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Date: May 20, 1996

Subject: Dry Scrubber Performance Memorandum
Medical Waste Pyrolysis (Dibenzofurans, HCl, Hg): Response to Comments
EPA Contract No. 68-D1-0115; Work Assignment No. IV-108
ESD Project No. 90/17; MRI Project No. 6504-08

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I. Introduction

The purposes of this memorandum are to (1) provide background information on how dry scrubbers were factored into the proposed regulation for medical waste incinerators (MWI's) and the subsequent availability of new test data; (2) describe the quality of the new dry scrubber emission test data; (3) quantify the performance of dry scrubbers in controlling emissions from MWI's based on these data; and (4) develop achievable emission levels that could be applied to MWI's controlled by dry scrubbers. The remainder of this memorandum is organized into the following sections: Background, Emission Test Data Quality, Dry Scrubber Performance, and Achievable Dry Scrubber Emission Levels.

II. Background

In the development of the proposed regulation for MWI's, the U. S. Environmental Protection Agency (EPA) emission test program included two tests (with several test conditions) on two dry scrubber systems controlling emissions from two MWI's. These tests included the injection of activated carbon into the systems. Additionally, prior to proposal, EPA had reviewed several emission tests on other dry scrubbers controlling MWI's but had discarded these data because the test reports and/or test data were incomplete. The EPA used the emissions data from the test program to set the proposed emission limits for MWI's. Additionally, EPA concluded that the performance of dry scrubbers in controlling emissions from MWI's was superior to that of wet scrubbers. In a separate memorandum dated September 15, 1995, a discussion of the background surrounding the need for the EPA to reassess the performance of wet scrubbers in controlling

emissions from medical waste incinerators (MWI's) was presented. In making the decision to reassess the performance of wet scrubbers, EPA also elected to reassess the performance of dry scrubbers. This memorandum presents the results of the reassessment of dry scrubber performance.

In reassessing the performance of dry scrubber systems, EPA obtained five test reports for tests conducted on MWI's in which activated carbon was injected into the dry scrubber for enhanced mercury (Hg) and polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (CDD/CDF) control.

A. Emission Test Data Quality

Upon receipt of the additional emission test reports, the reports were submitted to the EPA's Emission Measurements Center (EMC) for a review for completeness. This review is typical of the type of review that is commonly done to approve the use of emission test data in setting air emission standards. The results of this review are found in reference 2. Additionally, reference 2 describes the general selection rules that were used in qualifying and accepting the available emission test data for use in the reanalysis of dry scrubber performance.

B. Dry Scrubber Performance

Midwest Research Institute developed dry scrubber performance graphs for particulate matter (PM), CDD/CDF, CDD/CDF toxic equivalency (TEQ), hydrogen chloride (HCl), lead (Pb), cadmium (Cd), and Hg. These graphs are depicted in Figures 1 through 7, respectively, and were developed using the qualified data from the analysis described in reference 2. Additionally, the emission test data from the EPA test program are also presented in the graphs with the exception of the Hg data from Facility A (Borgess). A recent test conducted at Borgess after the implementation a battery collection program, a fluorescent lamp recovery program, and a mercury spill protocol showed mercury emissions at the inlet to the dry scrubber to be significantly reduced (approximately an 85 percent reduction) from previous levels. The results of this test invalidated the outlet emissions measured during the previous Hg test, and these data were removed from the reassessment of performance. All emission test data are corrected to 7 percent oxygen. The following paragraphs briefly describe the performance of the dry scrubber systems in removing emissions of each pollutant listed above.

Figure 1 shows the performance of the dry scrubber systems in controlling PM emissions. Emissions range from 0.001 to 0.009 gr/dscf.

Figure 2 shows the performance of the dry scrubber systems in controlling CDD/CDF emissions. Figure 3 shows the resulting

CDD/CDF emission in terms of TEQ. Emissions range from 0.5 to 19.9 nanograms per dry standard cubic meter (ng/dscm) and from 0.02 to 0.53 ng/dscm TEQ.

Figure 4 shows the performance of the dry scrubber systems in controlling HCl emissions. Emissions range from 0.0 to 179.8 ppm.

Figures 5, 6, and 7 show the performance of the dry scrubber systems in controlling Pb, Cd, and Hg emissions. Emissions of these metals are dependent on the amount of these metals present in the waste processed by MWI's. For Pb, emissions range from 0.002 milligrams (mg)/dscm to 0.059 mg/dscm. For Cd, emissions range from 0.001 to 0.028 mg/dscm. Finally, for Hg, emissions range from 0.010 to 0.446 mg/dscm.

C. Achievable Dry Scrubber Emission Levels

After reassessing the performance of dry scrubbers, EPA developed achievable dry scrubber emission levels based on the data presented above. These achievable emission levels are listed in Table 1 for each pollutant. Table 1 also shows how the achievable emission levels were developed for each pollutant and shows the typical performance of these systems in controlling each pollutant. The typical performance levels were developed by taking an average of the given groups of data for which achievable emission levels were developed.

