BAY COUNTY, FLORIDA, WASTE-TO-ENERGY FACILITY AIR EMISSION TESTS

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ABSTRACT

Air emissions were measured at the Bay County Waste-to-Energy Plant in Panama City, Florida. Concentrations for particulate and gaseous emissions were measured using test methods established by the U.S. Environmental Protection Agency (EPA) or by using continuous emission monitors.

The Bay County Facility is a 510 TPD facility that uses two Westinghouse-O'Connor combustors and boiler trains to recover energy to generate approximately 11.5 MW of electricity. Each water-walled rotary combustor is designed to mass burn 255 tons of municipal solid waste (MSW) per day or a mixture of MSW and wood chips. Each train is equipped with an electrostatic precipitator to remove particulate matter to meet the Florida DER permit conditions.

The plant began burning MSW during the spring of 1987. Emission compliance tests conducted in May and June, 1987 showed that the facility met the permit requirements of the Florida Department of Environmental Regulations.

INTRODUCTION

The Bay County Resource Management Center is located 10 miles Northeast of Panama City, Florida. Panama City is a resort community approximately 100 miles east of Pensacola, Florida, on the northwest coast of Florida's panhandle. The average population of this area is approximately 115,000. The average quantity of municipal solid (MSW) waste generated in Bay County during most of the year is 300 TPD. However, during the summer months when the population increases to more than 150,000, the community must handle in excess of 350 TPD of MSW. The County decided to design the facility to ultimately burn 510 tons of MSW to allow additional waste to be processed as the population and quantity of waste increases. Until other sources of MSW are procured, the facility is supplementing the 350 TPD of MSW with about 160 TPD of wood waste.

The facility began initial start-up, equipment checkout, and instrument calibration in February 1987. Plant shakedown and systems operational checks were made from February through May. Emission testing was conducted from late April through early June. The emission compliance tests were completed on June 4–5, 1987. The facility acceptance test and emission compliance test were completed five months ahead of the original project schedule.

FACILITY DESCRIPTION

The Bay County Resource Management Facility uses two Westinghouse-O'Connor water-walled rotary combustors to mass burn up to 510 TPD of MSW.

