Stack Emissions and Ash Characterization Data from a State of the Art Municipal Waste Resource Recovery Facility

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PEER-REVIEW

INTRODUCTION

Montgomery County, Maryland, is located outside of Washington, D.C. In 1987, the County implemented an Integrated Solid Waste Management Program which provided for a Waste-to-Energy municipal solid waste Resource Recovery Facility (RRF) as the County's central disposal facility for municipal waste. On February 12, 1993, the Maryland Department of Environment (MDE) issued a Permit to Construct (PTC) the RRF. Construction of the facility started in March 1993 and was completed in May, 1995. The RRF, which is constructed adjacent to a coal-fired power plant near Dickerson Maryland, consists of three units. Each unit is designed to combust 600 tons of refuse per day and generate approximately 20 megawatts (MW) of electricity.

Northeast Maryland Waste Disposal Authority (NEA) is the legal owner of the facility. Ogden Martin Systems of New Jersey (Ogden) is the full service vendor, who designed, constructed and operates the facility.

Waste is transported to the RRF by rail from the County's Waste transfer station located in Rockville, approximately 20 miles away. The County's residential, commercial and office waste as well as yard waste and recyclables are brought to the Transfer Station daily by trucks. The trucks are checked by County staff for potential hazardous substances. If any hazardous materials are found, the waste is not accepted by the County. The accepted waste is unloaded into the pit at the Transfer Station. The waste in the pit is again inspected for any hazardous substances. If any household hazardous substances are found, they are sent to the County's Household Hazardous Waste Collection Center. The recyclables are sent to the County's Material Recycling Facility (MRF) located adjacent to the Transfer Station. Non-processibles are sent to the Oaks landfill by truck. The non-recyclable and burnable waste is loaded in to specially designed balers that compact the waste in to 30-ton 37-foot logs. These logs are slid into 40-foot long intermodal containers. The containers are sealed with internal air bladders to prevent leakage, and loaded on to specially designed trailers and transported to the railyard approximately 500 feet from the Transfer Station. Although the RRF is designed to burn 1800 tons of waste per day, only 1200 tons of waste currently arrives at the Transfer station. Each rail carriage holds two 30-ton containers. Therefore, twenty carriages are needed to transport the 1200 tons of waste per day from the Transfer Station to the RRF.

When the loaded rail units arrive at the rail yard adjacent to the RRF every morning, the containers are lifted by an overhead MiJack crane and lowered on to specially designed trucks with tipping chases. The trucks take the containers to the RRF tipping floor. The waste is dumped into the 205-foot long, 65-foot wide and 30-foot deep pit by inclining the containers at a 70-degree angle.

After combustion of the waste, the residue is again loaded into the intermodal containers and taken

to the rail yard for transporting back to the County's Transfer Station. The ash-containers are then trucked approximately 10 miles to a landfill for disposal in a monofill.

Only two of the three units of the RRF are generally operating on any given day to combust the approximately 1200 tons of waste currently being shipped to the RRF.

The facility consists of three water wall boiler units, each unit combusting approximately 600 tons of waste per day (TPD) and generating approximately 20 megawatts (MW) of electricity. The facility is equipped with the state of the art Air Pollution Control (APC) System that consists of a reverse air fabric filter baghouse, spray dryer and activated carbon injection system for the control of organics, trace metals, acid gases, and mercury. A selective non-catalytic reactive system (SNCR) is installed for the control of nitrogen oxides (NOx). In addition, direct lime injection system in to the boiler further controls the acid gases, and addition of dolomitic lime to the ash minimizes leaching of metals from the ash when it is deposited in a landfill. Atmospheric discharge is through a 275-foot tri-flue stack (Figure 1). Technical information pertaining to the facility is presented in Tables 1, 2 and 3.

A Service Agreement signed by NEA and Ogden requires Ogden to conduct several engineering and environmental compliance tests to demonstrate that the facility can operate within the prescribed conditions in the Service Agreement before the facility can be accepted by the County and the Authority. The emission guarantees in the Service Agreement are based on stack test results from the vendor's best performing facilities. On May 5, 1995, the Maryland Department of Environment (MDE) issued a temporary Permit to Operate that required the vendor to conduct compliance tests within 180 days of start-up to demonstrate that the facility can operate in compliance with the permits issued by the Agency.

The facility commenced temporary operations on May 9, 1995. Compliance tests were conducted from July 24, 1995 to August 4, 1995. These tests included stack emissions and ash characterization programs. The facility passed all compliance tests that were required by NEA's Service Agreement and MDE's temporary operation permit. On November 8, 1995, the RRF received an Air Permit to Operate and a Waste Disposal Permit from MDE. The Air Permit to Operate is valid until October 31, 2000, and the Waste Disposal Permit is valid until February 9 1998.

