

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY CONTROL

STAPPA/ALAPCO

2.5

#122 BE 22 (6) 11/04/86 4.0

SOURCE TEST REPORT

NAME : Erie Sewer Authority, Erie, Pennsylvania

PROCESS/SOURCE TESTED : Sludge Incinerator No. 2

TEST NO. : 1981A 1981B

TEST DATE : 7/15/81 7/15/81

POLLUTANT SAMPLED : Particulate Heavy Metals

ACTUAL EMISSIONS : 0.011 gr/dscf (corrected to 12% CO₂) See Page 11

ALLOWABLE EMISSIONS : 0.10 gr/dscf (corrected to 12% CO₂) N.A.



TEST CONDUCTED BY : Richard D. Roller

REPORT PREPARED BY : Richard D. Roller

REPORT APPROVED BY : L. Blaine DeHaven

L. Blaine DeHaven 7/27/81

**ERIE SEWER AUTHORITY
ERIE, PENNSYLVANIA**

PROCESS DESCRIPTION

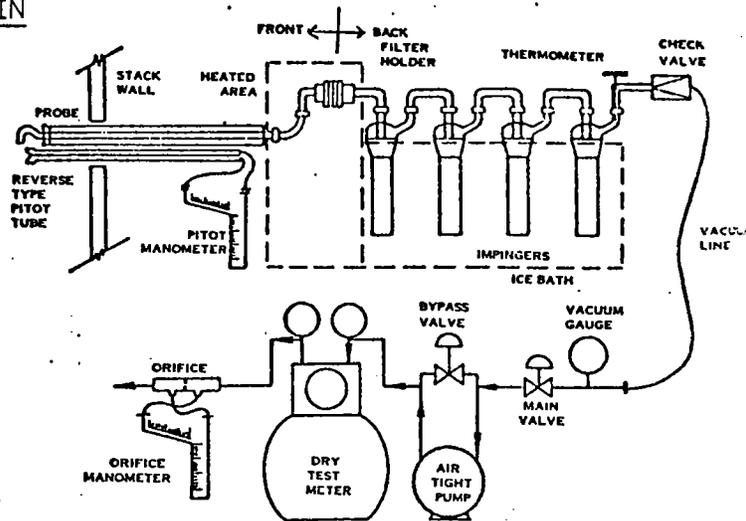
The Erie Sewer Authority operates two identical Eimco BSP multiple hearth sludge incinerators at their Erie facility. These incinerators are used to incinerate both human and industrial waste. Each furnace has a design feed rate of 22,500 lbs./hr. of wet filter cake. The normal feed rate is approximately 15,000 lbs./hr. per incinerator. Each incinerator was designed with 11 hearths. Hearths 3, 4, and 5 are each equipped with four natural gas-fired burners while hearths 7 and 9 are equipped with two burners. Test Nos. 1981A and B were conducted in the scrubber exhaust stack of Incinerator Unit No. 2.

Through a series of preliminary and secondary treatments consisting of settling tanks, aeration tanks, flotation thickeners, and chemical additives, the solids content of the sludge has been increased from 1% upon arrival at the plant to approximately 6% prior to being introduced to the three vacuum filters. These vacuum filters remove excess moisture and the resultant filter cake has now been increased to a solids content of approximately 16%. The concentrated sludge is pumped to an opening located at the top of the incinerator and is distributed onto the first hearth through a flap gate feeder. The sludge is moved by a rotating system of rakes towards an opening along the outside wall of the incinerator where it falls to the second hearth. These rakes are equipped with a cooling airchannel to prevent melting at high temperatures. The cooling air is provided by a Clarage Model 40 NH forced draft fan. Approximately 30% of the air in this totally enclosed system is recirculated onto the eighth and tenth hearths of the incinerator where it is reutilized as drying air. The remainder of the cooling air is exhausted through the warm air exhaust stack. The sludge is then raked towards an opening at the center of the second hearth. This reversal process continues with each hearth until the resultant ash reaches the eleventh hearth. The ash is screw conveyed to a hopper from which it is vacuum pumped to the ash silo. The ash is then trucked to off plant sites where it is used for such purposes as soil conditioning and in landfills.

Combustion air for the burners is provided by a North American forced draft fan rated at 7,500 cfm. Additional combustion air may be provided by a Clarage Model 66 NH forced draft fan. The hot flue gases travel countercurrent to the sludge flow and pass through 6 afterburners having a total heat input of 55,000 BTU/hr. These afterburners are rarely used. After the afterburners, the gases split with a portion being ducted through a waste heat recovery boiler and the remainder being bypassed. The percentage of the flow being bypassed is dependent upon the facility's steam need. The separate flue gas streams are then rejoined prior to being drawn through a precooler, an ARCO venturi scrubber, and an ARCO two stage impingement tray by a Clarage XL 229 induced draft fan rated at 22,000 cfm at 30 in. Hg. The total water usage is approximately 1,300 gpm and the pressure drop across the system is approximately 20 in. H₂O. From the fan the flue gases are ducted to the atmosphere through a 38 inch diameter stack having a discharge point approximately 75 feet above grade.