The basic process for developing the achievable emission levels was to identify the highest data point in a given group of data, to increase the highest data point by 10 percent, and then round up the result to some appropriate round number to obtain the achievable level. Table 1 shows the highest data point for the given ranges for each pollutant, the result of the 10 percent increase operation, and the subsequent emission level obtained through rounding. Additionally, Table 2 shows the achievable emission levels for the waste-related pollutants (HCl, Pb, Cd, and Hg) as a numerical concentration or as percent reduction. In discussions with the wet and dry scrubber vendors, the vendors indicated that while they could guarantee the achievable emission levels, a percent reduction alternative would be important because they have no control over the waste input to the MWI, and that slugs of these pollutants could make it difficult for their equipment to meet the emission level only.

The basic process for developing achievable emission levels was used for each pollutant with the exception of HCl. The HCl emission limit of 100 ppm was selected because this value represents the MACT floor. While the highest data point in the performance of dry systems is 179.8 ppm, EPA believes that the level of 100 ppm is achievable by dry systems. Figure 8 shows a graph of the dry scrubber HCl emissions data with respect to stoichiometric ratio. This graph shows that dry systems

operating with stoichiometric ratios greater than 5.2 consistently show emissions lower than 100 ppm. Another point to make about these data relates to the design of dry scrubber systems. From Figure 8, it is clear that most of the available data is from Facility A (Borgess). This system was one of the earliest installations of a dry scrubber; it does not have a retention chamber to increase the residence time of the lime with the HCl in the gas stream. Figure 8 shows that, for the newer systems with retention chambers (Facilities M, B, R, and MY), stoichiometric ratios lower than 5.2 can achieve emission levels significantly lower than 100 ppm.

D. Achievable Emission Levels for Batch MWI's Controlled By Dry Scrubbers

All of the available emission test data for dry scrubber systems controlling emissions from MWI's are for nonbatch MWI's; no test data are available for dry scrubbers controlling emissions from batch MWI's. Therefore, the data for the nonbatch MWI's were used to generate achievable emission levels for batch MWI's. Table 2 presents the achievable PM emission levels for batch MWI's controlled by dry scrubbers; these levels are identical to those for the nonbatch MWI's. Table 2 also presents the typical performance levels for dry scrubbers controlling emissions from batch MWI's. The typical performance levels for dry scrubbers controlling emissions during the burn and burndown/cooldown periods of a batch cycle were developed by taking the typical performance levels without controls developed for the burn and burndown/cooldown periods and multiplying these two numbers by the ratio of the achievable emission level for good combustion and the typical dry scrubber performance level.

