RESULTS OF THE JULY 11, 1983, EMISSION COMPLIANCE TEST ON THE NO. 6 INCINERATION SYSTEM AT THE MWCC METRO PLANT IN ST. PAUL, MINNESOTA

interpoll

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Submitted to:

Submitted to:

EBSP ENVIROTECH
P. O. Box 30514
St. Paul, Minnesota 55175

Attention: Bob LaLonde

Approved by:

Perry Lonnes, Ph.D.
President

Report Number 3-1571
July 15, 1983

TABLE OF CONTENTS

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (^{o}F)	degrees Fahrenheit
DIA.	diameter
FT/SEC	feet per second
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g	gram
HP	horsepower
HRS	hours
IN.	inches
IN. HG.	inches of mercury
IN. WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10^{6}BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/DSCM	milligrams per dry standard cubic meter
microns (μm)	micrometer
MIN.	minutes
ohm-cm	ohm-centimeter
PPH	pounds per hour
PPM	parts per million
PSI	pounds per square inch
SQ. FT.	square feet
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 ^{o}F (20 ^{o}C) and 29.92 IN. of mercury pressure.

1 INTRODUCTION

On July 11, 1983, Interpoll Inc. personnel conducted a particulate and odor emission compliance test on the No. 6 incinerator at the Metropolitan Waste Control Commission Metro Plant located in St. Paul, Minnesota. On-site testing was performed by a two-man team under the direction of S. Olson. Coordination between testing activities and plant operation was provided by Ernie Carlson. The test was witnessed by Joe Miceli of Accurex for the Environmental Protection Agency and Martin Osborn and Ray Bissonette of the Minnesota Pollution Control Agency.

The No. 6 Sludge Incinerator system consists of an EBSP furnace designed to incinerate up to 3.5 DRY TONS/HR of sludge. The furnace outlet temperature is maintained at 1200 to 1400 ^{o}F for odor control. Auxiliary fuel for sludge incineration may be either No. 2 fuel oil or natural gas. Hot gases from the furnace are quenched in the precooler to approximately 220 ^{o}F. The gas temperature is further reduced in the downstream venturi scrubber (for particulate control) to approximately 172 ^{o}F. A subcooler further cools the flue gas to about 70-120 ^{o}F before the gas is reheated (reheater operated with 15 PSIG steam) to 172 ^{o}F. The reheated gas stream then passes through the I.D. fan which further heats the gas stream to about 220 ^{o}F before discharge through the 39-inch diameter stack.

During this test, the furnace was fired at 3.6 DRY TONS/HR. The dry firing rate was estimated from the wet firing rate and a total solids analysis of a composite sludge sample collected during the particulate emission compliance test.

Particulate determinations were performed in accordance with EPA-Methods 1-5 and 9, CFR Title 40, Part 60, Appendix A (Revised July 1, 1982) and APC-28. A preliminary determination of the gas velocity

profile was made before the first particulate run to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. An Interpoll sampling train which meets or exceeds specifications in the above-cited reference was used to isokinetically extract particulate samples by means of a heated glass-lined probe.

Simultaneously with each particulate determination, an integrated flue gas sample was extracted using a specially designed gas sampling system. Flue gas samples were collected in 44-liter Tedlar or Teflon bags. In order to insure the integrity of each test bag, the oxygen concentration of the collected bag sample was measured on-site with a Teledyne Model 320P oxygen analyzer. After the samples were returned to Interpoll's laboratory for Orsat analysis, the oxygen concentration of the bag sample was measured again with a laboratory Teledyne oxygen analyzer.

Testing on the No. 6 Incinerator was conducted from two test ports on the stack oriented at 90 degrees, approximately 6 diameters downstream of a rectangular to round transition and 2.5 diameters upstream of the stack outlet. A 24-point traverse was used to extract representative flyash samples. Each traverse point was sampled 2.5 minutes to give a total sampling time of 60 minutes per run.

