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Subject: Acid Gases and Metals Typical Performance and Achievable Emission Levels for Medical Waste Incinerators with Combustion Controls  
EPA Contract No. 68-D1-0115; Work Assignment No. IV-108  
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## I. Introduction

The purpose of this memorandum is to document the methodology used to develop typical performance and achievable emission levels (in pollutant concentration) for medical waste incinerators (MWI) using combustion controls. Typical performance and achievable emission levels are developed for hydrogen chloride (HCl), oxides of nitrogen (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), lead (Pb), cadmium (Cd), and mercury (Hg<sup>x</sup>). The typical performance will be used to calculate nationwide annual emissions from MWI's under regulatory options reflecting combustion controls.

This memorandum presents a discussion of the EPA-sponsored testing program upon which the typical performance and achievable emission levels are set, averaging times used during the testing program, the impact of MWI type on average emissions and achievable emission levels, and the achievable emission levels and typical performance levels for HCl, SO<sub>2</sub>, NO<sub>x</sub>, Pb, Cd, and Hg.

## II. EPA-Sponsored Testing Program

The achievable emission levels presented in this memorandum were developed from actual test data from U. S. Environmental Protection Agency (EPA)-sponsored emission tests conducted at seven MWI's and one additional test report received from the State of Maryland.<sup>1,2</sup> Table 1 presents information on the type and size of each MWI tested.

TABLE 1. TESTED MWI FACILITIES

Facility	Description
A	650 lb/hr, intermittent, ram-fed; 2-sec residence time in secondary chamber; dry injection/fabric filter (DI/FF) system tested with and without activated carbon injection
B	1,500 lb/hr, continuous, ram-fed; 2-sec residence time in secondary chamber; venturi scrubber/packed bed (VS/PB) system
J	750 lb/batch, batch, manually fed; 1.75-sec residence time in secondary chamber; fabric filter/packed bed (FF/PB) system
K	300 lb/hr, intermittent, manually fed; 0.33-sec residence time in secondary chamber
M	800 lb/hr, continuous, ram-fed; 2-sec residence time in secondary chamber; spray dryer/fabric filter (SD/FF) system tested with and without activated carbon injection
S	250 lb/hr, intermittent, manually fed; 0.2-sec residence time in secondary chamber; conditions 1 and 2 = pathological waste, condition 3 = mixed medical waste
W	300 lb/hr, intermittent, ram-fed; 1-sec residence time in secondary chamber
Cumberland Memorial Hospital	600 lb/batch, batch, manually fed; 2-sec residence time in secondary chamber

All runs were used from each facility to determine typical performance and achievable emission levels with three exceptions. During testing of Facility S, only pathological waste was burned during runs 1 and 2. These runs are not representative of medical waste incineration. Secondly, data for condition 7 at Facility A were not used to calculate the HCl typical performance and achievable emission levels because this test was spiked with hexachlorobenzene (representing a cytotoxic waste) to determine the destruction efficiency of the MWI. The resulting HCl emissions are not representative of medical waste incineration. Finally, after proposal, Facility A was retested in July 1995.<sup>3</sup> The retest was conducted to determine the effectiveness of a battery separation program to reduce Hg from Facility A's waste stream. The test results showed that Hg emissions from Facility A were reduced significantly. Therefore, only runs from conditions 3 and 4 (during conditions 3 and 4 waste was being burned from another hospital) and the retest at Facility A were used to set the achievable emission levels. The typical emission rate was calculated using all the data from Facility A.

### III. Averaging Time

The achievable emission levels developed for proposal of MWI regulations were developed from actual test data from EPA-sponsored emission tests conducted at seven MWI's. Table 1 presents information on the type and size of each MWI tested. During each of the tests conducted at the seven MWI facilities, emissions were measured over three, 4-hour periods. However, additional test data has been collected to enhance the MWI test report data base. This additional data was collected using

three, 1-hour sampling runs. Because numerical achievable emission levels only have meaning when coupled with an averaging time, emission data must be expressed on a common basis. Therefore, the typical performance and achievable emission levels have been set based on one, 4-hour test run for the EPA-sponsored test data and the average of three, 1-hour test runs for the additional data collected.