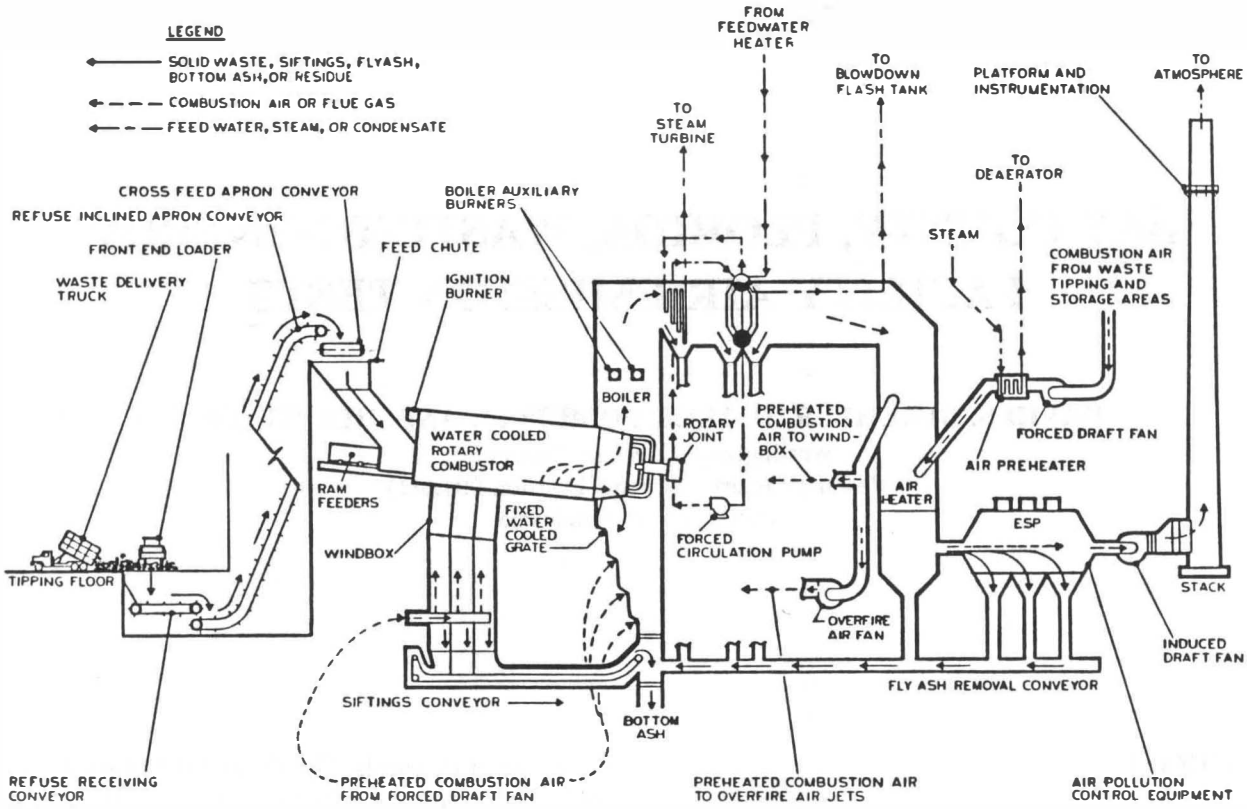

FIG. 1 SIMPLIFIED PROCESS FLOW DIAGRAM, GAS CYCLE FOR THE WESTINGHOUSE-BAY RESOURCE MANAGEMENT CENTER

The combustors can also burn a mixture of MSW and wood waste. Heat generated by the combustion of waste produces steam to drive a turbine generator. A process flow diagram of the Bay County facility is shown in Fig. 1.

The plant consists of two combustor/boiler units, a turbine-generator, a truck scale, tipping floor, front end loaders, conveyors, electrostatic precipitators, a stack, ash handling equipment, a central control room, and all required ancillary equipment. The facility also includes administration offices, change rooms, parking areas, roadways, and security fencing.

The heat released from the combustion process is recovered through the rotary combustor walls, boiler water walls and tubes, primary and secondary superheater, and the air preheater. Hot gases, produced during the combustion process, flow from the combustor barrel through the boiler's radiant, superheater, and convection sections. To maximize energy recovery and expedite combustion of high-moisture waste, the combustion gases exiting the convection section pass through a heat exchanger that preheats the incoming combustion air.

The flue gases from the air heater enter the electrostatic precipitator (ESP) to remove particulate matter before exiting the stack. The ESPs are arranged into three mechanical fields, each with its own electrical field and ash removal hopper. The ESPs are designed to meet the Florida Department of Environmental Regulations permit condition for particulate matter of 0.03 gr/dscf corrected to 12% CO_2. Figure 2 contains specific design details and the design operating conditions for the ESP.

The flue gas is drawn from the ESP by an induced draft fan before being discharged to the atmosphere through a separate flue in the common stack. The stack is made of precast concrete with two 4½ ft. diameter flues that are constructed of 4-in. thick acid resistant bricks. The stack is 125 ft tall and has air emissions monitoring ports located 60 ft from the stack base.

Fields: 3 (identical size)
Discharge Electrodes: Rigid Frame

Plate Dimensions: 24 ft. high by 9 ft. long

Collection Plate Area: 19,710 ft^2

Specific Collection Area (SCA): 350 ft^2/1000 acfm

Design Gas Flow Rate: 56,000 acfm @ 400°F

Gas Velocity through ESP and Gas
Retention Time: 4 ft/sec; 9.7 sec.

TR Sets: 3 per ESP rated at 23.5 KVA (55 KV, 300 mA)

Corona Density: 330 watt/1000 acfm; 0.94 watt/ft^2

Pressure Drop: 1 in. H_2O

Design Pressure: ± 15 in. H_2O

FIG. 2 ESP DESIGN INFORMATION FOR BAY COUNTY W-T-E FACILITY

EMISSION COMPLIANCE TEST RESULTS

Emission tests for determining the particulate matter concentration were conducted by a third-party stack testing firm from April 22 through June 5, 1987. The results of scheduled testing indicate that both Units 1 and 2 are in compliance with the particulate and visual emission levels required by the State of Florida Department of Environmental Regulations. The Method 5 particulate measurements conducted for determining compliance on June 4 and 5 are given in Table 1. The particulate matter concentration levels at the design capacity of 255 tons of MSW per day per unit averaged 0.0193 gr/dscf at 12% CO_2 for Unit 1 and 0.0243 gr/dscf at 12% CO_2 for Unit 2. Method 9 opacity measurements were consistently at or less than 10% for both units during the test runs. Additional testing, conducted at the plant for verification and troubleshooting purposes, are listed in Table 2. The results confirm the low emission levels measured during the compliance test runs indicating an average particulate emission concentration from Unit 1 of 0.0229 gr/dscf at 12% CO_2 and 0.0196 gr/dscf at 12% CO_2 from Unit 2. The air quality compliance tests clearly demonstrate that the plant meets the air quality permit conditions established by the Florida Department of Environmental Regulations. These conditions require particulate matter emissions to be less than 0.03 gr/dscf corrected to 12% CO_2 and limits plume opacity to no more than 10%. All emission tests conducted at the Bay County facility were performed while burning MSW only with the exception of a single particulate matter test run which was conducted while burning both MSW and wood waste.