Odor evaluations were also performed from the stack test site in accordance with ASTM 1391-57 as modified by Benforado et al and APC 9. Odor samples were collected from the stack using 7-liter Tedlar bags. The bag samples were returned to the laboratory and analyzed immediately by an experienced in-house six-member odor panel.

The important results of the test are summarized in Section 2. Detailed results are presented in Section 3. Results of preliminary measurements, field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The important results of the particulate emission test on the No. 6 Incinerator are summarized in Table 1. As will be noted, the particulate emission factor averaged 0.85 LB/TON dry sludge input. Federal new source performance standards limit emissions from sources of this type to 1.3 LB/TON dry sludge input (CFR Title 40, Part 60, Subpart O). The odor concentration averaged 59 odor units/SCF with a corresponding average emission rate of 1.0 10^6O.U./MIN. It should be noted that most of the panel members independently described the odor as pleasant and chlorine-like in nature (see Appendix F).

No difficulties were encountered in the field or in the laboratory evaluation of the flue gas and particulate samples. On the basis of this fact and a complete review of the entire data and results, it is our opinion that the particulate and odor concentrations, emission rates and emission factors reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

Table 1. Summary of the Results of the July 11, 1983 Particulate Emission Compliance Test on the No. 6 Incinerator located at the MWCC Metro Plant in St. Paul

ITEM	RUN 1	RUN 2	RUN 3
Time of test (HRS)	0810/0912	0940/1043	1105/1210
Sludge burning rate (TONS/HR)			
WET	11.17	11.17	11.17
DRY	3.61	3.61	3.61
Volumetric flow			
ACTUAL (ACFM)	21700	24900	25600
STANDARD (DSCFM)	15400	18900	19300
Gas temperature (DEG-F)	187	188	189
Moisture content (% v/v)	10.55	3.79	4.57
Gas composition (% v/v dry)			
carbon dioxide	10.00	10.00	10.40
oxygen	9.40	9.30	9.40
nitrogen	80.60	80.70	80.20
Oxygen analyzer (% v/v, dry)	9.77	9.69	9.97
Isokinetic variation (%)	102.5	93.9	98.1
Particulate mass rate (LB/HR)*	2.4	3.5	3.3
Particulate concentration*			
ACTUAL (GR/ACF)	.013	.016	.015
STANDARD (GR/DSCF)	.018	.021	.020
Emission factor* (LB/TON dry sludge)	.66	.96	.92

* Dry catch plus organic wet catch

Table 2. Summary of the Results of the July 11, 1983, Odor Emission Test on the No. 6 Incinerator System.

	Odor Concentration (O.U./DSCF)	Odor Emission Rate (10^6 O.U./MIN.)
Run 1	100	1.54
Run 2	40	0.76
Run 3	38	0.73
Average	59	1.0

Standard is 1 X 10^6

3 RESULTS

The results of all field and laboratory evaulations are presented in this section. Gas composition results (Orsat and moisture) are presented first; followed by the computer printout of particulate and visible emission data and the results of the odor concentration determinations. Preliminary measurements including traverse point description are given in Appendices A and B.

The results have been calculated on a DEC PDP-11 Computer using standard Fortran programs. EPA-published equations have been used as the basis of the calculation techniques in these programs. It should be noted in interpreting these results that the particulate emission rates have been calculated by both the "concentration x flow" and the "ratio of areas" methods and the average reported. The average is the best estimate of the true value, since the bias introduced by anisokinetic sampling is approximately equal but of opposite sign in the two calculation techniques and thus cancels in the average.