#### IV. MWI Type

Continuous, intermittent, and batch are three different MWI types, differing in physical design characteristics, operating characteristics, and overall emission profiles. However, for continuous and intermittent units, there is a period in the combustion cycle when the emission profiles are similar. In continuous and intermittent units this period occurs during waste-charging.

Because of the difference in how waste is charged in a batch unit, the emission profile for combustion-related pollutants (PM, CO, and CDD/CDF) vary significantly from continuous and intermittent units. This variance is illustrated by the differences in CDD/CDF and PM emissions between nonbatch (continuous and intermittent) MWI's and batch MWI's.

Typical performance and achievable emission levels for combustion pollutants from batch MWI's were developed from an EPA-sponsored test at Facility J and a test report received from Cumberland Hospital in Cumberland, Maryland. Since data from the EPA-sponsored test at Facility J and the Cumberland Hospital test yielded similar results to continuous and intermittent MWI's for uncontrolled emissions of HCl, SO<sub>x</sub>, NO<sub>x</sub>, Pb, Cd, and Hg, typical performance and achievable emission levels were developed from continuous and intermittent MWI data. The data from continuous and intermittent MWI's was much more readily available than testing data from batch MWI's.

#### V. Typical Performance and Achievable Emission Levels

In establishing the achievable emission levels for all pollutants, the amount of data available and variation in that data were taken into consideration. The achievable emission levels were set as 1.1 times the highest value in a given set of data (i.e., 10 percent higher) rounded up to the next appropriate round number. Because emissions of HCl, SO<sub>2</sub>, NO<sub>x</sub>, Pb, Cd, and Hg are waste-related, combustion controls do not reduce their emissions. Therefore, typical performance and achievable emission levels have been set based on 0.25-, 1-, and 2-sec combustion control levels.

Table 2 presents the typical performance and the achievable emission levels for HCl, NO<sub>x</sub>, SO<sub>2</sub>, Pb, Cd, and Hg. Figures 1 through 6 present each of the data points (graphically) that were used to develop Table 2.

TABLE 2. ACHIEVABLE EMISSIONS LEVELS AND TYPICAL PERFORMANCE FOR HCl, NO<sub>x</sub>, SO<sub>2</sub>, Pb, Cd, and Hg

Continuous, intermittent, and batch MWI's			
Pollutant	Units	Typical performance	Achievable emission levels
HCl	ppmdv	1,478	3,100
SO <sub>2</sub>	ppmdv	12	55
NO <sub>x</sub>	ppmdv	121	250
Pb	mg/dscm	3.8	10
Cd	mg/dscm	0.41	4.0
Hg	mg/dscm	3.7	7.5