The data in Tables 1 and 2 show the variation in particulate matter emissions during typical, every day facility operations. The particulate matter emission levels shown in the tables range from a low of 0.0157 to a high of 0.0355 gr/dscf at 12% CO_2. The high value exceeds the low value by a factor of 2.25 and also exceeds the overall mean value by a factor of 1.7. Since emission compliance is typically determined by the average of a one-time test consisting of three individual test runs, it can not be assumed that the emission results of this one time test would be at the low end of the data base day in and day out over the 20 to 25 year operating life of the facility. Therefore, facilities are typically designed with air pollution equipment to achieve emission levels that meet the permit conditions for the life of the facility.

GASEOUS EMISSION TESTING

Gaseous emissions testing was conducted from April through June to determine the stack gas concentrations of SO_2, NO_x, and HCl while CO testing was performed from November of 1987 to January 1988. The testing was conducted to verify the emission factors used to project emission rates in the PSD permit application.

The SO_2 emissions were determined using U.S. EPA Reference Method 8. The results of nine tests performed on five days are contained in Table 3. The average flue gas SO_2 concentration was 111 ppm_{dv}, corrected to 12% CO_2.

NO_x emissions were measured continuously using a Theta Sensor CEM over a 9-day test program. NO_x levels measured by the CEM were verified during an 8-hr period by simultaneously sampling using EPA Reference Method 7. Table 4 contains the 8-hr NO_x emissions data showing the average NO_x levels measured by the CEM and EPA Method 7. The average NO_x emission values from the CEM and Reference Method 7 were 180 and 157 ppm_{dv} corrected to 12% CO_2, respectively, for the 8-hr test. NO_x emissions measured by the CEM during the 9-day test period were in the range of 150–200 ppm_{dv} with a maximum of 300 ppm_{dv}.

TABLE 1 EMISSION COMPLIANCE TEST RESULTS FROM THE BAY COUNTY RESOURCE MANAGEMENT CENTER

Bay County Compliance Test Results - Unit 1

Date	Time	Flue Gas Flow kdscfm	Flue Gas Flow kacfm	Stack Temp deg F	Steam Flow klb/hr	Percent of Rated Capacity	Particulate Matter gr/dscf @ 12% CO_2
6/5	959	25.8	52.4	425.0	71.1	104.5	0.0140
6/5	1140	27.9	55.1	429.0	66.5	97.8	0.0240
6/5	1307	25.8	52.8	427.0	65.0	95.6	0.0200
AVERAGE					67.5	99.3	0.0193

Bay County Compliance Test Results - Unit 2

6/4	945	27.7	52.6	429.0	69.7	102.5	0.0250
6/4	1310	28.4	58.1	449.0	62.7	92.2	0.0190
6/4	1525	29.2	59.0	451.0	62.3	91.6	0.0290
AVERAGE					64.9	95.4	0.0243

TABLE 2 ADDITIONAL TEST RESULTS FROM THE BAY COUNTY RESOURCE MANAGEMENT CENTER

Bay County Additional Test Results - Unit 1

Date	Time	Flue Gas Flow kdscfm	Flue Gas Flow kacfm	Stack Temp deg F	Steam Flow klb/hr	Percent of Rated Capacity	Particulate Matter gr/dscf @ 12% CO_2
4/22	1436	25.0	45.5	373.0	58.6	86.2	0.0176
4/22(1)	1652	25.9	50.3	387.0	70.4	103.5	0.0279
4/27	1505	24.9	48.1	441.0	68.9	101.3	0.0265
4/29	1214	19.9	39.0	441.0	61.1	89.9	0.0252
5/20	1542	29.8	49.8	426.0	70.4	104	0.0256
6/1	1903	25.5	51.2	426.0	64.0	94.1	0.0177
6/1	2029	23.7	52.3	436.0	57.2	84.0	0.0195
AVERAGE					64.4	94.7	0.0229

