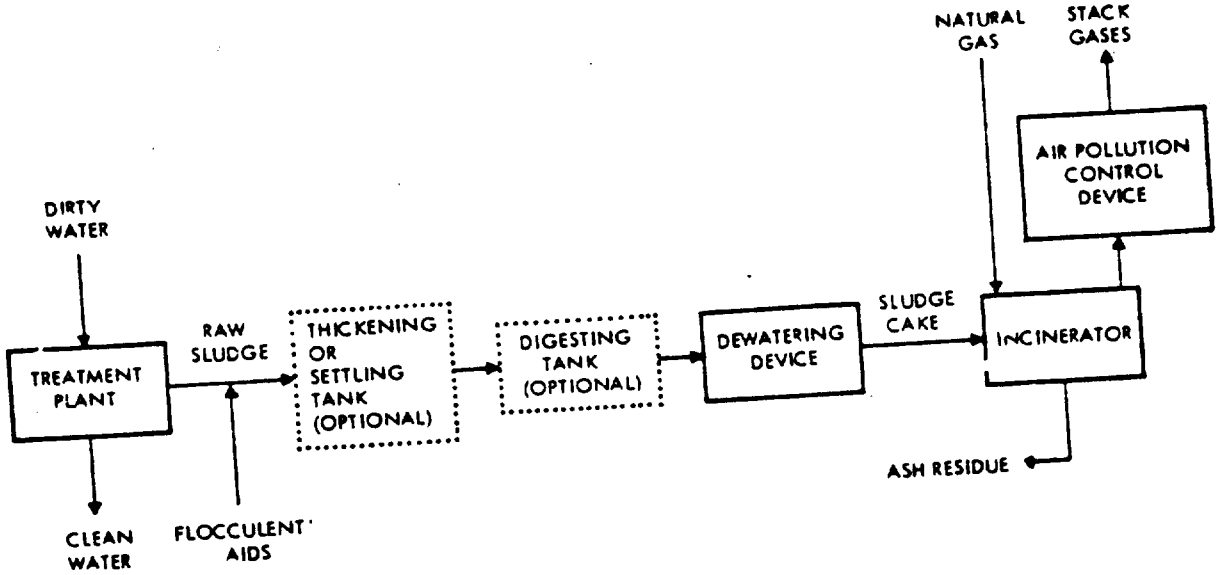


Figure 3.1 Sewage sludge treatment system.

Drying and combustion are successively accomplished in the multiple-hearth incinerator, shown in Figure 3.2. The multiple-hearth furnace consists of a circular steel shell surrounding a number of solid refractory hearths and a central rotating shaft to which rabble arms are attached. Complete drying and burnout requires that the incinerator have at least four hearths. Each hearth has an opening that allows sludge to be dropped to the next lower hearth. Many or all of the hearth stages have oil-or gas-fired burners to supply additional heat to the furnace. The rotating central shaft and rabble arms break up the large sludge particles to induce rapid and complete combustion.

Intermediate hearths provide a high-temperature zone (1600 to 1800°F), where combustion of the fixed carbon takes place. The bottom hearths of the furnace serve as a cooling zone (600°F), from which the exhaust gases rise to the top of the unit and then are ducted to a scrubber. A minimum of 50 percent excess air is required to burn the sludge properly. The fly ash slurry and ash from the incinerator are discharged through a hopper and transported to a landfill or lagoon.

As shown in Figure 3.2, a separate air system cools the central shaft. A forced-draft cooling air fan supplies air to the bottom of the shaft. The cooling air is heated as it passes upwards through the shaft. Most of the heated air is ducted to the incinerator for combustion; a small portion passes through a cooling air discharge duct, separate from the incinerator flue gas stack.

3.2 ATMOSPHERIC EMISSIONS

New or modified sewage sludge incinerators are subject to particulate and opacity standards. Although odors are major air contaminants, odor emissions are not covered by new source regulations. A well-operated sludge incinerator, employing proper housekeeping procedures, keep odors at a tolerable level.

NSPS pertain to the stack or stacks handling the combustion gases exiting from the incinerator and control device. The air used to cool the shaft and rabble arms, shown in Figure 3.2, is not directly involved in the combustion process. That portion of the cooling air that is allowed to escape to the atmosphere is excluded from the standards, and requires no testing or monitoring. If cooling gases are mixed with combustion gas, the steam plume will be minimized.