A process flow diagram is shown in Figure I.

SAMPLING TRAIN



Nozzle No. C-4 (Dn = 0.313 in.)

Sample Box No. 528

Probe No. 472 (Cps = 0.860)

Module No. 503

Impinger Solution: DISTILLED WATER

LABORATORY RESULTS

SAMPLE WEIGHTS (PARTICULATE)

TRAIN COMPONENT	INSOLUBLE wt.(gm)	SOLUBLE wt.(gm)
Front Half	0.0007	0.0042
Filter #50816	0.0399	
Filter #		
Filter #		
Back Half	0.0038	0.0523*
Subtotals	0.0444	0.0565
Total Less *		0.0486 gm

CONDENSATE (ml)

IMPINGER NO.	FINAL	INITIAL
1(H ₂ O)	305.0	150.0
2(H ₂ O)	185.0	150.0
3(H ₂ O)	150.0	150.0
4		
5		
Silica Gel	358.8	344.0
TOTAL (V _{lc})		204.8 ml

GAS ANALYSIS

	PRELIM.	SAMPLING
%CO	0.0	0.0
%CO ₂	6.3	6.3
%O ₂	14.2	13.0
%N ₂	79.5	80.7

CONDENSATE VOLUME

$$V_{wc} = 0.0474 \times V_{lc}$$

$$V_{wc} = 0.0474 \times 204.8 = 9.7 \text{ SCF}$$

MOISTURE BY VOLUME

$$B_{ws} = \frac{V_{wc}}{V_{wc} + V_{ms}}$$

$$B_{ws} = \frac{9.7}{9.7 + 78.0} = 11.1\%$$

DRY MOLECULAR WEIGHT

$$M_d = (\%CO \times 0.28) + (\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 \times 0.28)$$

$$M_{dp} = (0.0 \times 0.28) + (6.3 \times 0.44) + (14.2 \times 0.32) + (79.5 \times 0.28) = 29.58$$

$$M_{ds} = (0.0 \times 0.28) + (6.3 \times 0.44) + (13.0 \times 0.32) + (80.7 \times 0.28) = 29.53$$

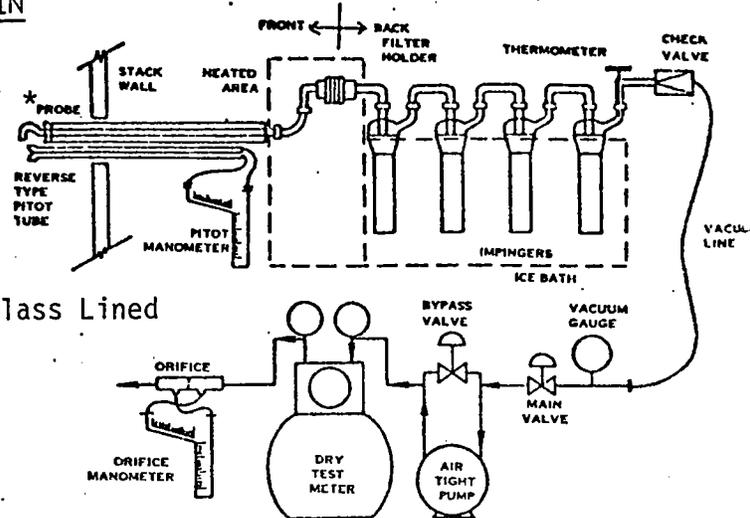
MOLECULAR WEIGHT

$$M_s = (B_{ws} \times 18.00) + (M_d \times (1 - B_{ws}))$$

$$M_{sp} = (0.111 \times 18.00) + (29.58 \times (1 - 0.111)) = 28.29$$

$$M_{ss} = (0.111 \times 18.00) + (29.53 \times (1 - 0.111)) = 28.25$$

SAMPLING TRAIN



Nozzle No. C-2 (Dn = 0.314 in.)