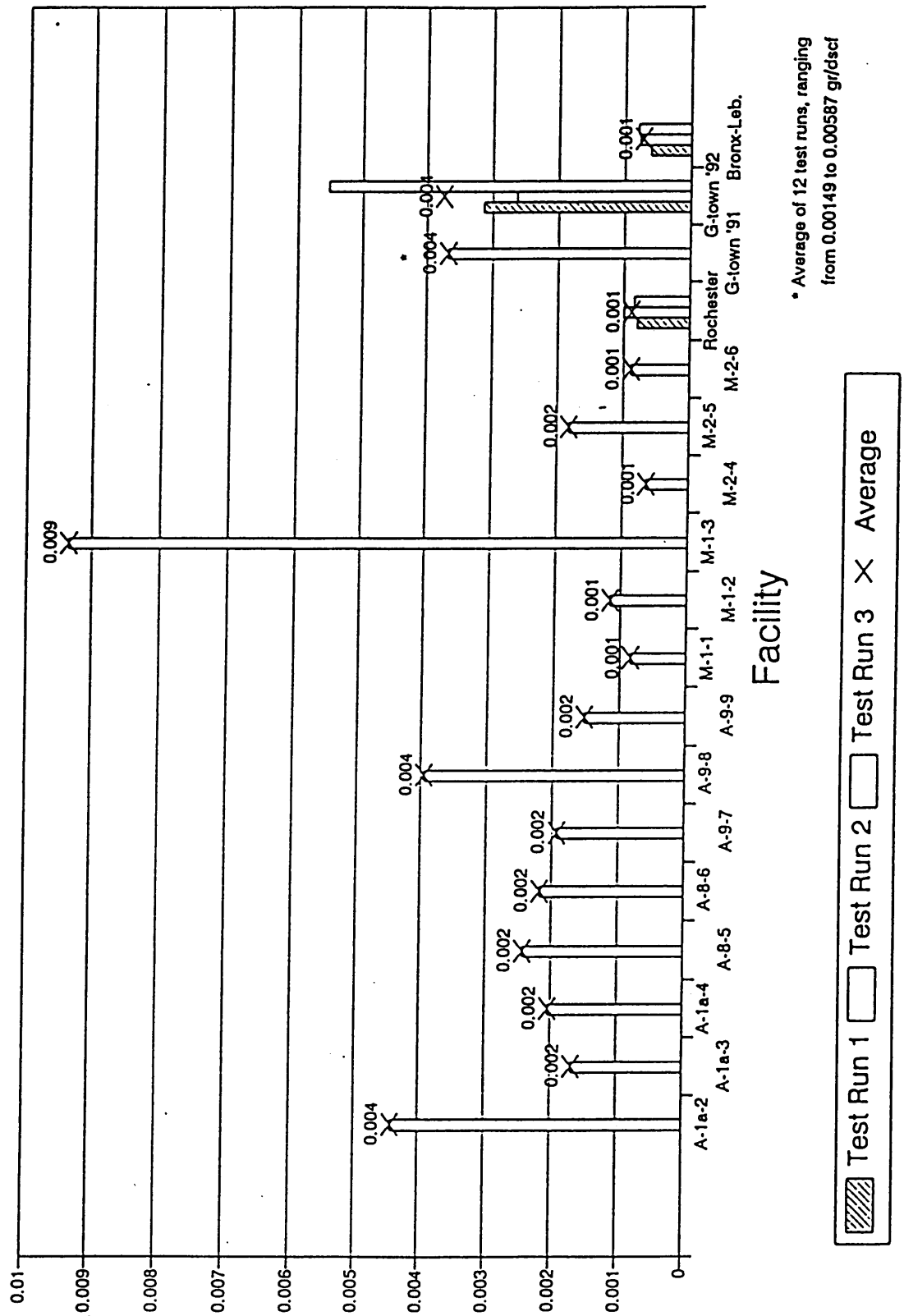

Figure 1. PM emissions for fabric filter systems (corrected 7 percent oxygen).

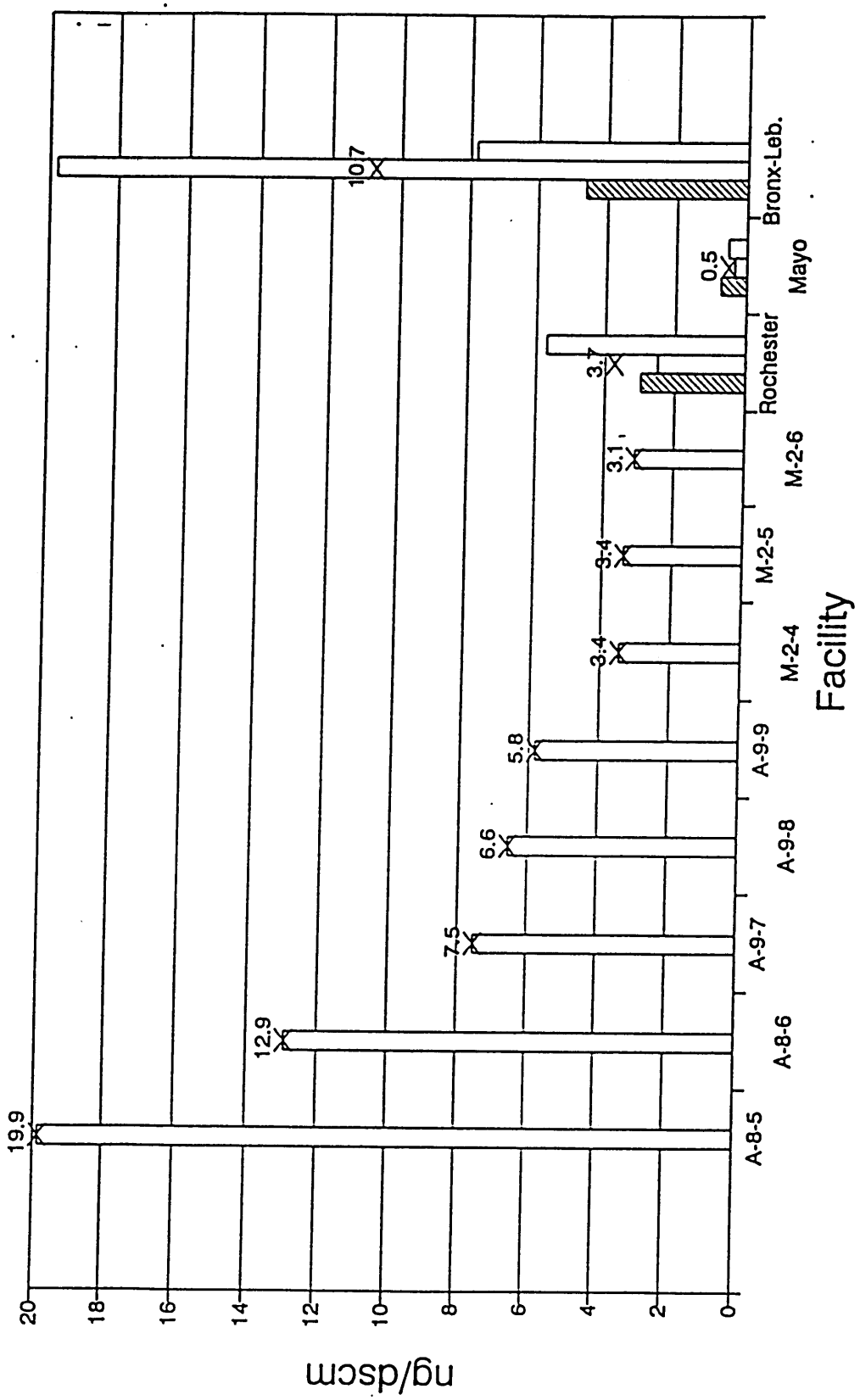

Figure 2. CDD/CDF emissions for fabric filter systems (corrected to 7 percent oxygen).