# HCl Emissions for Good Combustion

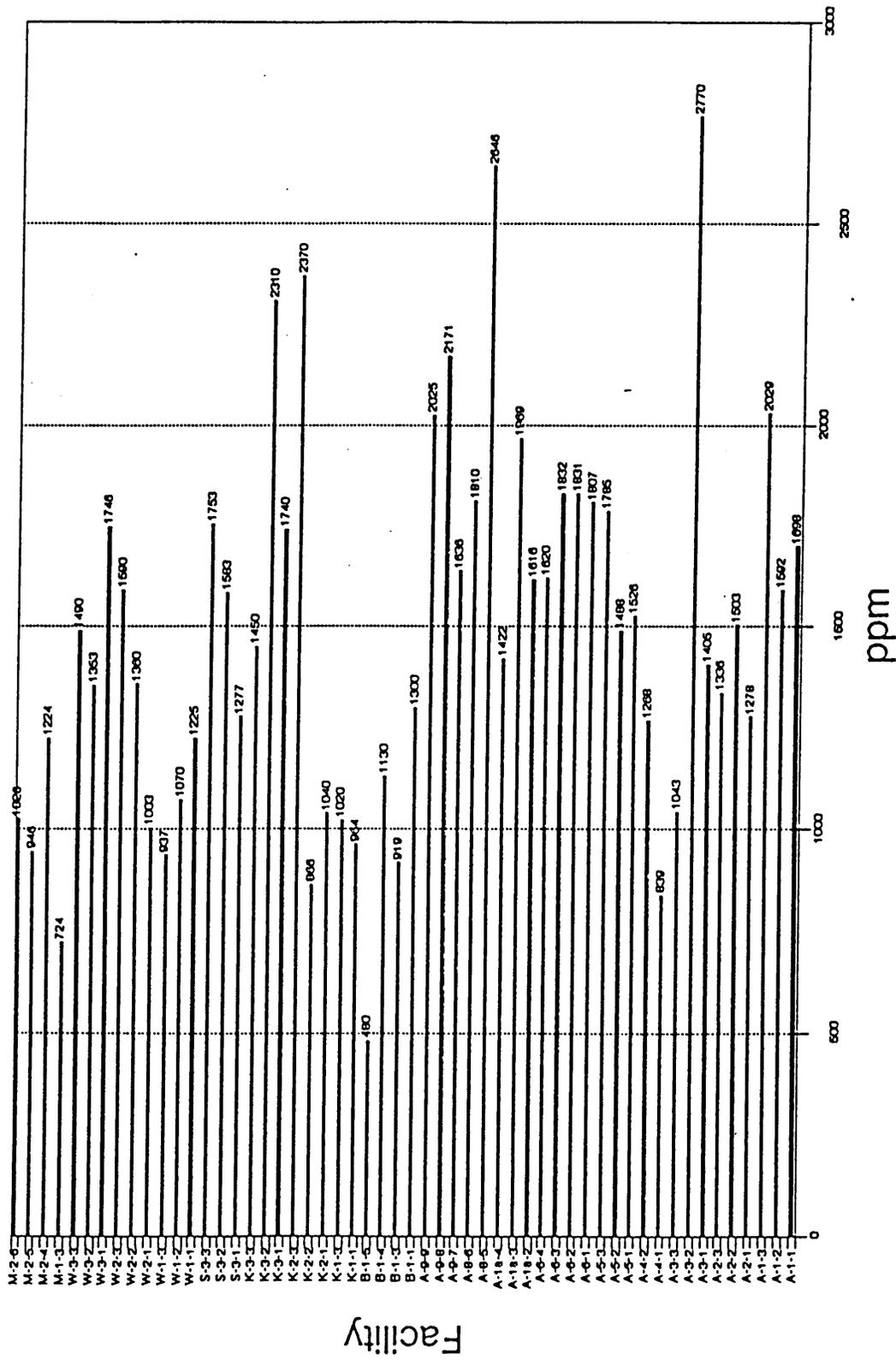


Figure 1. HCl emissions data used to set achievable emission levels for uncontrolled MWI's (corrected to 7 percent O<sub>2</sub>).