MDE's Air Permit to Operate requires that stack emission tests for certain pollutants be conducted quarterly for each combustion train for the first year of operation after initial compliance testing, and annually thereafter. The pollutants to be tested are: particulates, nitrogen oxides, sulfur dioxide, carbon monoxide, hydrogen chloride, sulfuric acid mist, non-methane hydrocarbons, fluorides, mercury, cadmium, beryllium, lead and total dioxins and furans. For certain other pollutants, stack emissions testing are conducted on one combustion train rotated quarterly for the first three years of operation. These pollutants are: chlorophenols, polychlorinated biphenyls, chlorobenzenes,

ammonia, total chromium, chromium$_{VI}$, copper, zinc, antimony, arsenic, barium, cobalt and selenium. MDE's Waste Disposal Permit required ash characterization prior to the startup of commercial operations of the facility. However, the County required quarterly ash testing during the first year of operation.

As required by MDE's air permit, compliance tests were conducted in August 1995 and quarterly tests during the first year of operation in December 1995, February 1996, May 1996 and August 1996. During the second year of operation, quarterly stack testing for one combustion train (Unit 2) was conducted in November 1996.

SAMPLING AND ANALYTICAL METHODS

Stack Air Emissions

As required by MDE's Air Permit to Operate, emissions tests were conducted for each unit in accordance with the protocol approved by MDE. The test methods are listed in Table 4.

Combustion Residue Characterization.

Fly ash from the baghouse is carried via ash conveyors and is combined with residue from the scrubber and bottom ash from the boiler ash dischargers. Dolomitic lime is added to the ash between the scrubber and the baghouse to stabilize the ash to bind the metals. Combined ash samples are collected at a location after the ferrous material has been removed so that the sample represents the ash as it leaves the site. In accordance with the requirements of MDE's Waste Disposal Permit, an ash residue characterization program was conducted within 90 days of startup of the RRF. The program was designed in accordance with USEPA's draft guideline document entitled " Sampling and Analysis of Municipal Refuse Incinerator Ash" , "Guidance for Sampling and Analysis of Municipal Waste Combustion Ash for the Toxicity Characteristics", and other supporting documents. The ash sampling methods are listed in Table 9. The ash testing program was repeated quarterly after the initial compliance test. A total of six quarterly tests have been conducted over the last eighteen months.

DISCUSSION OF RESULTS

Stack Emissions

A total of five stack tests were conducted on units 1 and 3, and six tests on unit 2. Of the six tests, five were conducted by Clean Air Engineeribg and one test was conducted by Entropy. The County screened these consultants for their compliance record. The results are reported by Ogden in Environmental Test Reports[1,2,3,4,5,6]. MDE's permit limits for organics and acid gases are standardized

to 7% O_2 and for particulates and metals to 12% CO_2. EPA's requirements for organics as well as metals are standardized to 7% O_2. Therefore two sets of stack emission test results were reported, one standardized to 7% O_2 and the other to 12% CO_2. However, the difference between the two sets of results is generally less than five percent. These results are summarized in Tables 5 to 8. The emission limits required by MDE's Permits, the NEA's Service Agreement and the USEPA are also listed in these Tables. The results for selected compounds are discussed below.

Organics.

A total of 16 samples of dioxins and furans were collected between August 1995 and November 1996. The overall maximum and minimum concentrations of total dioxins in the flue gas are 7.06 and 0.26 ng/dscm @ 7% O_2 respectively. MDE's Permit limit is 30 ng/dscm @ 7% O_2. The overall maximum and minimum dioxin concentrations expressed as 2-3-7-8TCDD (EPA 89 TEF or ITEF) are 0.004 ng/dscm @ 7% O_2 and 0.0142 ng/dscm @ 7% O_2, compared to the NEA's Service Agreement requirement of 1 ng/dscm @ 7% O_2. The results of total dioxins obtained in the quarterly tests from each of the three units are shown in Figure 2. The results indicate that no specific data point is consistently highest or any test series consistently the highest. This means that the variations from test to test or unit to unit may be nothing more than random noise. Flue gas concentrations of PCBs, PAHs, Chlorophenols and Chlorobenzenes were below laboratory detection limits. These detection limits are shown in Table 4.

Particulates and Trace Metals.

From the data obtained in the six stack tests conducted so far, the range of particulate concentrations in the flue gas is from 0.00016 to 0.0018 gr/dscf @ 12% CO2 compared to MDE's permit limit of 0.01 gr/dscf @ 12% CO2. In all six stack tests, mercury was found above detection limits. The overall maximum and minimum concentrations of mercury in the flue gas are 76.9 and 1.8 microg/dscm @ 7% O_2 respectively compared to EPA's requirement of 80 microg/dscm @ 7% O_2. The results of mercury flue gas concentrations in the quarterly tests from each of the three units are shown in Figure 3. In three stack tests, cadmium was below laboratory detection limits of 0.06 microg/dscm @ 7% O_2. The range of detected concentrations of cadmium in the flue gas is 0.2 to 0.63 microg/dscm @ 7% O_2 compared to EPA's requirement of 40 microg/dscm @ 7% O_2. In three stack tests, lead was below laboratory detection limits of 0.1 microg/dscm @ 7% O_2. The range of detected concentrations of lead in the flue gas is 0.17 to 13.8 microg/dscm @ 7% O_2 compared to EPA's requirement of 490 microg/dscm @ 7% O_2. The results indicate that there is no seasonal trend in the metals.