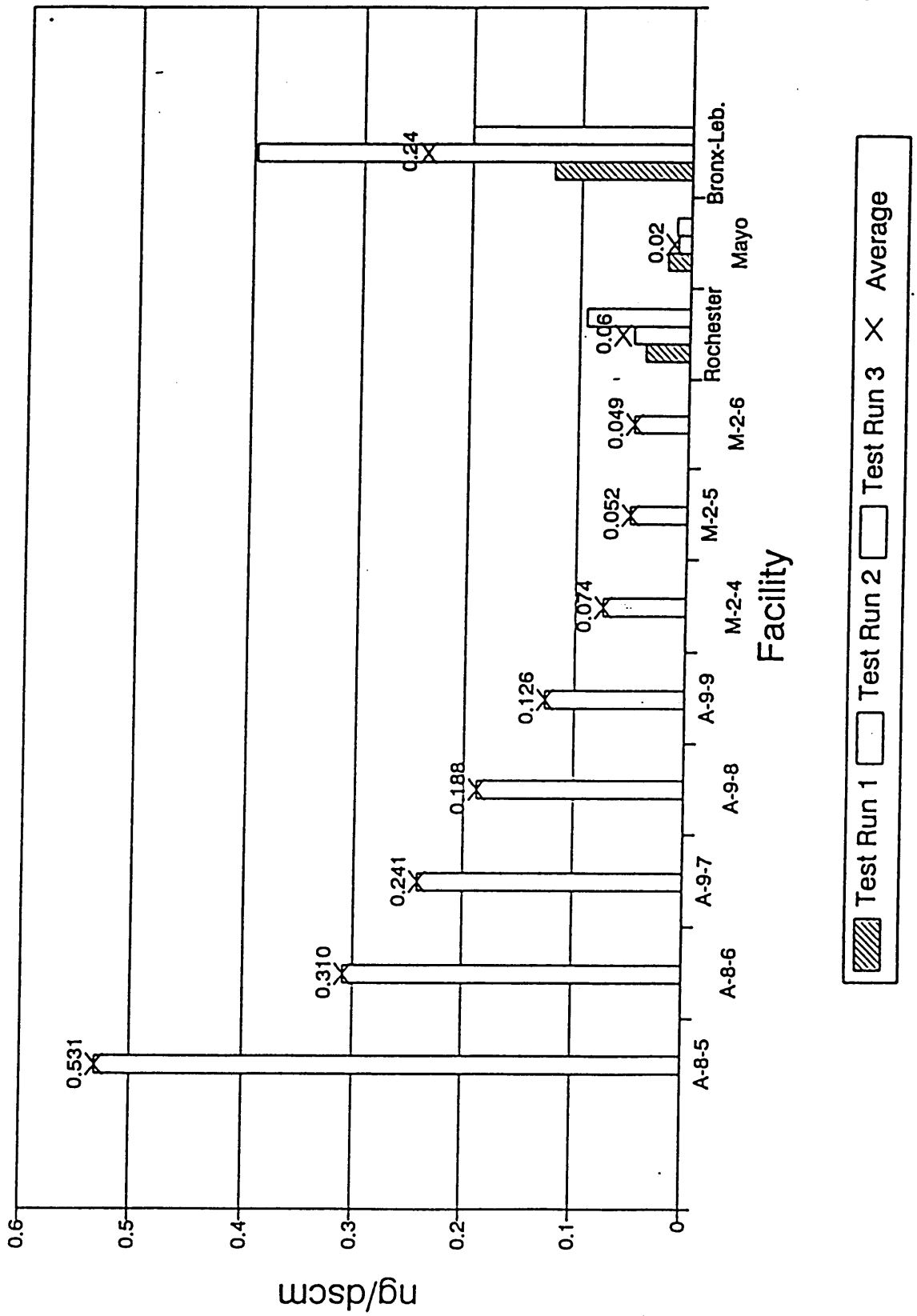

Figure 3. TEQ CDD/CDF emissions for fabric filter systems (at 7 percent oxygen).