# SO2 Emissions for Good Combustion

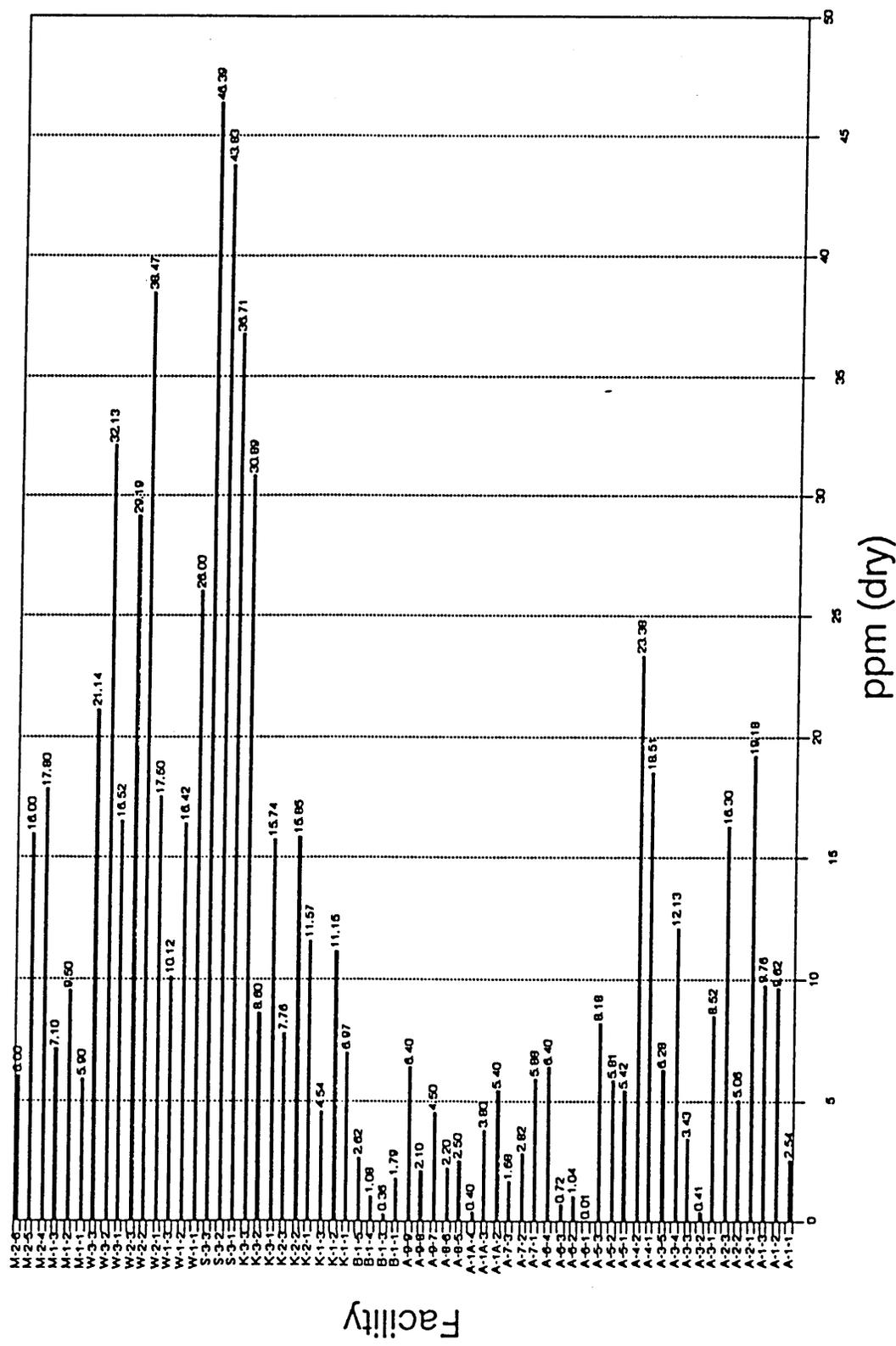


Figure 2. SO2 emissions data used to set achievable emission levels for uncontrolled MWI's (corrected to 7 percent O2).