Test No. 1
No.6 Incinerator Stack

3.1 Results of Orsat & Moisture Analysis -- Methods 3 & 4 (% v/v)

	Run 1	Run 2	Run 3
Date of run	07/11/83	07/11/83	07/11/83
Dry basis (orsat)			
carbon dioxide	10.00	10.00	10.40
oxygen	9.40	9.30	9.40
carbon monoxide	.00	.00	.00
nitrogen	80.60	80.70	80.20
Wet basis (orsat)			
carbon dioxide	8.94	9.62	9.92
oxygen	8.41	8.95	8.97
carbon monoxide	.00	.00	.00
nitrogen	72.10	77.64	76.53
Moisture content	10.55	3.79	4.57
Dry molecular weight	29.98	29.97	30.04
Wet molecular weight	28.71	29.52	29.49
Specific gravity (relative to air)	.9918	1.0196	1.0186
Teledyne oxygen analyzer (velocity & time weighted avg.)	9.77	9.69	9.97
FO	1.15	1.16	1.11

Test No. 1
No.6 Incinerator Stack

3.2 Results of Particulate Loading Determinations -- Method 5(BE)

	Run 1	Run 2	Run 3
Date of run	07/11/83	07/11/83	07/11/83
Time run start/end (HRS)	0810/0912	0940/1043	1105/1210
Pitot tube coefficient	.853	.853	.853
Water in sample			
condensate (ml)	83.0	24.0	30.0
silica gel (grams)	11.5	11.5	16.0
Total particulate material collected (grams) *	.0443	.0588	.0590
Meter correction coefficient	1.0047	1.0047	1.0047
Volume through gas meter			
at meter conditions...(CF)	40.54	45.25	48.17
standard conditions..(SCF)	37.72	42.44	45.23
Total sampling time (MIN)	60.0	60.0	60.0
Nozzle diameter (IN)	.246	.246	.246
Average stack gas temperature during determination (DEG-F)	187	188	189
Volumetric flow			
actual.....(CFM)	21745	24881	25623
standard.....(DSCFM)	15407	18908	19304
Isokinetic variation (%)	102.5	93.9	98.1
Particle concentration			
actual.....(GR/ACF)	.0129	.0163	.0152
dry standard.....(GR/DSCF)	.0181	.0214	.0201
Particle mass flow (LB/HR)	2.39	3.46	3.33

* Dry Catch Plus Organic Wet Catch

Test No. 1
No.6 Incinerator Stack

3.3 Results of Opacity Observations - EPA Method 9

Percent Opacity	Optical Density	Relative Frequency (%)
0	.0000	12.08
5	.0223	86.67
10	.0458	1.25
15	.0706	.00
20	.0969	.00
25	.1249	.00
30	.1549	.00
35	.1871	.00
40	.2219	.00
45	.2596	.00
50	.3010	.00
55	.3468	.00
60	.3979	.00
65	.4559	.00
70	.5229	.00
75	.6021	.00
80	.6990	.00
85	.8239	.00
90	1.0000	.00
95	1.3010	.00
99	2.0000	.00
4.46	.01990	Time Average

Observer: J. Stock
Cert. Date: 6/23/83
Date of Observation: 7/11/83
Time of Observation: 0950-1050

APPENDIX A

RESULTS OF PRELIMINARY MEASUREMENTS

Test No. 1
No.6 Incinerator Stack

Results of Flow Determination -- Method 2

Time and date	0810 hrs. 07/11/83
Barometric pressure (uncompensated, in. Hg)	29.00
Pitot tube coefficient	.853
Number of sampling ports	2
Total number of points sampled	20
Duct or stack diameter (IN)	39.0
Cross sectional area (SQ FT)	8.30
Direction of flow	vertical, up
Static pressure (IN WC)	.80
Average gas temperature (DEG-F)	187
Absolute gas pressure (IN HG)	29.06
Average moisture content (% v/v)	6.30
Average linear velocity (FT/SEC)	43.3
(standard deviation, FT/SEC)	5.6
Volumetric flow	
actual (ACFM)	21542
dry standard (DSCFM)	15988
Mass flow of gas - wet (LB/HR)	77767