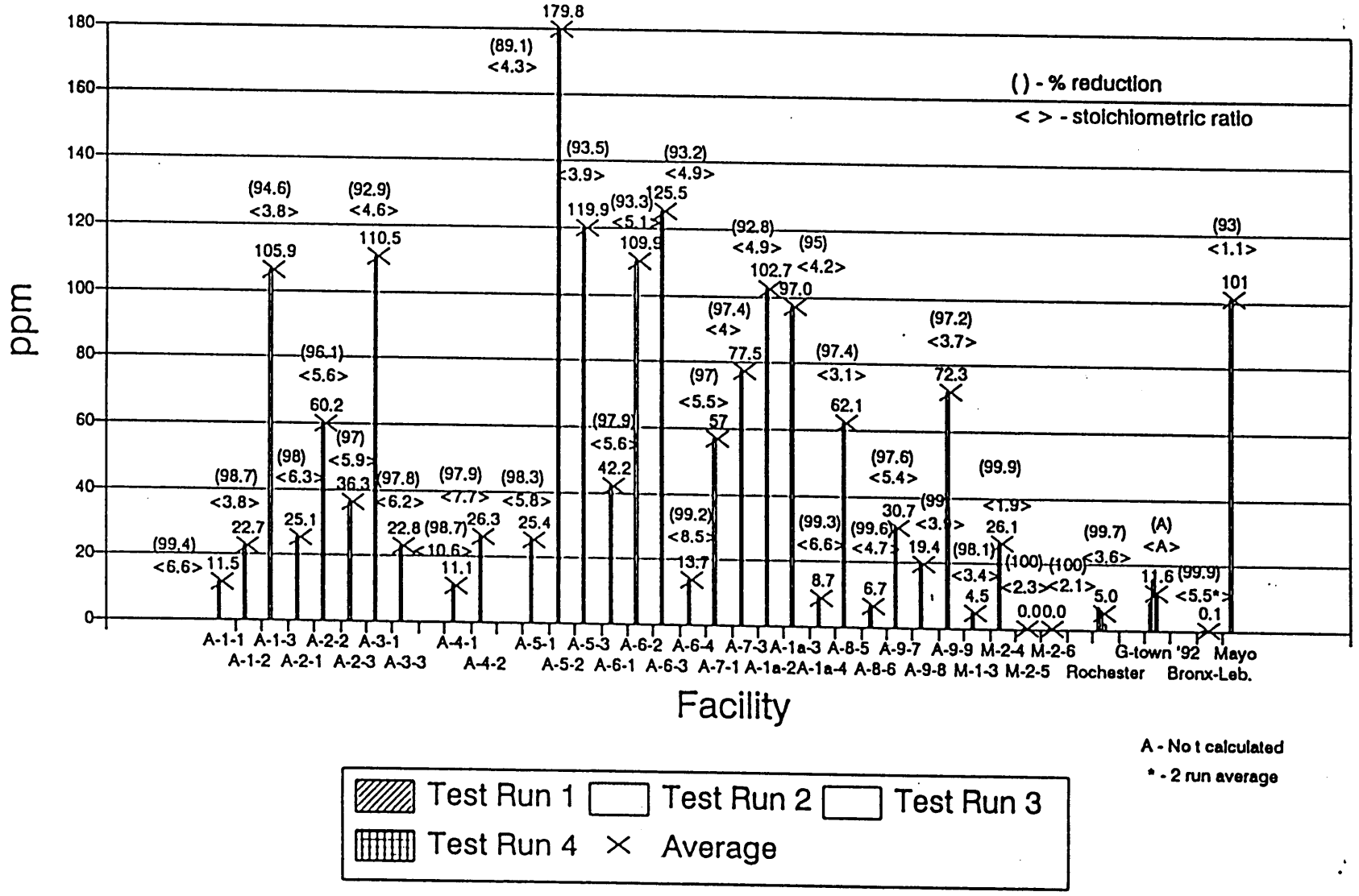

Figure 4. HCl emissions for fabric filter systems (corrected to 7 percent oxygen).

