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ENVIRONMENTAL PROTECTION AGENCY

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RESULTS OF THE MAY 23, 1983,
EMISSION COMPLIANCE TEST
ON THE NO. 9 INCINERATION SYSTEM
IN THE F & I 2 BUILDING AT THE
MWCC METRO PLANT IN
ST. PAUL, MINNESOTA

Submitted to:

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Report Number 3-1526
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President

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INTRODUCTION

On May 23, 1983, Interpoll Inc. personnel conducted a particulate and odor emission compliance test on the No. 9 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 Dr. P. Lonnes. Coordination between testing activities and plant operation was provided by Dr. P. Lonnes via radio. The test was witnessed by Marty Osborn of the Minnesota Pollution Control Agency, Air Quality Division.

The No. 9 Sludge Incinerator System consists of an EBSP furnace designed to incinerate up to 23,000 LB/HR of sludge. The furnace outlet temperature is maintained at 1200 °F or higher for odor control. Auxiliary fuel for sludge incineration may be either No. 2 fuel oil or natural gas. A quad cyclone system at the furnace outlet removes large particulate material which serves to protect the tubes in the waste heat recovery boiler which may produce up to 32,700 LB/HR of saturated steam (400 PSIG) which in turn is used to drive a steam turbine. When the waste heat boiler is off-line, the system employs an evaporative cooler to reduce flue gas temperatures to 500 °F, the design temperature for the precooler which combined with the downstream venturi scrubber (for fine particulate control) reduce the flue gas temperatures to approximately 172 °F. A subcooler further cools the flue gas to about 120 °F before the gas is reheated (reheater operated with 15 PSIG steam) to 220 °F for discharge through the ID fan and jacketed stack to the atmosphere.

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. 9 Incinerator was conducted from two test ports on the stack oriented at 90 degrees, approximately 0.5 diameters downstream of an egg crate flow straightener and two diameters upstream of the stack outlet. A 16-point traverse was used to extract representative flyash samples. Each traverse point was sampled four minutes to give a total sampling time of 64 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.

SUMMARY AND DISCUSSION

The important results of the particulate emission test on the No. 9 Incinerator are summarized in Table 1. As will be noted, the particulate emission factor averaged 0.56 LB/TON dry sludge input. The odor concentration averaged 113 odor units/SCF with a corresponding emission rate of 2.3×10^6 O.U./MIN.

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 May 23, 1983 Particulate Emission Compliance Test on the No 9 Incinerator Stack at the MWCC Metro Plant Located in St. Paul, Minnesota

ITEM	RUN 1	RUN 2	RUN 3
Time of test (HRS)	1146/1253	1310/1418	1434/1540
Sludge burning rate (TONS/HR)			
NET	11.53	11.53	11.53
ORG	3.50	3.50	3.50
Volume flow			
ACTUAL (ACFM)	27200	26200	25700
STANDARD (DSCFM)	21100	20500	19900
Gas temperature (DEG-F)	187	192	193
Moisture content (% v/v)	3.49	3.96	4.70
Gas composition (% v/v dry)			
carbon dioxide	7.80	7.20	7.00
oxygen	12.20	12.80	12.60
nitrogen	80.00	80.00	80.40
Oxygen analyzer (% v/v, dry)	11.47	11.81	11.22
Isokinetic variation (%)	100.6	101.7	102.4
Particulate mass rate (LB/HR)	2.00	1.94	1.92
Particulate concentration			
ACTUAL (GR/ACF)	.0086	.0087	.0088
STANDARD (GR/DSCF)	.011	.011	.011
12 % CO2 (GR/DSCF)	.013	.015	.015
(LB/TON dry sludge input)	.57	.55	.55

Table 2. Summary of the Results of the May 23, 1983, Odor Emission Test on the No. 9 Incinerator System.

	Odor Concentration (O.U./DSCF)	Odor Emission Rate (O.U./MIN.)
Run 1	94	2.0
Run 2	125	2.6
Run 3	120	2.4
Average	113	2.3

The results of all field and laboratory evaluations 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 results of 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 9 Incinerator Stack.

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

	Run 1	Run 2	Run 3
Date of run	05/23/83	05/23/83	05/23/83
Dry basis (orsat)			
carbon dioxide	7.80	7.20	7.00
oxygen	12.20	12.80	12.60
carbon monoxide	.00	.00	.00
nitrogen	80.00	80.00	80.40
Wet basis (orsat)			
carbon dioxide	7.53	6.91	6.67
oxygen	11.77	12.29	12.01
carbon monoxide	.00	.00	.00
nitrogen	77.21	76.83	76.62
Moisture content	3.49	3.96	4.70
Dry molecular weight	29.74	29.66	29.62
Wet molecular weight	29.33	29.20	29.08
Specific gravity (relative to air)	1.0130	1.0087	1.0044
Teledyne oxygen analyzer (velocity & time weighted avg.)	11.47	11.81	11.22
FO	1.12	1.13	1.19

Test No. 1
 No 9 Incinerator Stack

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

	Run 1	Run 2	Run 3
Date of run	05/23/83	05/23/83	05/23/83
Time run start/end (HRS)	1146/1253	1310/1418	1434/1540
Pitot tube coefficient	.853	.853	.853
Water in sample			
condensate (ml)	26.0	34.0	31.0
silice gel (grams)	17.0	14.0	25.0
Total particulate material collected (grams) *	.0400	.0394	.0391
Meter correction coefficient	.9918	.9918	.9918
Volume through gas meter			
at meter conditions... (CF)	59.34	57.65	56.42
standard conditions.. (SCF)	56.00	54.82	53.49
Total sampling time (MIN)	64.0	64.0	64.0
Nozzle diameter (IN)	.186	.186	.186
Average stack gas temperature during determination (DEG-F)	187	182	183
Volumetric flow			
actual..... (CFM)	27177	26249	25651
standard..... (DSCFM)	21125	20455	19823
Isokinetic variation (%)	100.6	101.7	102.4
Particle concentration			
actual..... (GR/ACF)	.0086	.0087	.0088
dry standard..... (GR/DSCF)	.0110	.0111	.0113
Particle mass flow (LB/HR)	2.00	1.94	1.92

* Dry Catch Plus Organic Wet Catch

Test No. 1
 No 9 Incinerator Stack

3.3 Results of Opacity Observations - EPA Method 9

Percent Opacity	Optical Density	Relative Frequency (%)
0	.0000	100.00
5	.0223	.00
10	.0458	.00
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
.00	.00000	Time Average

Observer: J. Stock
 Cert. Date: 06/09/82
 Date of Observation: 5/23/83
 Time of Observation: 1400-1500