Bay County Additional Test Results - Unit 2

4/23	925	28.9	56.8	422.0	64.0	94.1	0.0161
4/23	1148	24.3	48.2	422.0	65.6	96.5	0.0215
4/23	1356	23.4	45.4	405.0	62.6	92.1	0.0192
4/30	957	27.4	51.7	427.0	NO DATA	NO DATA	0.0167
5/12	1350	25.7	54.2	437.0	76.0	112	0.0246
5/13(2)	1635	23.7	48.2	408.0	72.0	106	0.0355
5/14	826	25.3	51.3	421.0	80.0	118	0.0157
5/21	1016	34.1	57.3	431.0	72.6	107	0.0172
5/21(3)	1705	30.6	50.2	411.0	69.9	103	0.0184
6/1	927	25.9	54.4	436.0	64.5	94.8	0.0164
6/1	1045	24.3	52.3	428.0	60.8	89.4	0.0173
6/1	1215	25.2	55.4	426.0	57.8	85.0	0.0177
6/3	1023	25.8	52.0	438.0	59.8	87.9	0.0191
AVERAGE					67.1	98.7	0.0196

(1) Test discontinued after 1/2 hour due to plant shutdown.
(2) Furnace went positive for a few minutes while conducting this test when an air actuator valve was being repaired.
(3) Incinerator was fired with municipal waste and wood chip mixture.

TABLE 3 UNCONTROLLED SO_2 EMISSIONS DATA FROM BAY COUNTY RESOURCE RECOVERY FACILITY

DATE	TIME	UNIT	FLUE GAS FLOW KSCFM	TEMP OF GAS DEG F	BOILER STEAM FLOW Klb/hr	H2O VOL%	CO2 DRY VOL%	SO2 DRY PPMv	SO2-DRY CORRECTED TO 12% CO2 PPMv
4/27	1100	1	25.1	428	64.7	13.3	12.1	113	112
4/27	1505	1	24.9	440	68.9	12.3	11.7	89	91
4/29	1214	1	19.9	441	61.1	14.6	11.0	213	233
4/29	1456	1	17.8	418	63.5	13.9	11.5	171	178
5/13	920	1	29.7	436	66.0	19.1	8.8	36	49
5/13	1337	2	26.4	451	65.6	19.5	9.7	68	84
5/13	1632	2	23.7	408	72.0	19.2	9.6	36	46
5/13	1850	2	28.0	434	70.5	16.4	9.7	82	102
5/14	826	2	25.3	421	80.0	17.8	9.7	85	105
AVERAGE			24.5	431	68.0	16.2	10.4	99	111

TABLE 4 NO_x EMISSIONS DATA USING METHOD 7 AND A CEM ON BOILER 2 AT THE BAY COUNTY RESOURCE RECOVERY FACILITY

						METHOD 7		CEM	
DATE	TIME	FLUE GAS FLOW KSCFM	TEMP OF GAS DEG F	BOILER STEAM FLOW Klb/hr	CO2 DRY VOL%	NOX DRY PPM	NOX-DRY @ 12% CO2 PPM	NOX DRY PPM	NOX-DRY @ 12% CO2 PPM
5/20	2252	29.5	414	72.6	10.9	166	183	165	182
5/20	2254	29.5	414	72.6	10.9	186	204	165	182
5/20	2352	27.0	410	72.3	10.3	136	158	155	181
5/20	2353	27.0	410	72.3	10.3	191	223	155	181
5/21	52	27.3	415	72.0	12.0	92	92	155	155
5/21	53	27.3	415	72.0	12.0	122	122	155	155
5/21	152	26.6	418	71.9	11.7	85	87	140	144
5/21	153	26.6	418	71.9	11.7	148	152	140	144
5/21	249	29.7	412	72.0	11.5	167	174	155	162
5/21	251	29.7	412	72.0	11.5	180	187	155	162
5/21	361	28.2	405	71.6	11.5	191	199	210	219
5/21	352	28.2	415	71.6	11.5	129	135	210	219
5/21	451	26.7	405	71.4	12.1	140	139	220	218
5/21	452	26.7	415	71.4	12.1	141	140	220	218
AVERAGE		27.9	413	72.0	11.4	148	157	171	180