Sample Box No. 526

Probe No. 475 (Cps = 0.833)

Module No. 503

Impinger Solution: 0.1 N Nitric Acid

LABORATORY RESULTS

SAMPLE WEIGHTS (HEAVY METALS)

TRAIN COMPONENT	INSOLUBLE wt.(gm)	SOLUBLE wt.(gm)
Front Half		
Filter #50802		
Filter #		
Filter #	See Page 11	
Filter #		
Back Half		
Subtotals		
Total		

CONDENSATE (ml)

IMPINGER NO.	FINAL	INITIAL
1	254.0	150.0
2	178.0	150.0
3	161.0	150.0
4		
5		
Silica Gel	344.0	333.2
TOTAL (Vlc)		153.8 ml

GAS ANALYSIS

	PRELIM.	SAMPLING
%CO	0.0	0.0
%CO2	6.3	5.0
%O2	14.2	17.7
%N2	79.5	77.3

CONDENSATE VOLUME

$$V_{wc} = 0.0474 \times V_{lc}$$

$$V_{wc} = 0.0474 \times 153.8 = 7.3 \text{ SCF}$$

MOISTURE BY VOLUME (from test number 1981A)

$$B_{ws} = \frac{V_{wc}}{V_{wc} + V_{ms}}$$

$$B_{ws} = 11.1\%$$

DRY MOLECULAR WEIGHT

$$M_d = (\%CO \times 0.28) + (\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 \times 0.28)$$

$$M_{dp} = (0.0 \times 0.28) + (6.3 \times 0.44) + (14.2 \times 0.32) + (79.5 \times 0.28) = 29.58$$

$$M_{ds} = (0.0 \times 0.28) + (5.0 \times 0.44) + (17.7 \times 0.32) + (77.3 \times 0.28) = 29.51$$

MOLECULAR WEIGHT

$$M_s = (B_{ws} \times 18.00) + (M_d \times (1 - B_{ws}))$$

$$M_{sp} = (0.111 \times 18.00) + (29.58 \times (1 - 0.111)) = 28.29$$

$$M_{ss} = (0.111 \times 18.00) + (29.51 \times (1 - 0.111)) = 28.23$$

Erie Sewer Authority
Erie, Pennsylvania

Incinerator Unit No. 2
Test No. 1981 B 7/15/81

<u>Element</u>	<u>Total Weight Collected (10⁻⁶ gms.)</u>	<u>Emissions (gms./hr.)</u>
Cobalt	2.2	0.02
Manganese	49.5	0.51
Copper	149.5	1.55
Chromium	87.5	0.91
Nickel	215.5	2.24
Zinc	592.5	6.16
Lead	987.0	10.26
Cadmium	3465.5	36.04
Aluminum	0.0	0.0
Beryllium	0.0	0.0
Antimony	0.0	0.0
Tin	0.0	0.0
Asbestos	0.0	0.0

All metals were analyzed using flame atomic absorption.

Example Calculation:

$$E = (Mn/Vms)(Qsp)(60 \text{ min./hr.})$$

Where:

E = Emission, gms./hr.

Mn = Weight Collected, gms.

Vms = Volume of Gas Collected, dscf

Qsp = Volumetric Flow Rate (preliminary traverse), dscfm

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY AND NOISE CONTROL

DATE 7/15/81

PROCESS DATA

TEST NUMBER 1981A and B

NAME OF FIRM

Erie Sewer Authority, Erie, Pennsylvania

DESCRIPTION OF EQUIPMENT TESTED AND OPERATION COVERED IN TEST

Eimco BSP Multiple Hearth Sludge Incinerator No. 2

SAMPLING STATION LOCATION

Approximately 5 feet upstream of the scrubber exhaust stack exit

LENGTH OF PROCESS CYCLE Continuous TIME CYCLE BEGINS _____ ENDS _____

1981A: 9:35 a.m. 10:58 a.m.
TIME OF TEST: BEGINS 1981B: 11:50 a.m. ENDS 1:12 p.m. CYCLE COVERAGE Complete

RAW MATERIAL CHARGED DURING THIS TIME:

Test No.	1981A	1981B
MATERIAL <u>Sludge</u> WT(LBS.)	<u>19,365*</u>	<u>19,135*</u>
MATERIAL _____ WT(LBS.)		
FUEL CHARGED <u>Natural Gas</u> ft. ³	<u>23,730</u>	<u>20,700</u>
TOTAL POUNDS _____ WT(LBS.)		

COLLECTION EQUIPMENT TYPE

Arco venturi scrubber
Arco two stage impingement tray

PLANT OFFICIAL AND TITLE

Mr. Alois Zasada, Chief, Bureau of Sewers

ADDITIONAL COMMENTS

*Approximate value based upon operator's data recorded between 7:00 a.m. and 1:00 p.m.

During Test Nos. 1981A and B the solids content of the sludge leaving the vacuum filters was approximately 15.3 and 15.1%, respectively.