Acid Gases and Nitrogen Oxides.

The range of detected 3-hour average concentrations of sulfur dioxide (SO_2) in the flue gas is 0.1 to

15.2 ppmv @ 7% O_2 compared to MDE's permit limit of 30 ppmv @ 7% O_2. The removal efficiencies ranged from a maximum of 99.9% to a minimum of 92.4% compared to MDE's permit requirement of 85% removal efficiency. The range of 1-hour average concentrations of hydrogen chloride (HCl) in the flue gas is 8.0 to 21.8 ppmv @ 7% O_2 compared to MDE's permit limit of 25 ppmv @ 7% O_2. The removal efficiencies ranged from a maximum of 98.1% to a minimum of 95.9% compared to MDE's permit requirement of 95% removal efficiency. The range of 24-hour average concentrations of nitrogen oxides (NO_x) in the flue gas is 151 to 177 ppmv @ 7% O_2 compared to MDE's permit limit of 180 ppmv @ 7% O_2.

Combustion Residue Characterization

A total of six quarterly ash characterizations have been done over the last eighteen months. The results are reported by Ogden in Environmental Test Reports[7,8,9,10,11,12]. In all six quarterly ash characterization programs conducted so far, volatile/semivolatile organics, herbicides and pesticides were below detection limits. Therefore, only trace metal results are presented in Table 10, and are discussed below.

Trace Metals.

In all six quarterly ash characterization programs, arsenic, selenium and silver were below laboratory detection limits. These detection limits are shown in Table 10. Cadmium was found in all six tests but lead was only detected in three of the six tests while mercury was detected in four of the six tests. Barium and chromium were detected in only one test. The sampling results and regulatory thresholds are presented in Table 8. The range of 90% upper confidence interval concentration of cadmium in the ash was 0.019 to 0.434 mg/liter compared to the regulatory threshold value of 1.0 mg/liter. The range of detected 90% upper confidence interval concentration of lead in the ash was 0.051 to 0.44 mg/liter compared to the regulatory threshold value of 5.0 mg/liter. The range of detected 90% upper confidence interval concentration of mercury in the ash was 0.0006 to 0.0038 mg/liter compared to the regulatory threshold value of 0.2 mg/liter.

SUMMARY AND CONCLUSIONS

This paper summarizes stack emissions and ash characterization data obtained in six quarterly tests conducted over an eighteen month period for the Montgomery County Waste-to-Energy Resource Recovery facility (RRF) located near Dickerson, Maryland. The facility started testing and temporary operations in May 1995. The first stack test was a compliance test conducted in August 1995 to demonstrate to the County, NEA and the Maryland State that the facility can comply with all applicable permit conditions prior to the issuance of an operation permit by the Maryland Department of Environment (MDE). In November 1995, MDE issued the operation permit. Subsequent to this date, five quarterly tests have been conducted. The last quarterly test reported in

this paper was conducted in November 1996. Of all the stack emissions, dioxin and mercury levels in the flue gas are of focal interest both from a regulatory compliance perspective and public perception.

Of the sixteen samples obtained in the six stack tests conducted for the three units, nine samples of total dioxins in the flue gas were less than 1 ng/dscm @ 7% O_2. Four samples were between 1 and 2 ng/dscm @ 7% O_2 and two samples were between 3 and 4 ng/dscm @ 7% O_2. The remaining sample, the maximum reported in this paper is 7.06 ng/dscm @ 7% O_2. A comparison of these values with the data obtained from other facilities that have similar air pollution control equipment, indicate that the dioxin levels recorded in the stack tests of Montgomery County Facility are the lowest values recorded by any other currently operating modern facility in the United States. Activated carbon injection system proved to be effective not only for mercury control, but also for dioxin and trace metal control.

Of the sixteen mercury samples obtained in the six stack tests conducted for the three units, fifteen samples were less than 51 microg/dscm @ 7% O_2. Only one sample (76.9 microg/dscm @ 7% O_2), the maximum reported in this paper came close to the EPA's requirement of 80 microg/dscm @ 7% O_2. Of the fifteen samples which were below 51 microg/dscm @ 7% O_2, eight samples were less than 20 microg/dscm @ 7% O_2 and the remaining seven samples were between 20 and 51 microg/dscm @ 7% O_2. Mercury removal efficiencies exceeded 93% compared to EPA's requirement of 80% removal efficiency.