# NO<sub>x</sub> Emissions for Good Combustion

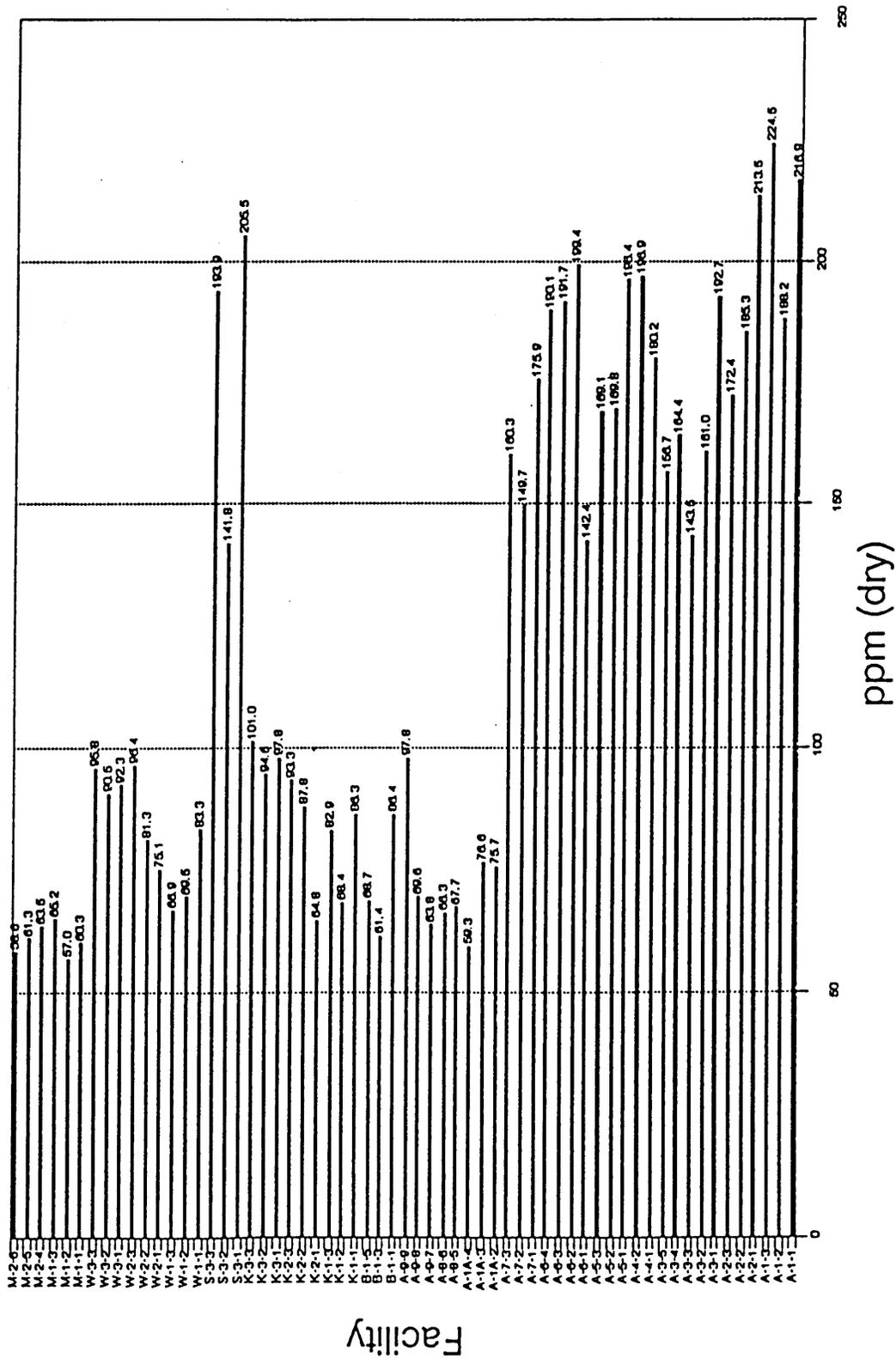


Figure 3. NO<sub>x</sub> emissions data used to set achievable emission levels for uncontrolled MWI's (corrected to 7 percent O<sub>2</sub>).