TABLE 5 UNCONTROLLED HCL EMISSIONS DATA FROM BAY COUNTY RESOURCE RECOVERY FACILITY

DATE	TIME	UNIT	FLUE GAS FLOW KSCFM	TEMP OF GAS DEG F	BOILER STEAM FLOW Klb/hr	H2O VOL%	CO2 DRY VOL%	HCL DRY PPMv	HCL-DRY CORRECT TO 12% PPMv
4/22	1436	1	25.0	373	58.6	13.3	11.9	591	596
4/22	1652	1	25.9	387	70.4	17.5	14.0	432	371
4/23	925	2	28.9	422	64.0	15.1	12.8	857	802
4/23	1148	2	24.3	422	65.6	15.8	12.6	703	669
4/23	1356	2	23.4	405	62.6	15.5	13.7	657	577
4/26	1200	1	17.8	468	61.8	20.0	15.0	819	655
4/26	1352	1	29.7	473	61.8	22.1	15.1	422	336
4/26	1545	1	30.5	481	60.0	18.8	12.0	677	675
5/12	1350	2*	25.7	488	76.0	19.6	10.2	473	556
5/12	1350	2	25.7	437	76.0	19.6	10.2	301	354
5/13	920	1	29.7	436	66.0	19.1	10.4	481	555
5/13	1130	1	30.5	466	69.0	19.3	10.7	456	511
5/13	1337	1	26.4	451	65.6	19.5	11.4	301	316
5/13	1632	2	23.7	408	72.0	19.2	10.4	523	603
5/14	825	2	25.3	421	80.0	17.8	10.2	581	684
6/2	1139.0	1	26.6	461	66.7	16.9	10.2	167	196
6/2	1338.0	1	24.8	460	68.4	17.8	10.4	260	300
6/2	1512.0	1	25.6	455	ND	15.1	9.1	148	195
6/3	910.0	2	28.3	437	70.2	13.7	8.3	151	218
6/3	1023.0	2	25.9	438	59.8	15.7	12.0	161	161
AVERAGE			26.2	439	67.1	17.6	11.5	458	467

*Sample taken at inlet to precipitator.

TABLE 6 CO EMISSION DATA FROM THE BAY COUNTY RESOURCE RECOVERY FACILITY

DATE	TIME	UNIT	O2 WET VOL%	CO WET PPMv	CO-DRY CORRECTED TO 7% O2 PPMdv
11/23/87	1800	2	6.3	50	57
11/23/87	1900	2	5.4	47	51
11/23/87	2000	2	5.6	54	59
11/23/87	2100	2	5.5	57	62
12/17/87	1600	2	6.2	70	80
12/17/87	1700	2	5.8	67	74
12/17/87	1800	2	5.6	61	67
12/17/87	1900	2	5.7	49	54
12/17/87	2000	2	5.5	60	65
12/17/87	2100	2	5.8	62	69
12/17/87	2200	2	5.5	48	52
12/17/87	2300	2	5.5	51	55
1/2/88	1400	2	5.7	83	92
1/2/88	1500	2	5.9	86	96
1/2/88	1600	2	5.7	77	85
1/2/88	1700	2	5.8	83	92
1/2/88	1800	2	5.4	51	55
1/2/88	1900	2	6.0	56	63
1/2/88	2000	2	5.4	90	97
1/2/88	2100	2	5.6	62	68
1/2/88	2200	2	5.8	54	60
1/2/88	2300	2	5.5	38	41
AVERAGE			5.7	62	68

HCl concentrations determined using NIOSH Method 112B are listed in Table 5. Twenty samples were taken on seven different days with an average HCl concentration of 467 ppm_{dv} corrected to 12% CO_2.

Carbon Monoxide (CO) emissions were measured on three separate days using a Land NDIR analyzer. CO levels measured by the CEM are given in Table 6. The data are corrected to 7% O_2 and are reported on a dry basis by assuming an average flue gas moisture content of 17.0%. This moisture level is the average of the values measured during the April through June test program. The average value for CO was 68 ppm_{dv} corrected 7% O_2.

SUMMARY

The results of the emission compliance tests conducted at the Bay County Resource Recovery facility indicate that the facility is in compliance with the particulate and visual emission limitations imposed by the Florida Department of Environmental Regulations. Additional particulate matter testing confirmed routine compliance with the permit emission limitations. The emissions of SO_2, HCl and CO from the Bay County facility were similar to the emissions reported from other MSW combustor facilities without acid gas control equipment; NO_x emissions were somewhat lower than reported elsewhere.