The results of ash characterization programs indicate that all organics are below detection limits. Of the trace metals, cadmium, lead and mercury are present in detectable quantities. However, the maximum lead concentrations were less than 10% of the regulatory threshold and the maximum mercury concentrations were less than 2% of the regulatory threshold. The maximum concentrations of cadmium were less than 50% of the regulatory threshold. Most recent tests indicated that cadmium is the only metal that is present in detectable quantities.

References:

1. Ogden Martin Systems, INC., September 1, 1995. Environmental Engineering Department, Volume 2, Part 1, Clean Air Engineering, Inc. Report on Compliance Testing, Environmental Test Report.

2. Ogden Projects, Inc., April 9, 1996. Environmental Engineering Department Volume 1, Executive Summary, Environmental Test Report, prepared for Ogden Martin Systems of Montgomery.

3. Ogden Projects INC., April 24, 1996. Environmental Engineering Department, Volume 1,Executive Summary, Environmental Test Report, prepared for Ogden Martin Systems of Montgomery.

4. Ogden Projects INC., June 25, 1996. Environmental Engineering Department, volume 1, Executive Summary, Environmental Test Report, prepared for Ogden Martin Systems of Montgomery.

5. Ogden Projects INC., October 10, 1996. Environmental Engineering Department, volume 1, Executive Summary, Environmental Test Report, prepared for Ogden Martin Systems of Montgomery.

6. Ogden Projects INC., January 13, 1997. Environmental Engineering Department, Volume 1, Executive Summary, Environmental Test Report, prepared for Ogden Martin Systems of Montgomery.

7. Ogden Projects, In., August 8, 1995. Environmental Engineering Department, Environmental Test Report for Ogden Martin Systems of Montgomery, INC., Ash Residue Characterization Report.

8. Ogden Projects, In., January 1, 1996. Environmental Engineering Department, Environmental Test Report for Ogden Martin Systems of Montgomery, INC., Ash Sampling and Analysis Results.

9. Ogden Projects, In., April 4, 1996. Environmental Engineering Department, Environmental Test Report for Ogden Martin Systems of Montgomery, INC., Ash Sampling and Analysis Results.

10. Ogden Projects, In., June 14, 1996. Environmental Engineering Department, Environmental Test Report for Ogden Martin Systems of Montgomery, INC., Ash Sampling and Analysis Results.

11. Ogden Projects, In., October 9, 1996. Environmental Engineering Department, Environmental Test Report for Ogden Martin Systems of Montgomery, INC., Ash Sampling and Analysis Results.

12. Ogden Projects, In., January 14, 1997. Environmental Engineering Department, Environmental Test Report for Ogden Martin Systems of Montgomery, INC., Ash Sampling and Analysis Results.

TABLE 1. Technical Information for the Montgomery County Waste-to-Energy Resource Recovery Facility

Waste-to-Energy System	Three 600 tons-per-day (TPD) mass-burning waterwall furnaces with Martin reverse-reciprocating grates and ash handling system
Waste Type	Municipal residential, commercial and office waste
Guaranteed Throughput	558,450 tons per year (1530 TPD)
Boiler Design	865 psig/830 deg F superheater outlet conditions
Air Pollution Control Equipment	Dry flue gas scrubbers, direct lime injection system into boilers, reverse air fabric filter baghouses, nitrogen oxide control with Selective Non Catalytic Reactive (SNCR) system and mercury control with activated carbon injection system. Scrubber Inlet Temp: 440 deg F Scrubber Outlet Temp:295 deg F
Gross Energy Generation at Rated Capacity	54 MW
Net Energy Generation at Rated Capacity	48 MW
Customer	Potomac Electric Power Company (PEPCO)
Special Features	Waste is transported by rail in closed containers. Combustion residue, after ferrous materials recovery is also transported by rail in closed containers

Table 2. Reagents used in the Air Pollution Control and Ash Leaching in 1996

(Average Amounts in Pounds per Ton of Refuse Burned)				
Pebble Lime	Hydrated Lime	Dolomitic Lime	Ammonia	Carbon
15.0	3.1	12.8	1.8	1.7