Erie Sewer Authority
Erie, Pennsylvania

Process Data

Test Nos. 1981A and B 7/15/81
Incinerator Unit No. 2

TEMPERATURES, OF

Time	Hearth											Shaft		Afterburner		Boiler		Precooler		Venturi		Scrubber	
	1	2	3	4	5	6	7	8	9	10	11	Air Outlet	Outlet	Outlet	Outlet	Inlet	Inlet	Outlet	Outlet	Outlet	Outlet		
9:35 AM	815	825	1059	1094	1308	1384	1425	1344	1217	739	179	354	742	324	289	143	115						
9:45	824	832	1076	1107	1266	1330	1581	1439	1402	1119	191	353	745	325	286	150	123						
9:55	840	849	1091	1120	1200	1270	1735	1569	1515	1211	209	354	750	321	278	150	125						
10:05	832	850	1101	1136	1242	1338	1797	1628	1480	1045	230	355	750	320	276	149	124						
10:15	837	848	1104	1140	1319	1445	1776	1573	1474	1042	245	357	753	320	275	149	123						
10:25	843	852	1118	1154	1299	1391	1621	1544	1478	1165	234	360	757	321	276	147	122						
10:35	858	868	1173	1199	1519	1646	1617	1478	1455	1165	223	364	775	319	267	148	123						
10:45	860	880	1173	1219	1478	1594	1538	1414	1416	1169	214	370	771	320	274	143	118						
10:55	861	884	1179	1213	1459	1582	1500	1365	1401	1156	209	373	772	320	275	143	123						
11:50	886	927	1220	1300	1556	1571	1424	1311	1394	1166	202	392	793	320	274	136	108						
12:00 N	881	916	1198	1288	1516	1537	1374	1278	1374	1155	194	394	791	320	278	134	110						
12:10	865	898	1176	1252	1451	1477	1317	1249	1362	1148	188	393	780	320	278	135	111						
12:20	848	881	1160	1215	1410	1463	1292	1228	1364	1144	183	390	771	321	282	134	110						
12:30	839	871	1133	1183	1387	1462	1282	1221	1353	1132	180	386	764	321	283	133	110						
12:40	821	837	1083	1119	1350	1448	1281	1213	1351	1136	177	381	751	322	287	133	110						
12:50	809	826	1065	1094	1269	1369	1292	1214	1350	1138	178	376	744	321	286	134	112						
1:00	817	835	1086	1118	1257	1326	1659	1339	1348	1137	182	372	747	323	282	143	120						
1:10	825	849	1083	1109	1330	1397	1722	1428	1376	1160	188	370	751	321	274	147	124						

Time	Auxiliary Air	Shaft Cooling Air	Afterburner Outlet	Venturi Pressure Drop	Incinerator I.D. Fan Inlet	Incinerator I.D. Fan Outlet	Hearth No. 11	Precooler	Venturi	Impingement Tray	Spray	CO2 READING
												PERCENT*
9:35 AM	2.1	7.2	0.160	9.0	16.5	25	0.14	83	300+		24	10.0
9:45	2.1	7.2	0.155	11.1	20.0	26	0.14	83	300+	Gauge	24	11.0, 13.0, 13.0
9:55	2.1	7.3	0.155	9.0	17.0	26	0.16	83	300		24	11.5, 12.0
10:05	2.1	7.2	0.155	8.7	17.0	25	0.16	83	300	not	24	12.5, 12.5
10:15	2.1	7.2	0.155	8.5	17.0	26	0.16	84	300+		24	11.0, 12.0
10:25	2.1	7.1	0.155	6.6	17.0	26	0.16	84	300+	working	24	10.5, 11.5
10:35	2.1	7.2	0.155	9.3	19.0	28	0.13	83	300+		24	12.0, 12.5
10:45	2.1	7.1	0.155	9.1	17.0	25	0.17	83	300+		24	9.5, 9.5
10:55	2.1	7.1	0.155	9.0	17.0	25	0.17	83	300+		24	8.5, 9.0
11:50	2.1	7.1	0.150	7.8	15.0	24	0.20	83	300+		24	
12:00 N	2.1	7.1	0.150	7.0	14.0	23	0.20	84	300+		24	
12:10	2.0	7.1	0.160	7.0	14.0	23	0.20	84	300+		24	
12:20	2.1	7.1	0.160	7.0	14.0	23	0.20	84	300+		24	
12:30	2.1	7.1	0.160	7.1	14.0	23	0.21	84	300+		24	
12:40	2.1	7.1	0.155	7.0	13.5	22	0.20	83	300+		24	
12:50	2.1	7.1	0.160	7.0	14.0	23	0.21	83	300+		24	
1:00	2.1	7.1	0.165	8.1	17.0	26	0.13	84	300+		24	
1:10	2.1	7.1	0.165	9.0	17.5	27	0.11	84	300+		23	

*These readings were obtained using a tyrite analyzer at the outlet of the incinerator and were used to correct the emission concentration to 12% CO2.