# Pb Emissions for Good Combustion

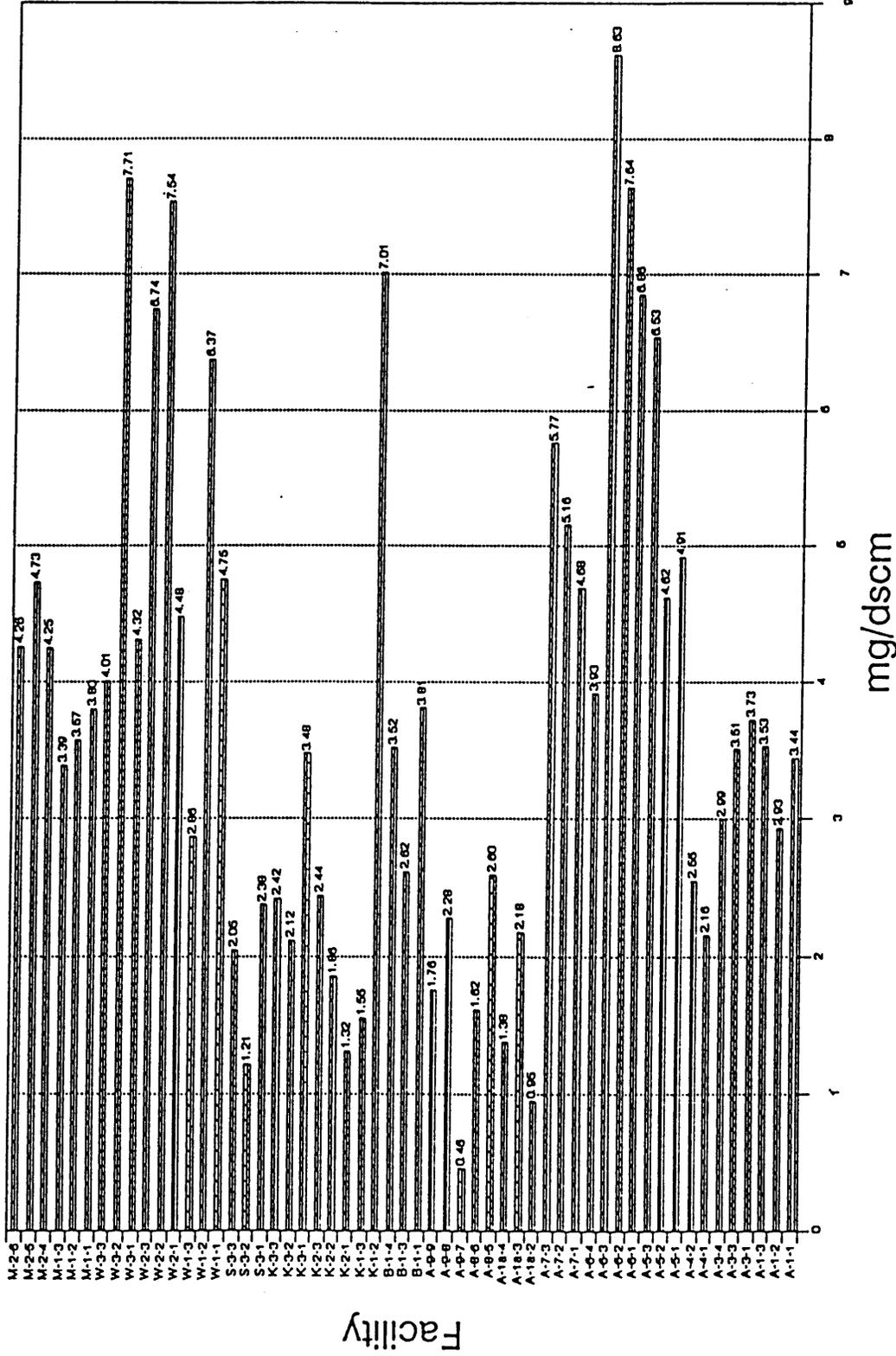


Figure 4. Pb emissions data used to set achievable emission levels for uncontrolled MWI's (corrected to 7 percent O<sub>2</sub>).