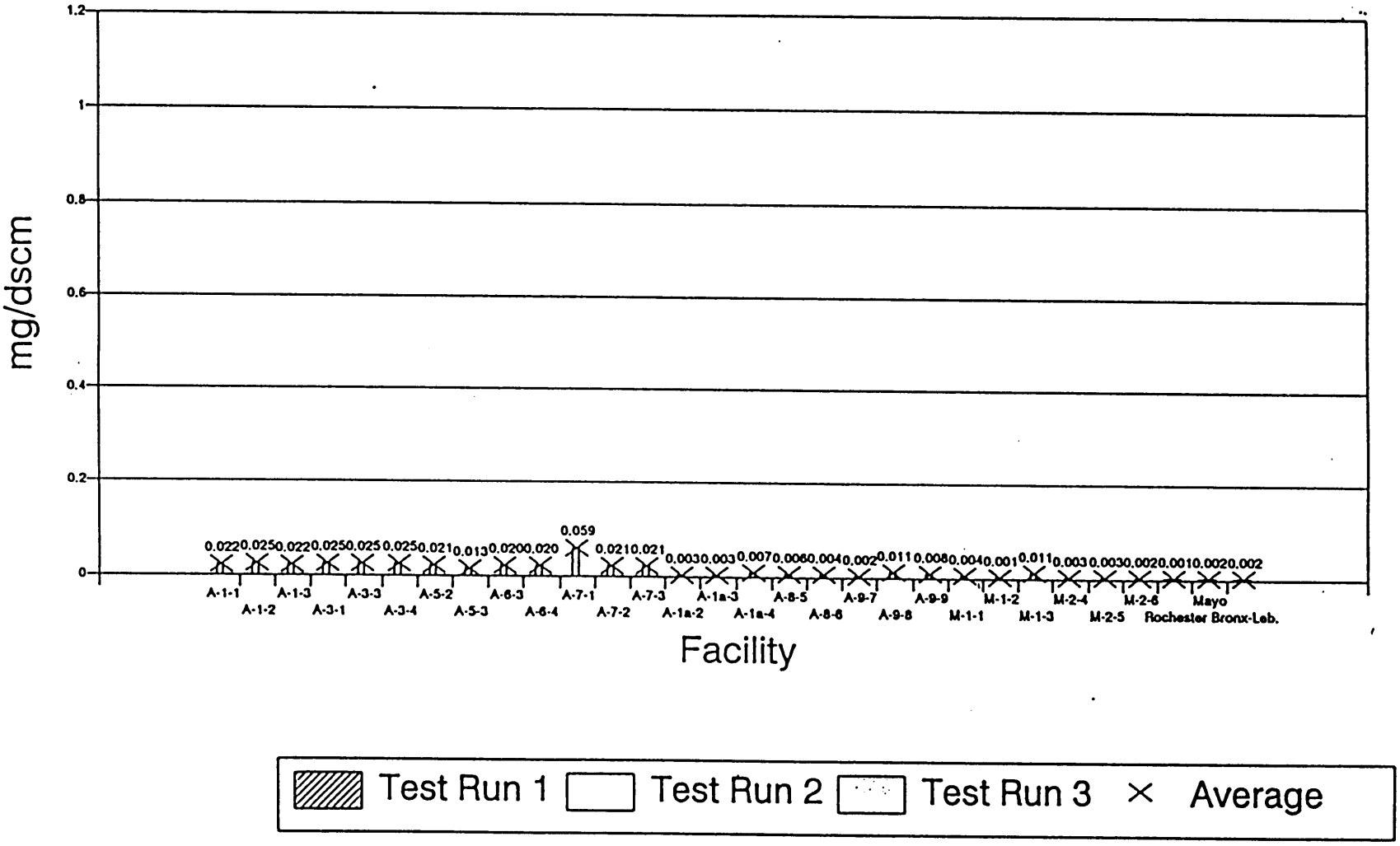

Figure 5. Lead emissions for fabric filter systems (corrected to 7 percent oxygen).

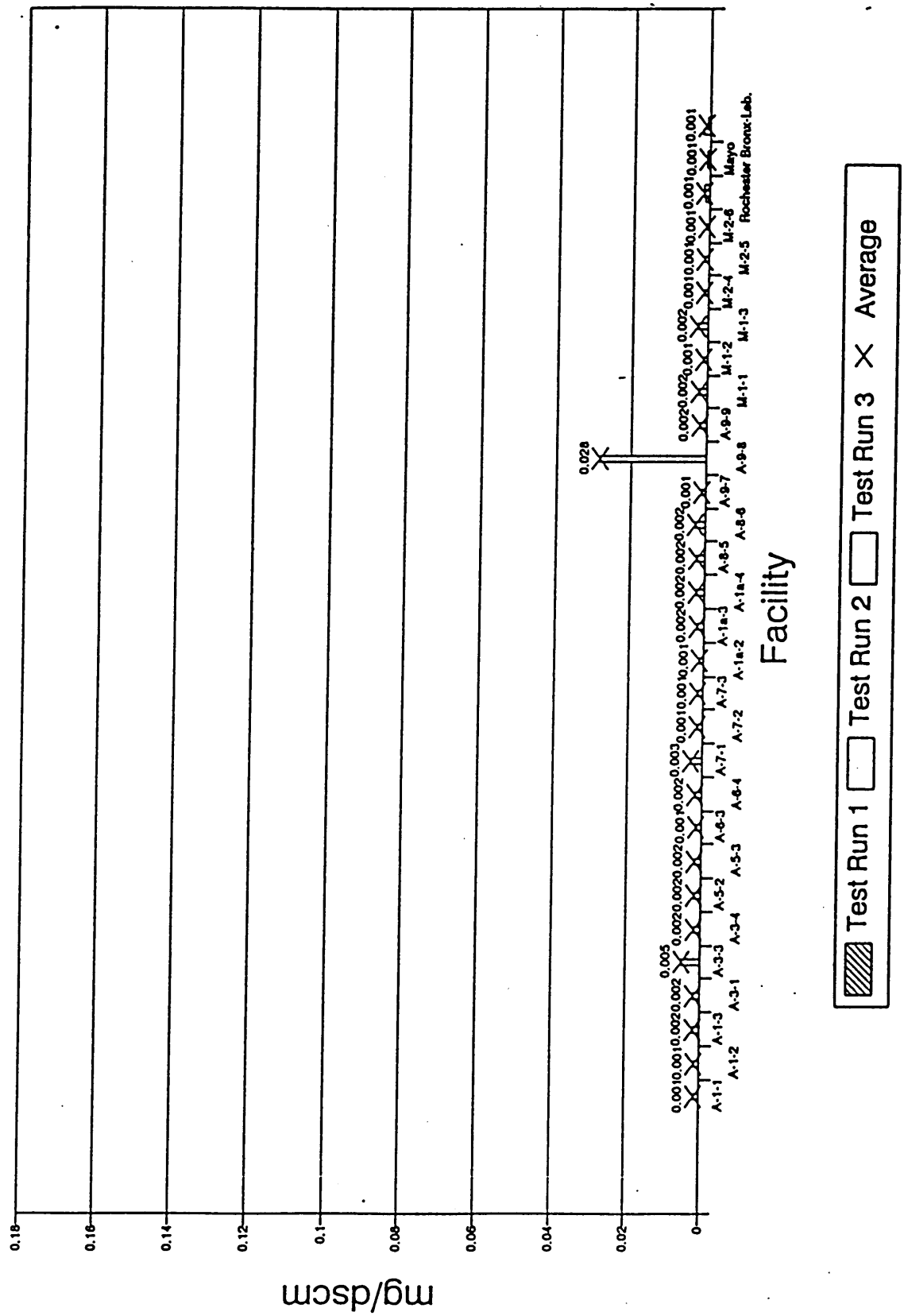

Figure 6. Cd emissions for fabric filter systems (corrected to 7 percent oxygen).