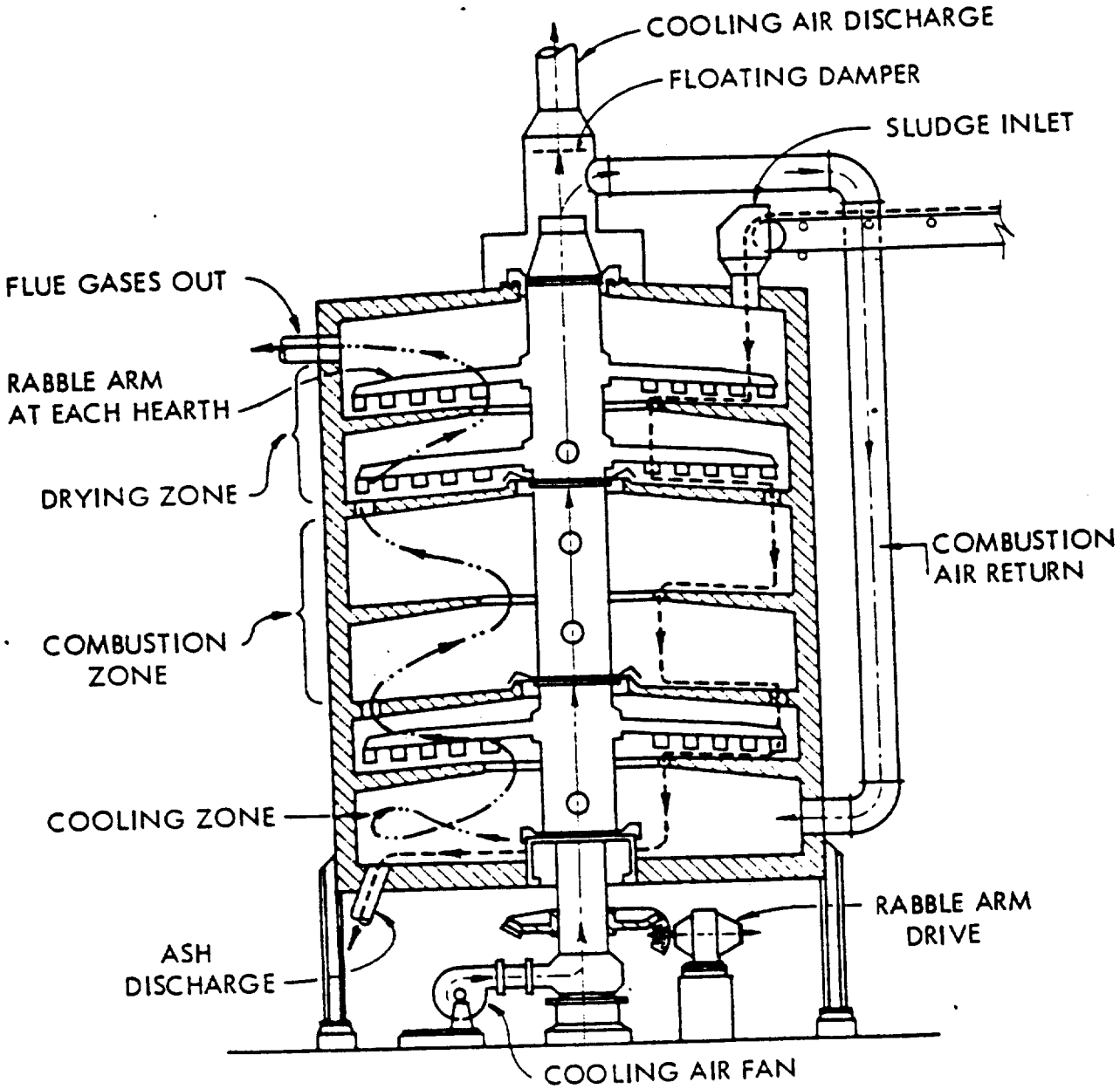


Figure 3.2 Typical section of a multiple-hearth sludge incinerator.

Particulate emissions into the atmosphere are almost entirely a function of scrubber efficiency and are only minimally affected by incinerator conditions, although emissions will increase if design temperatures are not maintained, or if excess sludge is fed into the incinerator. Uncontrolled multiple-hearth incinerator gases contain about 20 g/kg of dry sludge. Scrubbers need an efficiency of approximately 97 percent to meet the particulate standard of 0.65 g/kg. When the incinerator and control equipment are operating properly, stack opacities in most instances will be within allowable standards.

Continuously running sewage sludge incinerators require little or no auxiliary fuel to attain complete burnout of the sludge. Many incinerators are, however, shutdown during the weekend and must be restarted. To avoil excessive particulate emissions during start-up, the hearths of these units must be preheated with gas- or oil-fired heat before sludge is added.