Test No. 1
No.6 Incinerator Stack

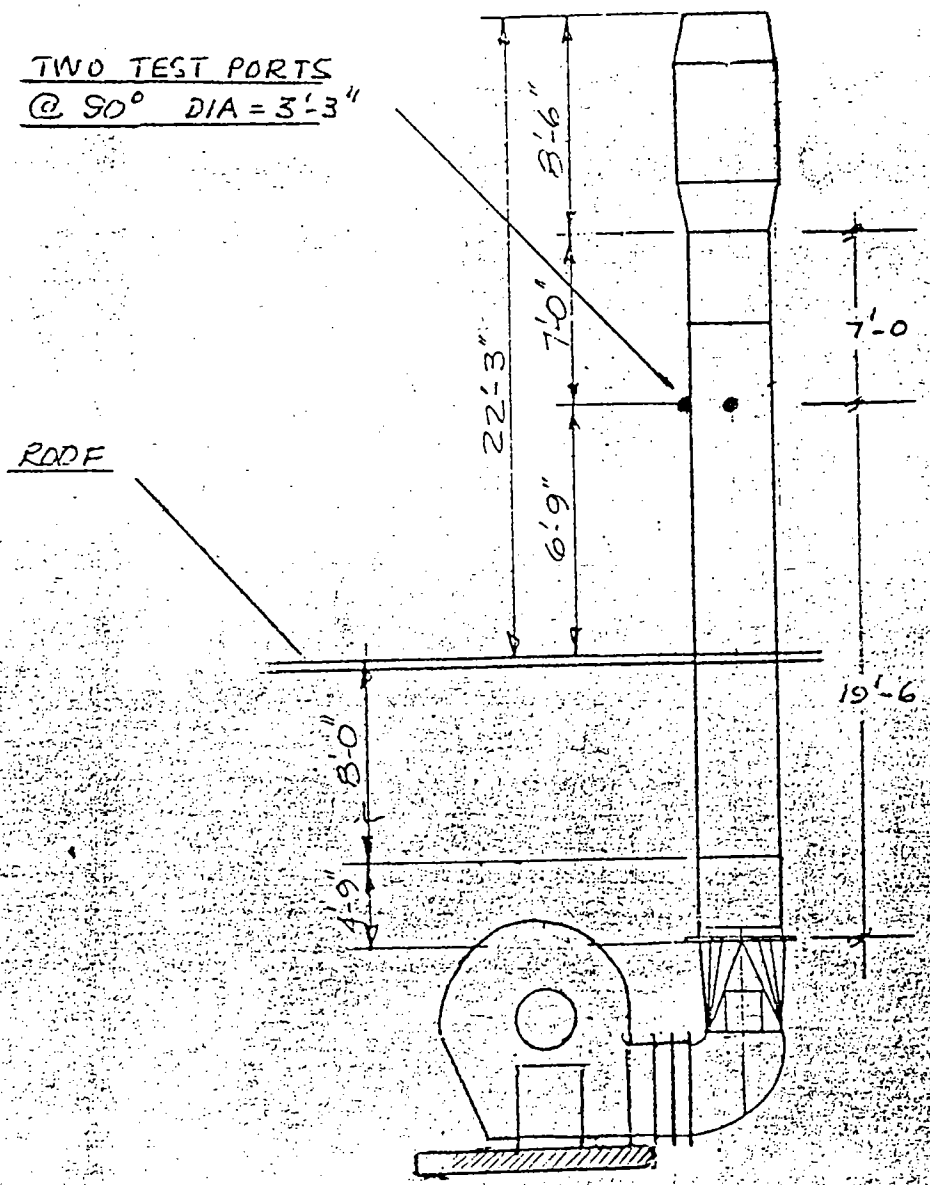
Appendix A -- Point Velocity and Temperature Data

Port/Point	Gas Temperature (DEG-F)	Linear Velocity (FT/SEC)
A/ 1	190	36.7
A/ 2	190	34.9
A/ 3	190	36.7
A/ 4	190	34.9
A/ 5	188	37.7
A/ 6	188	37.7
A/ 7	190	40.4
A/ 8	190	41.4
A/ 9	188	42.7
A/10	188	42.7
B/ 1	185	44.9
B/ 2	185	50.8
B/ 3	180	51.8
B/ 4	180	50.6
B/ 5	180	50.6
B/ 6	188	48.1
B/ 7	188	45.9
B/ 8	188	44.6
B/ 9	188	46.4
B/10	188	45.9

APPENDIX B

LOCATION OF TEST PORTS AND TRAVERSE POINTS

MWCC METRO PLANT
NO 6 INCINERATOR STACK



LP 7/83

NOTE: MUFFLER NOT IN PLACE @ THE TIME OF THE COMPLIANCE TEST.