# Cd Emissions for Good Combustion

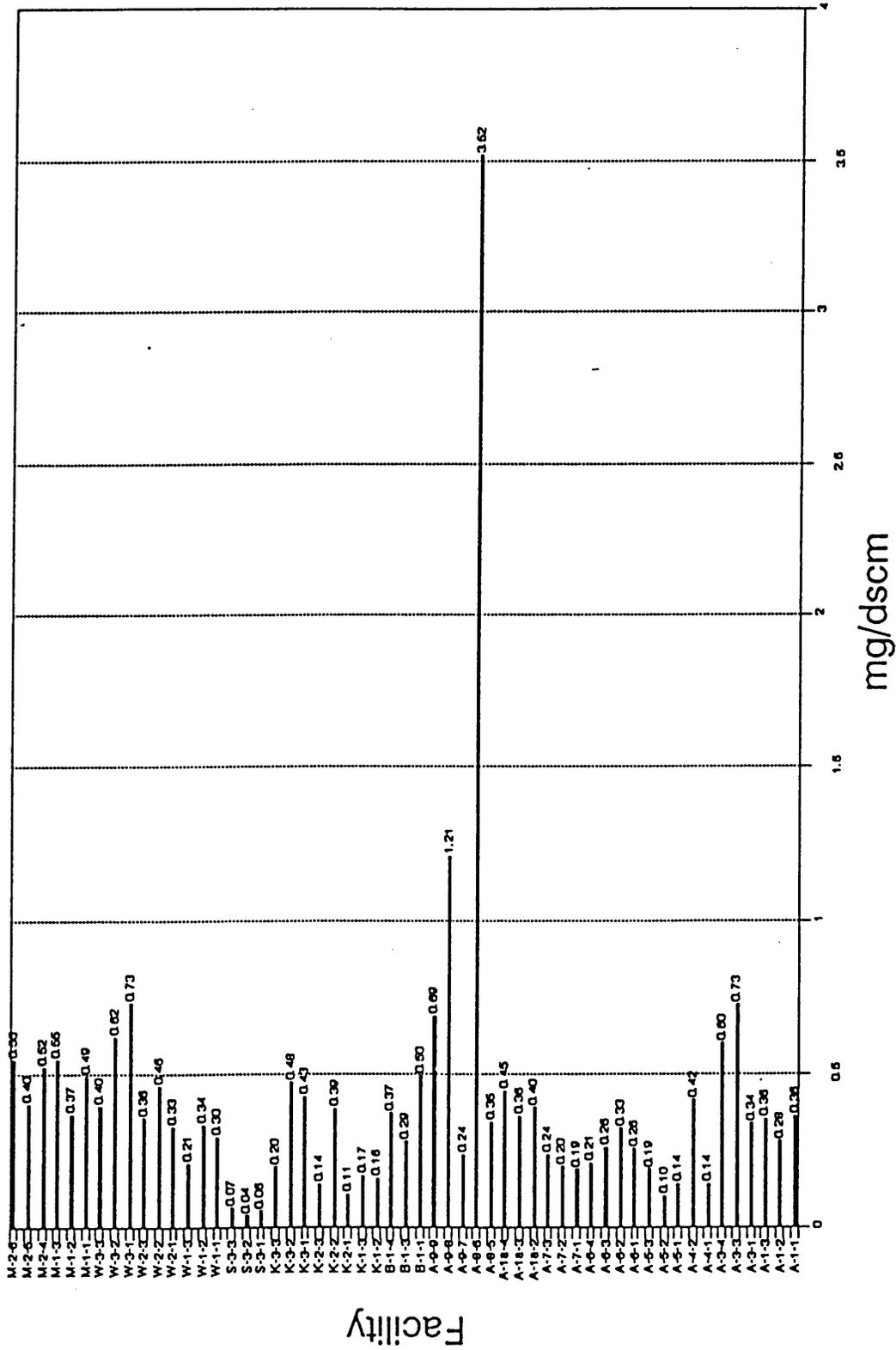


Figure 5. Cd emissions data used to set achievable emission levels for uncontrolled MWI's (corrected to 7 percent O<sub>2</sub>).