3.3 EMISSION CONTROL METHODS

Water scrubbing is the most effective method for cleaning sludge incinerator exhaust gases. Wet scrubbers are relatively insensitive to particulate loadings and gas temperatures, and they collect the condensable portion of the emissions. Mechanical collectors may possibly be used on some existing modified units, but a mechanical collector cannot meet particulate standards unless it is augmented by a wet collection system.

Venturi, baffle plate, impingement, orifice, and cyclone-type scrubbers are potentially effective for controlling particulate emissions. Venturi and impingement types have successfully met emission standards.

In the venturi scrubber, the particulate-laden gas passes through a duct throat, where high velocities of 60 to 180 m/sec (200 to 600 fps) are attained at pressure drops of 50 to 75 cm (20 to 30 inches) water gage. Coarse water spray, injected into the duct throat at the rate of 19 to 38 liters per 28 cubic meters of gas (5 to 10 gallons per 1000 cubic feet of gas) atomizes and impacts with the particulate.

In impingement towers, the large particulates are removed by impingement on wet surfaces and contact with water spray in an area below the filter bed. The gas containing the remaining particulates then passes upward through a bed of spheres. These particulates are subjected to increased velocities in the interstices of the bed, which results in their impingement upon the surfaces of the spheres.

FINAL

05-0116-01

C-795

991932I

WASTE OIL INCINERATION
PRELIMINARY DESIGN REPORT

to

Aluminum Company of America
Alcoa, TN 37701

and

City of Maryville
Maryville, TN 37801

from

Dennis W. Weeter, Ph.D., P.E.
Dennis W. Weeter Associates
Rt 4 Box 94
Louisville, TN 37777

September 29, 1980

Table 1 presents the projected oil sludge volumes for operating the incinerator under various modes and time periods. Also, Table 1 presents the expected material inputs and outputs to the incinerator.

CONTROLLED TEST BURN

Given concerns over the self burning capability of the oil sludge and the potential air quality emissions, it was decided to test burn the oil sludge. Five hundred gallons of ALCOA waste were shipped to the John Zink Co., Tulsa, OK., and was burned on August 19-20, 1980. Experiments were conducted on waste atomization temperature, atomization media (steam versus compressed air), required excess air for complete combustion, turndown ratio of the burner from a high heat rate to a low heat rate, and ability of the oil to sustain self burning without gas assist. Also a total mass loading particulate test was run as well as a particle size distribution.

The waste oil atomizes very well between 110°-140°F. Compressed air (50-100 psi) is preferable to steam in that less haze is generated around the fire ball when air is used. At least 25% excess air above stoichiometric is required. The burner was able to be turned down by a factor of 3.3 from a maximum heat rate of 8×10^6 BTU/hr (100 gallons of fuel/hr). The oil fire was self sustaining at both high and low heat rates. Due to the existance of aluminum shavings, some as large as 3/16", the fuel needs filtering to prevent burner plugging. The results of the air quality studies will be discussed later.

concept now is to fuel switch with oil sludge and also to keep the incinerator temperature up when not burning sewage sludge.

The purpose of this project is to modify the incinerator at the MRWTP to burn the ALCOA oil sludge. Considerable economies exist for both parties given the fuel savings at MRWTP and the cost of sludge storage and disposal at ALCOA. This report will detail the projected capital modifications, the material balances, studies to date, and regulatory impacts (air, water quality, and oil spill prevention).

MATERIAL BALANCES AND WASTE CHARACTERISTICS

Presently the MRWTP incinerator operates under the following conditions:

Avg. % Solids to Incinerator = 17.6%
% Volatiles = 13.2%
% Ash = 4.4%
Dry Wt. Solids = 88.1 tons/mo.
Wet Wt. Solids = 489.9 tons/mo.
Wet solids/dry solids = 5.56
Incinerator Loading = 506#/hr dry weight
Operating Time = 50%
Incineration Energy = 6900 BTU/#Dry Solids
Holding Temperature Energy = 0.86 million BTU/hr
Heat Value of Sludge = 7500 BTU/#Dry Solids
Raw Waste BOD = 100 mg/l
Raw Waste SS = 140 mg/l
Raw Waste Flow = 4.25 MGD
Projected Sludge Production at Plant
Capacity = 11572#/day (482#/hr) dry Wt.