Table 3. Combustion Residue and Ferrous Materials generated in 1996

Percent by Weight ofRefuse Burned	
Combustion Residue	Ferrous
26.1	3.0

TABLE 4. Stack Emissions Test Methods

Parameter	Test Method	Location
Particulate Matter (PM)	EPA Method 5	Stack
Particulate Matter <10 micr. (PM10)	EPA Method 201A	Stack
Sulfur Dioxide (SO2)	EPA Method 6C	Inlet/Stack
Hydrogen Chloride (HCl)	EPA Method 26	Inlet/Stack
Total Fluorides (HF)	EPA Method 13B	Stack
Carbon Monoxide (CO)	EPA Method 10	Inlet
Sulfuric Acid Mist	EPA Method 8	Stack
Nitrogen Oxides (NOx)	EPA Method 7E	Stack
Mercury (Hg)	EPA Method 101A	Inlet/Stack
Dioxins/Furans (PCDD/PCDF)	EPA Method 23	Stack
Polychlorinated Biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs), Chlorophenols, Chlorobenzenes	SW846 - 0010	Stack
Ammonia (NH3)	EPA Method 26	Stack
Carbon Dioxide (CO2)	EPA Method 3A	Inlet/Stack
Oxygen (O2)	EPA Method 3A	Inlet/Stack
Multi Metals: Antimony (Sb), Arsenic (As), Barium (Ba), Beryllium (Be), Cadmium (Cd), Total Chromium (Cr), Cobalt (Co), Copper (Cu), Lead (Pb), Nickel (Ni), Selenium (Se), Zinc (Zn)	EPA Method 29	Stack
Non-Methane Hydrocarbons (NMHC)	EPA Method 25A	Stack
Hexavalent Chromium (Cr6)	BIF Cr_6	Stack
Opacity	EPA Method 9	Stack

TABLE 5. Stack Emissions Test Results - Organics

Flue Gas Concentration in nanograms per dry standard cubic meter (ng/dscm @ 7% O_2)	Unit 1	Unit 2	Unit 3	MDE Operating Permit Standards	EPA's Standards promulgated on 10/31/95	NEA Service Agreement Requirements
Dioxins (Total)	0.29 - 1.41	0.294 - 7.06	0.26 - 3.51	30 (4-hr)	30	None
EPA 89 TEF	0.004	0.012	0.014	None	None	1.0[a] 0.9[b]
PCBs	<2661	<4454	<2300			
Total PAHs	<3959	<4575	<6445			13,400
Chlorophenols	<3673	<15,431	<18,069			
Chlorobenzenes	<3670	<6976	<8148			

TABLE 6. Stack Emissions Test Results - Trace Metals

Flue Gas Concentration, microg/dscm @ 12% CO_2 or 7% O_2	Unit 1	Unit 2	Unit 3	MDE's Operation Permit Standards @ 12% CO_2	EPA's Standards promulgated on 10/31/95 @ 7% O_2	NEA Service Agreement Requirements @ 12% CO_2
Arsenic (As)	<0.21 - 0.23	0.15 - <0.2	<0.19 - 0.37	None	None	26[b]
Beryllium (Be)	<0.05 - <0.06	<0.04 - <0.06	<0.04 - <0.06	0.36	None	0.88[a] 0.82[b]
Cadmium (Cd)	0.06 - 0.63	0.06 - 0.25	0.04 - 0.12	None	40	64.4[b]
Chromium (Cr)	<0.16 - 0.83	<0.17 - <0.5	<0.2 - 6.0	None	None	465[b]
Cr_{VI}	0.11 - <0.32	0.13 - <0.46	0.15 - <0.40	None	None	None
Nickel (Ni)	<0.16	<0.15	0.26			444[b]
Lead (Pb)	<0.1 - <1.07	<0.2 - <3.3	<0.4 - 13.8		490	2702[a] 537[b]
Mercury (Hg)	5.0 - 77.0	12.4 - 47.0	1.8 - 51.0		80 85% removal	130 80% Remov[a,b]

EPA 89 TEF: EPA's 1989 Toxicity Equivalent Factors for dioxins/furans
a: NEA Service Agreement Compliance Test Requirement
b: NEA Service Agreement Annual Average Requirement
7% O2: adjusted to 7% oxygen in dry gas at standard conditions

TABLE 7. Stack Emissions Test Results - Acid Gases, NO_x, CO & NH_3

Flue Gas Concentration ppmv @ 7% O_2	Unit 1	Unit 2	Unit 3	MDE's Operation Permit Standards	EPA's Standards promulgated on !0/31/95	NEA Service Agreement Requirements
Sulfur Dioxide (SO_2)	1.4 - 15.2	0.14 - 7.03	2.1 - 10.2	30	31	30
Removal Efficiency %	95.5 - 98.8	92.4 - 99.9	93.8 - 97.5	85	75	85
Hydrogen Chloride (HCl)	8.0 - 16.7	9.9 - 21.8	8.2 - 19.1	25	31	30[a] 25[b]
Removal Efficiency %	97.1 - 98.1	96.1 - 97.5	95.9 - 97.9	95	95	90[ab]
Nitrogen Oxides (NOx)	151 - 168	154 - 168	153 - 177	180 (24h)	200	180[ab]
Carbon Monoxide (CO)	16.8 - 31.2	11.4 - 25.6	18.0 - 31.8	200 (1h) 50 (24h)	100 (4h)	50[b]
Ammonia (NH_3)	1.4 - 8.7	<0.11 - 4.7	2.2 - 4.7	None	None	None

TABLE 8. Stack Emissions Test Results - Fluorides, NMHC, H2SO4 Mist, Particulates and PM10