(879)

MINNESOTA POLLUTION CONTROL AGENCY
Air Quality Division

PERFORMANCE TEST EVALUATION REPORT

I. DESCRIPTION

SOURCE: MWCC Unit 6 FILE: 879

LOCATION: Pigs Eye - St. Paul

Tested BY: Interpoll DATE: July 11, 1983 of test

II. COMPLIANCE DETERMINATION

Analysis of the performance test indicates the following has been demonstrated:

Parameter	Compliance	Non-Compliance	Not Determined
TSP	x		
SO_2			x
NO_x			x
V.E.	x		
Acid Alkalines			x
Odor	x		
Other			x

standard = 1.3 lb/dry ton

Explanation of Non-Compliance / DISCUSSION :-

The Number 6 incinerator was re-tested on July 11th after installation of a new stack. The new stack increased the linear velocity from less than 10 ft/sec. to 43 ft/sec. making the test much more reliable. Particulate emissions were found to be 0.85 lb/ton, V.E. was 0-10% (86% @ 5). Odors were found to average 59 O.U./ft³ and 1.0 X 10⁶ O.U./min. (wet catch was included in the reported results.)

III. MAJOR DEFICIENCIES IN TEST REPORT

(Back half was included)
Exhibit C missing
No info in the report about scrubber operation during the test. very little info on production (eg type of sludge etc)
(Bryce Pickhart will supply additional info. for permit processing.)

IV. RECOMMENDATIONS

A. Source in Compliance

Recommendations for special conditions in the operating permit:

(same as other 5 incinerators)
contact Bryce Pickhart.

B. Source not in Compliance

Recommendations for action:

Date 1-10-0-

Name of Panel Member Rae C Vigeant

Test No. 1

Sample No.	Response	
1	(Y)	N
2	(Y)	N
3	Y	(N)
4	Y	(N)
5	Y	(N)
6	(Y)	N
7	Y	N
8	Y	N
9	Y	N
10	Y	N

Test No. 2

Sample No.	Response	
1	Y	(N)
2	Y	(N)
3	Y	(N)
4	Y	(N)
5	Y	(N)
6	(Y)	N
7	Y	(N)
8	Y	N
9	Y	N
10	Y	N

Test No. 3

Sample No.	Response	
1	(Y)	N
2	(Y)	N
3	(Y)	N
4	Y	(N)
5	(Y)	N
6	(Y)	N
7	Y	N
8	Y	N
9	Y	N
10	Y	N

Test No. _____

Sample No.	Response	
1	Y	N
2	Y	N
3	Y	N
4	Y	N
5	Y	N
6	Y	N
7	Y	N
8	Y	N
9	Y	N
10	Y	N

S-0032

APPENDIX G

PROCESS RATE DOCUMENTATION

(As submitted to Interpoll)

INCINERATOR NO. 2

OPERATOR	TIME	ON TIR	+15	+30	+45	EMA
	0000					
	0100					
	0200					
	0300					
	0400					
	0500					
	0600					
	0700			173598	173823	
	0800	174145	174461	174641	174915	
	0900	175139	175450	175712	176017	
	1000	17817	176565	176870	177203	
	1100	177457	177808	178145	178405	
	1200	178743	179087			
	1300					
	1400					
	1500					
	1600					
	1700					
	1800					
	1900					
	2000					
	2100					
	2200					
	2300					
	AVE.					

179087
174145
00494
X0.96
29652
44478
474432

4.744 | 4.25
425 | 11.16
494
425
690
425
2750

Avg Feed rate in Ton/Hr →
11.17