# Hg Emissions for Good Combustion

7.00  
7.97

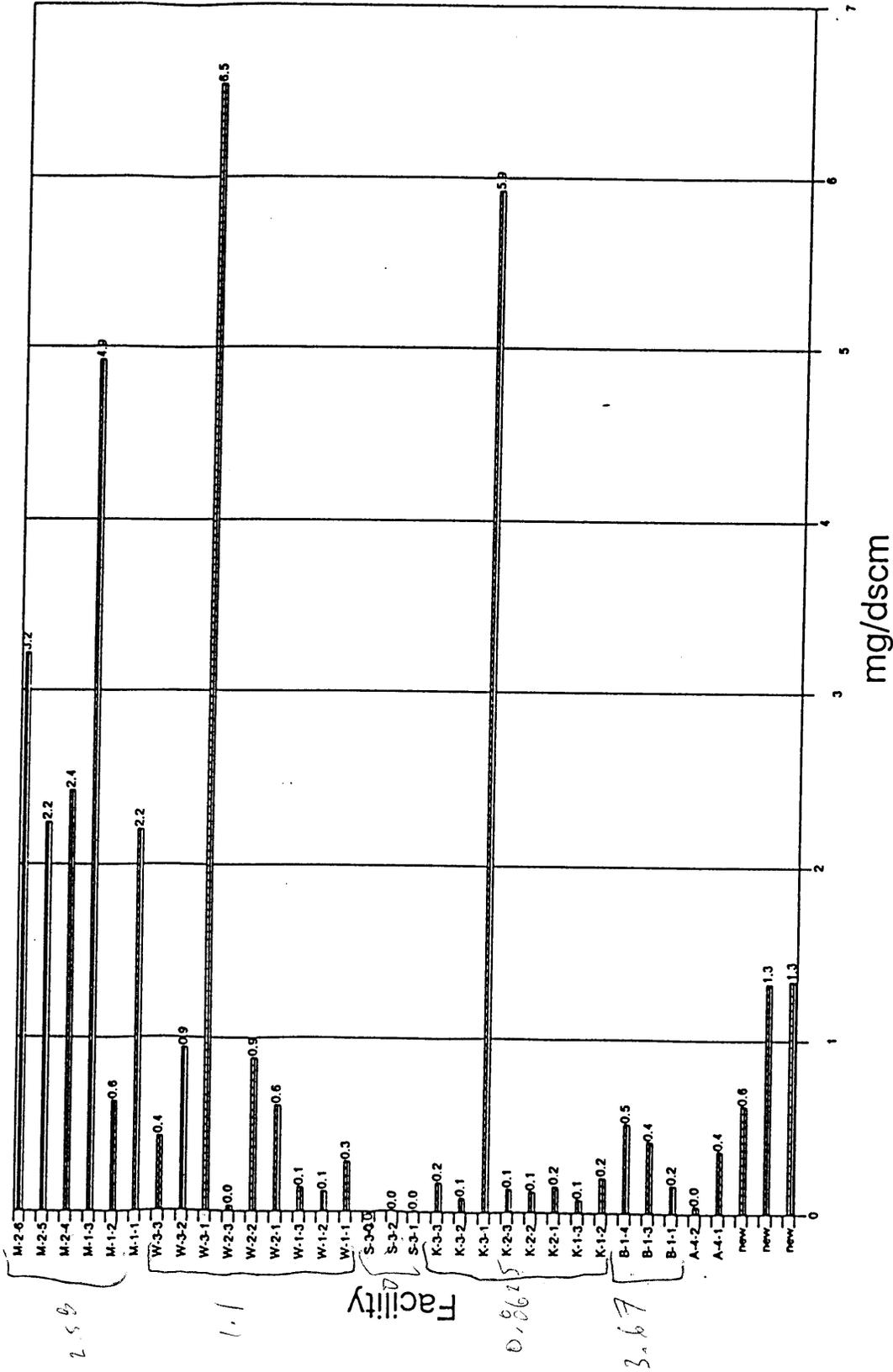


Figure 6. Hg emissions data used to set achievable emission levels for uncontrolled MWI's (corrected to 7 percent O<sub>2</sub>).

## VI. References

1. U. S. EPA. Medical Waste Incinerators - Background Information for Proposed Standards and Guidelines: Control Technology Performance Report for New and Existing Facilities. Research Triangle Park, North Carolina. Publication No. EPA-453/R-94-am. July 1994. 191 pp.
2. CSA Company. Source Emissions Test at Cumberland Memorial Hospital, Cumberland, Maryland, Medical Waste Incinerator Stack. October 8, 1992.
3. M. Turner, MRI, to R. Copland, EPA:ESD. September 15, 1995. Mercury Waste Reduction Program at Borgess Medical Center, Kalamazoo, Michigan.