Flue Gas Concentration in grains per dry standard cubic foot (gr/dscf @ 12% CO2)	Unit 1	Unit 2	Unit 3	MDE's Operation Permit Standards	EPA's Standards promulgated on !0/31/95	NEA's Service Agreement
Fluorides	<0.02 - <0.283	<0.02 - <0.207	<0.02 - <0.220	3.1	None	None
Nonmethane Hydrocarbons (NMHC)	0.1 - <1.2	0.1 - <1.2	0.2 - <1.2	4.4 (3h)	None	None
Sulfuric Acid Mist	0.0184 - 2.51	0.0507 - 2.85	0.0484 - 2.75	20 (3h)	None	None
Particulates	0.00016 - 0.0018	0.00024 - 0.0012	0.00024 - 0.00074	0.01	None	0.01
PM10	<0.0007	<0.0007	<0.0007	0.01 (3h)	0.012	0.01[ab]

a: Service Agreement Compliance Test Requirement,

b: Service Agreement Annual Average Requirement

TABLE 9. Ash Testing Methods

Parameter	Analytical Method[b]
TCLP Metals[a]	
Arsenic	3010 and 6010A (ICP)
Barium	3010 and 6010A (ICP)
Cadmium	3010 and 6010A (ICP)
Chromium	3010 and 6010A (ICP)
Lead	3010 and 6010A (ICP)
Mercury	7471 (CVAA)
Selenium	3010 and 6010A (ICP)
Silver	3010 and 6010A (ICP)
Other TCLP Constituents	
Volatiles	8260 (GC/MS)
Semi volatiles	8270 (GC/MS)
Pesticides & Herbicides	8080 and 8150 (GC)
2.0 Moisture	160.3

(a) EPA Method 1311, Toxic Characterization Leaching Procedure
(b) ICP: Inductively Coupled Plasma Spectroscopy CVAA : Cold Vapor Atomic Absorption
GC: Gas Chromatograph GC/MS: Gas Chromatograph and Mass Spectroscopy

Table 10. Ash Characterization Results from Six Quarterly Tests - Metals

Metals	Lowest Detection Limit	90% Upper Conf. Interval* (milligrams per liter)	Regulatory Threshold** (Milligrams per Liter)
Arsenic	0.028	ND	5.0
Barium	0.26	0.47 (1)	100
Cadmium	0.001	0.019 - 0.434 (6)	1.0
Chromium	0.001	0.018 (1)	5.0
Mercury	0.0003	0.0006 - 0.0038 (4)	0.2
Lead	0.003	0.051 - 0.44 (3)	5.0
Selenium	0.03	ND	1.0
Silver	0.019	ND	5.0

*: SW-846 (b) **: 40 CFR Part 261 ND: Not Detected (--): Number of Tests in which the metal is detected