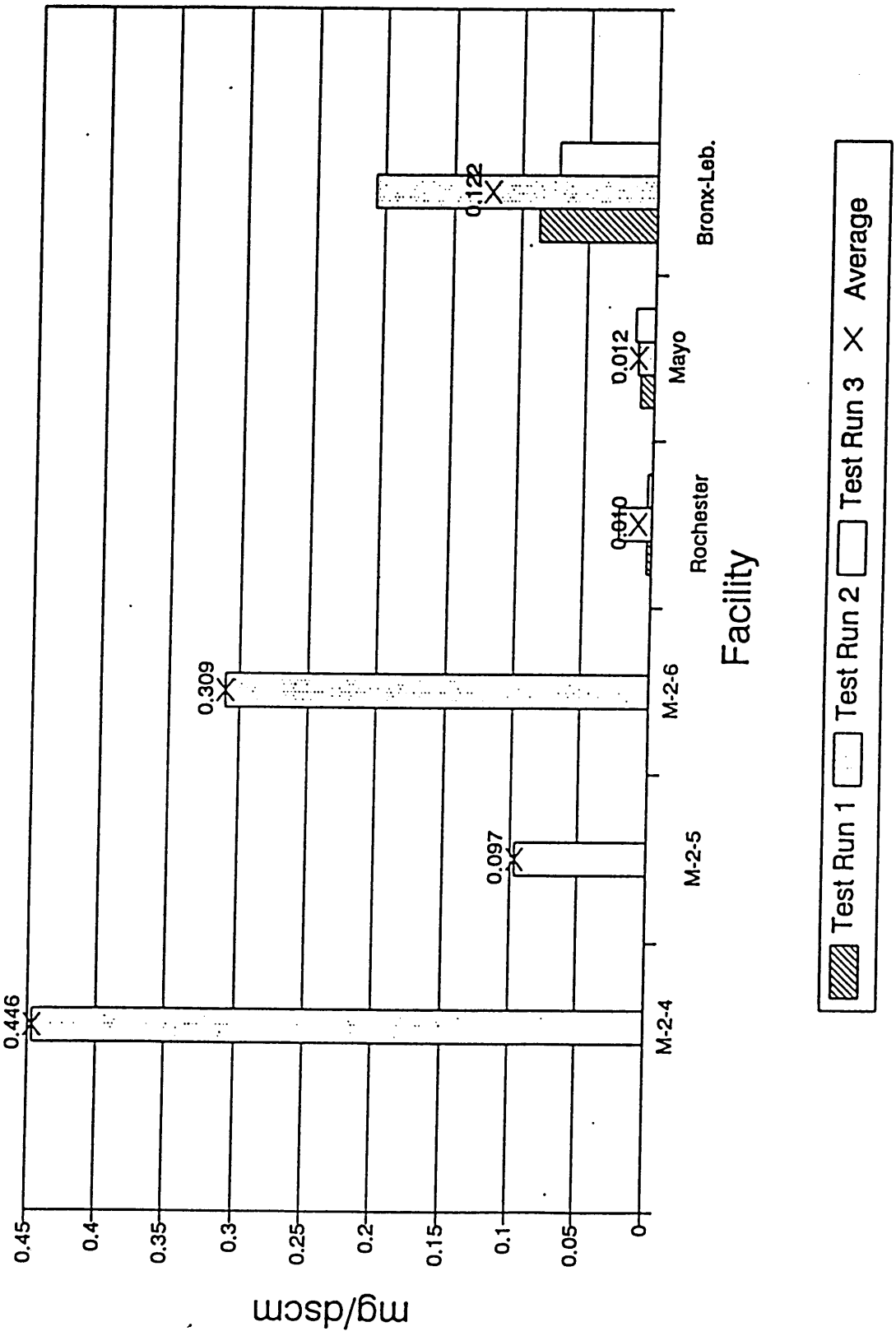

Figure 7. Hg emissions for fabric filter systems (corrected to 7 percent oxygen).