The ALCOA oil sludge has the following characteristics:

BTU Content = 70,000-100,000 BTU/gal
Availability: 10,000-15,000 gal/week (20,000 gal/wk max)
Non Volatile Residue= 1.3% by weight (550°C)
Moisture content: 10-30% by weight

PCB's	=	None
Al		1146 mg/l
Mn		3500 mg/l
Cd		3.5 mg/l
Pb		21.8 mg/l
Hg		< 0.005 mg/l
Zn		13.8 mg/l
Sulfur		0.19%

INTRODUCTION

Incineration offers the opportunity to reduce sludge to a sterile landfill and remove offensive odors, but it also has the potential to be a significant contributor to the air pollution problem in an urban community. The quantity and size of particulate emissions leaving the furnace of an incinerator vary widely, depending on such factors as the sludge being fired, operating procedures, and completeness of combustion. Incomplete combustion can form objectionable intermediate products, such as hydrocarbons and carbon monoxide. There is also the potential for discharge of air pollutants such as sulfur dioxide, nitrous oxides, and metals such as mercury.

PARTICULATE MATTER

New Source Performance Standards (NSPS) regulating discharges from municipal sludge incinerators have been promulgated by the Environmental Protection Agency (EPA). These standards limit the discharge of particulate matter from both new and modified sewage sludge incinerators. The process weight and opacity restrictions placed on this atmospheric pollution source are:[1]

- No more than 0.65 g/kg dry sludge input (1.30 lb/ton dry sludge input).
- Less than 20 percent opacity. Visible emissions caused solely by the presence of uncombined water are not subject to the opacity standard.

Available data indicate that, on the average, uncontrolled multiple-hearth incinerator gases contain about 0.6 grain of particulate per standard cubic foot of dry gas.[2] Uncontrolled fluid-bed reactor gases contain about 1.0 grain of particulate per standard cubic foot.[3] For average municipal wastewater sludge, these uncontrolled pollutant concentrations correspond to about 33 pounds of particulates per ton of sludge burned in a multiple hearth, and about 45 pounds of particulates per ton of sludge burned in a fluid-bed incinerator. Particulate collection efficiencies of 96 to 97 percent are required to meet the NSPS,[4] based on the above uncontrolled emission rate.

Sludge incinerators differ from most other types of incinerators in that the sludge does not normally supply enough heat to sustain combustion. Furthermore, there is less emphasis on retaining ash in the incinerator and much of it is discharged in stack gases. Particulate emissions to the atmosphere are almost entirely a function of the scrubber efficiency and are only minimally affected by incinerator conditions. Sludge incinerators in the United States are equipped with scrubbers of varying efficiency. These scrubbers range from simple spray-tower-type units to venturi-type scrubbers with pressure drops up to 40 inches of water.

Existing State or local regulations in the United States tend to regulate sludge incinerator emissions through incinerator codes or process weight regulations.[5] Many State and local standards are

Fluidized Bed 18" w.p. 20" capacity Venturi scrubber

Table 1.—*Sludge incinerator facility A_1: Summary of results*

Item	Run number			Average
	1	2	3	
Date	1-11-72	1-12-72	1-12-72	
Test time, minutes	108	108	108	108
Furnace feed rate, ton/h dry solids	0.550	0.560	0.560	0.557
Stack effluent:				
Flow rate, dscfm	2,880	2,550	2,660	2,700
Flow rate, dscf/ton feed	314,000	273,000	285,000	291,000
Temperature, °F	59	59	59	59
Water vapor, volume %	1.93	1.92	2.23	2.03
CO_2, volume % dry	12.8	12.6	11.5	12.3
O_2, volume % dry	4.8	4.7	6.4	5.3
CO, volume % dry	0	0	0	0
SO_2 emissions, ppm	<0.3	<0.3	<0.3	<0.3
NO_x emissions, ppm	4.2	5.7	6.4	5.4
HCl emissions, ppm	<3.8	<2.9	<4.1	<3.6
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions:				
Probe and filter catch:				
gr/dscf	0.024	0.005	0.004	0.011
gr/acf	0.023	0.005	0.004	0.011
lb/h	0.583	0.116	0.099	0.266
lb/ton of feed	1.06	0.207	0.177	0.481
Total catch:				
gr/dscf	0.032	0.007	0.010	0.0163
gr/acf	0.031	0.007	0.010	0.016
lb/h	0.779	0.160	0.227	0.389
lb/ton of feed	1.42	0.286	0.405	0.704

The one that was a venturi Scrubber

Note.—dscfm indicates dry standard cubic feet per minute; dscf indicates dry standard cubic feet; acf indicates actual cubic feet.

Source: *Background Information for Proposed New Source Performance Standards*, EPA Report APTD-13526, June 1973, vol. 2, appendix.

corrected to a reference base of 12 percent carbon dioxide or 6 percent oxygen. Corrections to CO_2 or O_2 baselines are not directly related to the sludge incineration rate, because of the high percentage of auxiliary fuel required. In some regulations, the CO_2 from fuel burning is subtracted from the total when determining compliance.