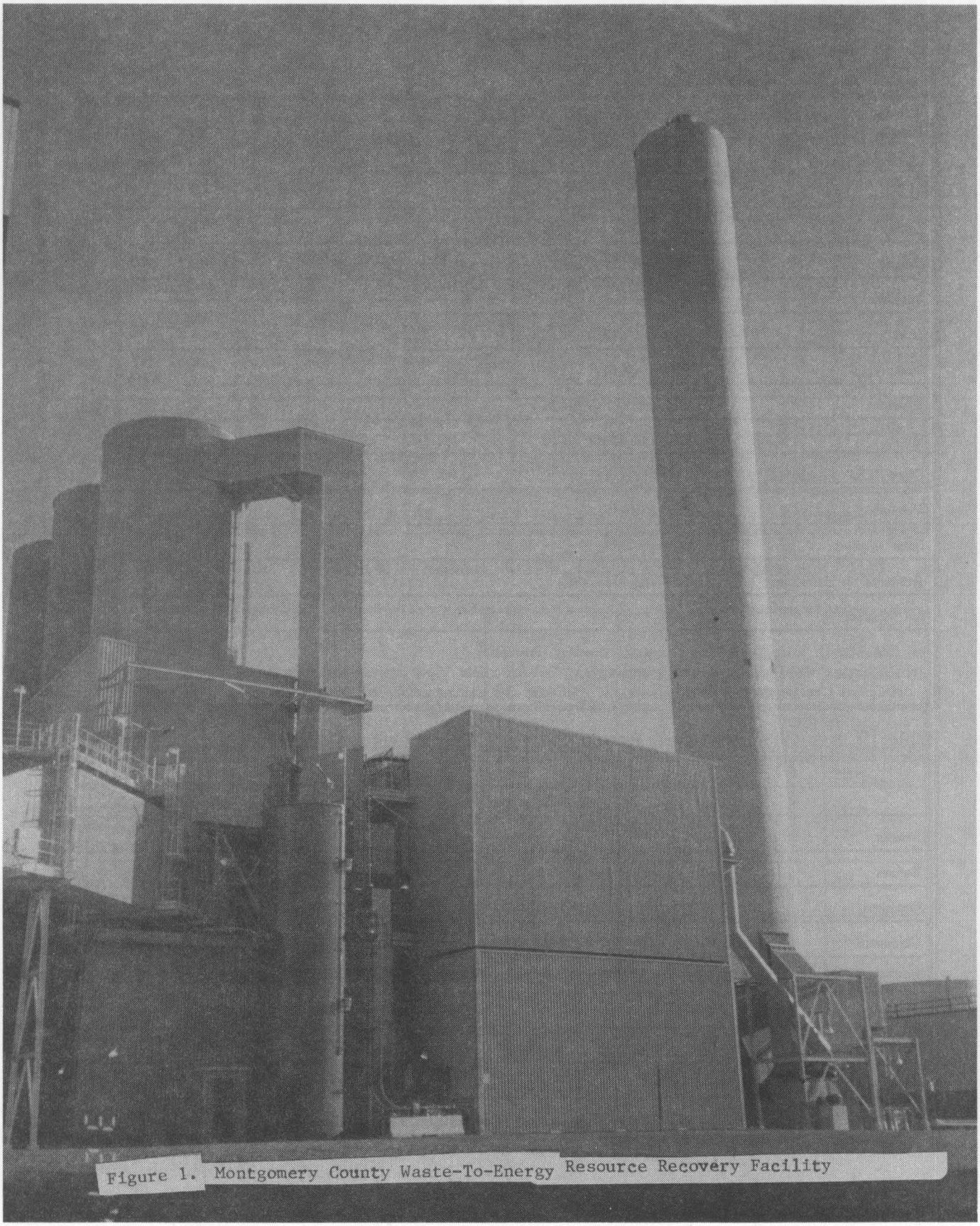

Figure 1. Montgomery County Waste-To-Energy Resource Recovery Facility

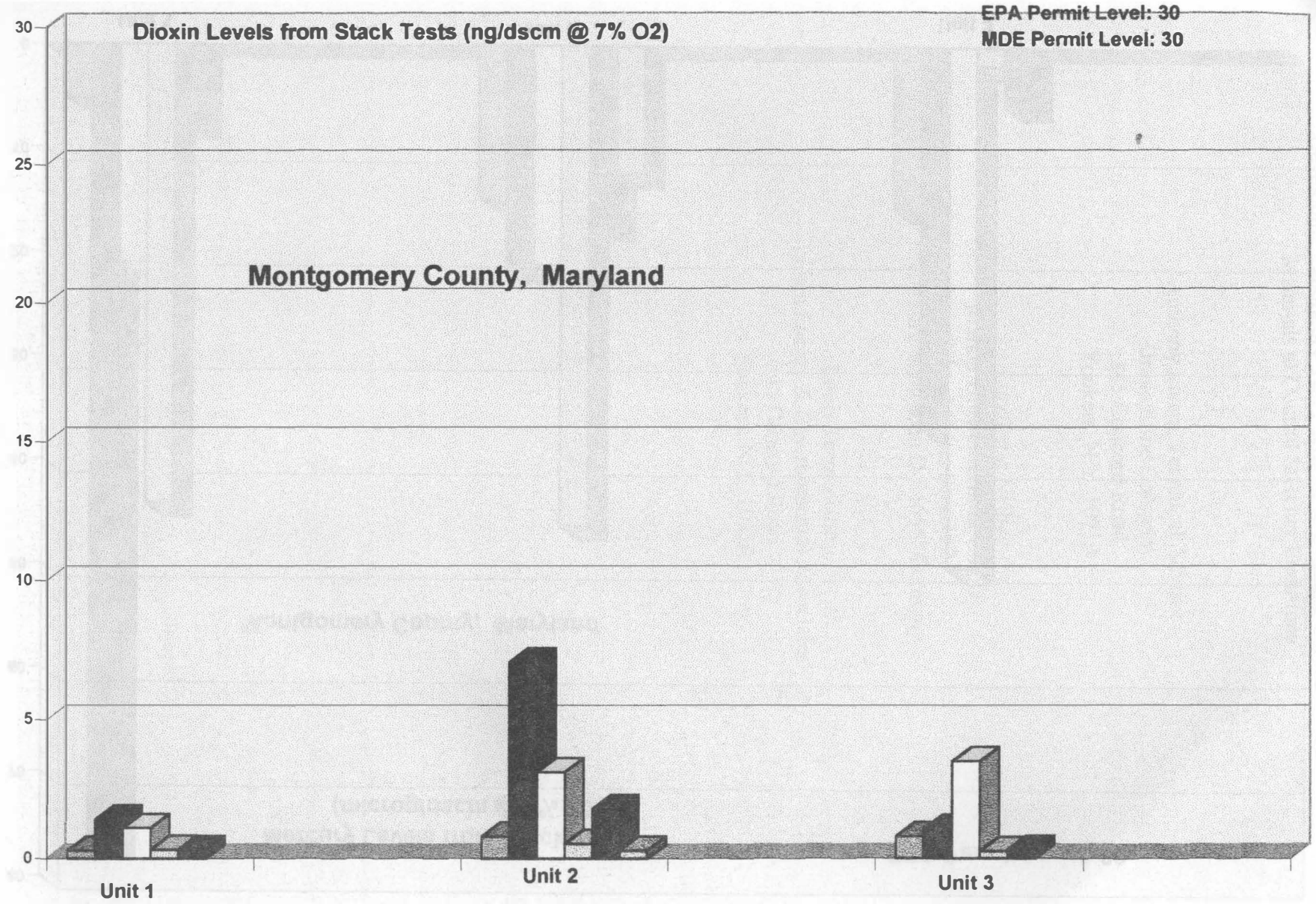