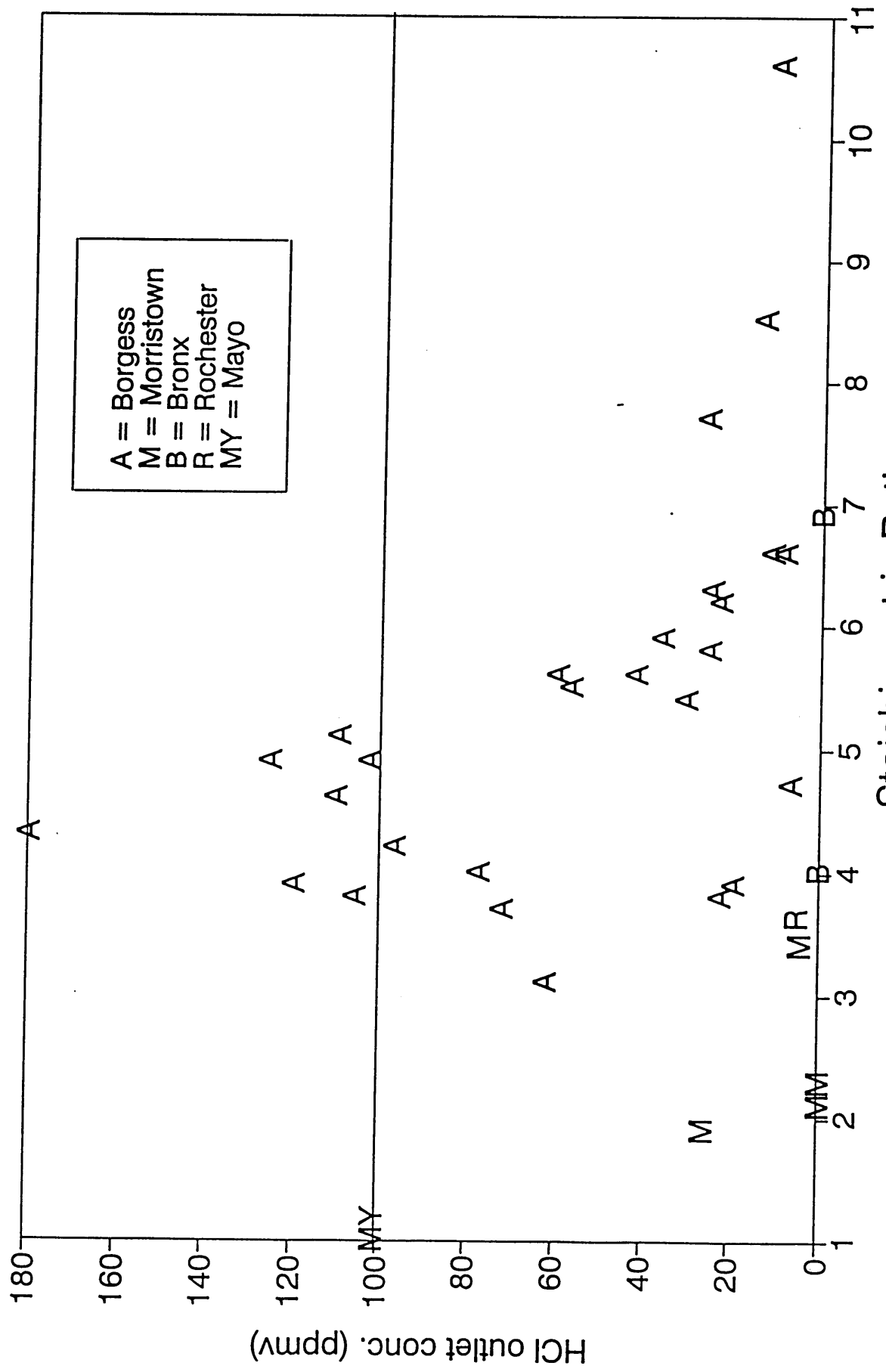

Figure 8. Stoichiometric ratio vs. outlet HCl emissions.

TABLE 1. DEVELOPMENT OF ACHIEVABLE EMISSION LEVELS FOR DRY SCRUBBERS AND TYPICAL PERFORMANCE

Pollutant	Highest data point	10 percent operation	Achievable emission level (rounded)	Typical performance
PM, gr/dscf	0.009	0.0099	0.015	0.0025
CDD/CDF, ng/dscm	19.9	21.89	25	7.0455
TEQ, ng/dscm	0.531	0.584	0.6	0.16
HCl, ppmv	97	106.7	100 or 93%	28.7407
Pb, mg/dscm	0.059	0.0649	0.07 or 98%	0.0131
Cd, mg/dscm	0.0283	0.03113	0.04 or 90%	0.0026
Hg, mg/dscm	0.446	0.4906	0.55 or 85%	0.166

TABLE 2. ACHIEVABLE PM EMISSION LEVELS FOR BATCH MWI's CONTROLLED BY DRY SCRUBBERS

Batch cycle	Rounded achievable emission levels	Typical performance, gr/dscf
Burn	0.015	0.0004
Burn down/cool down	0.015	0.0012

III. References

1. Turner, M. B., K. Hanks, Midwest Research Institute, memorandum to R. A. Copland, EPA. Wet Scrubber Performance Memorandum. May 20, 1996.

2. Turner, M. B., Midwest Research Institute, memorandum to R. A. Copland, EPA. Description of General Selection Rules for Medical Waste Incinerator/Air Pollution Control Device Emission Test Data. September 15, 1995.

3. 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-94-044a. July 1994. 191 pp.

4. E^3 Killam, Inc. Compliance Stack Test Report, Project No. S93023, University of Rochester Medical Center, Rochester, New York, University of Rochester. Project No. 89512, September 14-15, 1993. Report Date: January 28, 1994.

5. Clean Air Engineering. Diagnostic Testing Report, Project No. 584, Waste Management of North America, Inc., Facility, Germantown, Wisconsin. October 1, 1991. Report date October 28, 1991.

6. Clean Air Engineering. Compliance Testing Report, Project No. 6165, WMI Medical Services of Wisconsin, Germantown, Wisconsin, April 29-30, 1992. Report date June 9, 1992.

7. Interpoll Laboratories, Inc. Air Emission Performance Testing, Mayo Foundation, Rochester, Minnesota, March 15-17, 1994. Report date March 31, 1994.

8. E^3 Inc. Stack Emission Test, Montenay-Bronx, Inc. Facility at Bronx-Labanon Hospital Center, Bronx, New York. November and December 1992. Report date December 31, 1992.