Figure 2. Average Dioxin Concentrations for each test series.

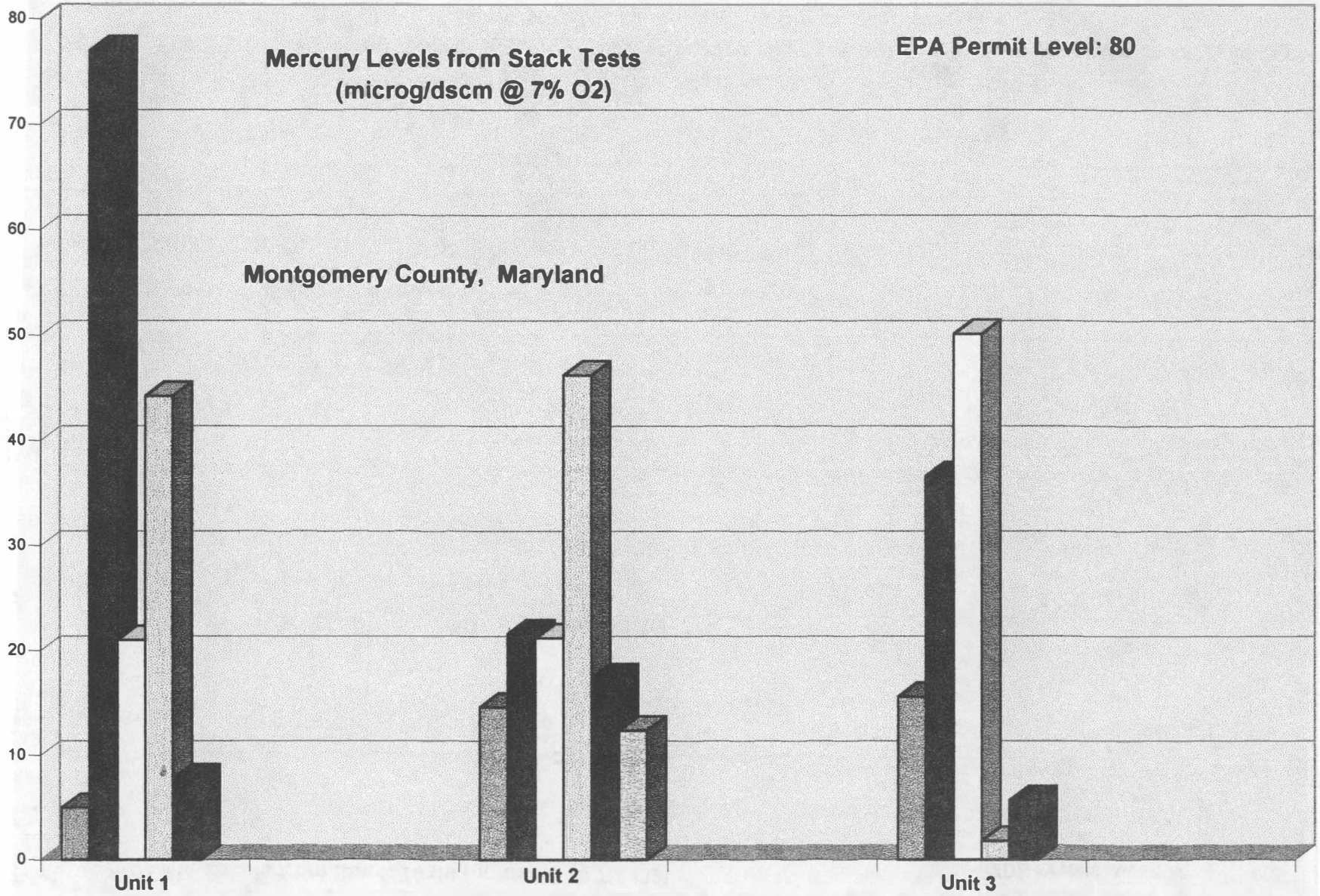

Figure 3. Average Mercury Concentrations for each test series.