2.1/4.0/2

SUMMARY OF CADMIUM AND LEAD EMISSIONS DATA FROM MUNICIPAL WASTE COMBUSTORS

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1.0 INTRODUCTION

Section 129 of the Clean Air Act Amendments of 1990 directs the U.S. Environmental Protection Agency (EPA)to establish standards for emissions of cadmium and lead from new and existing municipal waste combustor (MWC) units. Cadmium and lead are volatile at temperatures present in combustion systems, but condense onto particulate matter (PM) at temperatures associated with the operation of most PM control systems. As a result, the control of cadmium and lead emissions from combustion systems is generally related to the control of PM emissions. However, because of the potential for enrichment of these metals onto fine PM that is less readily collected than larger PM, the control efficiency for these metals may be lower than for total PM.

This report presents information on cadmium and lead emissions from 37 different MWC plants operating in the U.S., and examines the effectiveness of several different types of air pollution control devices (APCD's) at controlling emissions of these two metals. Section 2.0 summarizes data on the uncontrolled levels (i.e., prior to the APCD) of cadmium and lead present in MWC flue gas. Sections 3.0 through 7.0 review cadmium and lead emissions data from MWC's equipped with the following APCD configurations: electrostatic precipitator (ESP) only (Section 3.0), furnace sorbent injection (FSI) or duct sorbent injection (DSI) combined with an ESP (Section 4.0), spray drying (SD) combined with an ESP (Section 5.0), DSI combined with a fabric filter (FF) (Section 6.0), and SD combined with a FF (Section 7.0). Each of these five sections reviews outlet (i.e., stack) levels of cadmium and lead, percent removal of cadmium and lead across the APCD system and its relationship to the removal of PM, and relationships between emissions control and key operating variables associated with specific APCD types. Section 8.0 provides a summary overview of the data for all the pollution control categories.

2.0 CHARACTERIZATION OF AVAILABLE DATA

2.1 CHARACTERIZATION OF DATABASE

Cadmium and lead emissions data have been compiled from MWC units located at 37 separate facilities. Of these 37 facilities, 25 have mass burn waterwall (MB/WW) combustors, one has mass burn waterwall rotary (MB/RC) combustors, one has mass burn refractory (MB/R) combustors, six have refuse derived fuel combustors (RDF), two have modular excess-air (MOD/EA) combustors, and two have modular starved-air (MOD/SA) combustors. A summary description of each of these facilities is presented in Table 1, and includes combustor type, APCD type, and whether inlet and outlet concentrations of PM, cadmium, and lead were reported. A tabulation of the measured inlet and outlet concentrations of PM, cadmium, and lead (corrected to 7 percent oxygen (O_2)), and the number and capacity of MWC units at each facility is presented in Appendix A.

Table 1 identifies six different APCD types. Nine of the MWC's are equipped with an ESP only, one is equipped with an FSI/ESP, seven use SD/ESP's, five have DSI/FF's, and 15 have SD/FF's. In addition, the database includes emissions data collected during parametric testing at the Dayton MWC when ESP only, DSI/ESP, and FSI/ESP systems were used, and during pilot-scale testing at the Quebec City MWC, which evaluated DSI/FF and SD/FF performance.

The primary data source used to develop the database was the MWC Background Information Document (BID) on Post-Combustion Technology Performance.[1] Data for the Babylon, SEMASS, Vancouver, and Indianapolis MWC's were taken from Appendix C of the Promulgation BID.[2] Data for the Detroit, Honolulu, West Palm Beach, and Portland MWC's were taken directly from individual facility test reports.[3-6] Data from the Hillsborough, Bridgeport, Gloucester, Bristol, Fairfax, Hempstead, Concord, and Alexandria MWC's were supplied directly from vendors.[7,8]

Data presented in the Post-Combustion Technology Performance BID from the Munich, Germany and NSP Red Wing MWC's were not included in the data analysis due to deficiencies in data quality. The Munich metals data were collected during 40 continuous hours of nonsteady-state testing and are considered atypical of normal operating conditions. As a result, these data are not comparable to cadmium and lead emissions data from other

TABLE 2-1. SUMMARY OF PM, CADMIUM, AND LEAD MEASUREMENTS FROM EXISTING MWC's

MWC Name	Combust Type	APCD Type	PM		CD		Pb	
			In	Out	In	Out	In	Out
Hillsborough	MB/WW	ESP		X				X
Pinellas County	MB/WW	ESP		X		X		X
Quebec City	MB/WW	ESP		X		X		X
Tulsa	MB/WW	ESP		X		X		X
Charleston	MB/WW	SD/ESP				X		X
Haverhill	MB/WW	SD/ESP		X		X		X
Millbury	MB/WW	SD/ESP		X		X		X
Portland	MB/WW	SD/ESP		X		X		X
Concord	MB/WW	DSI/FF		X				X
Burnaby (Vancouver)	MB/WW	DSI/FF		X	X	X	X	X
Quebec City (Pilot)	MB/WW	DSI/FF			X	X	X	X
Wurzburg	MB/WW	DSI/FF		X		X		X
Babylon	MB/WW	SD/FF		X		X		X
Bridgeport	MB/WW	SD/FF		X		X		X
Bristol	MB/WW	SD/FF		X		X		X
Commerce	MB/WW	SD/FF			X	X	X	X
Fairfax	MB/WW	SD/FF		X		X		X
Gloucester	MB/WW	SD/FF		X		X		X
Hempstead	MB/WW	SD/FF		X		X		X
Huntsville	MB/WW	SD/FF		X				X
Indianapolis	MB/WW	SD/FF		X				X
Kent	MB/WW	SD/FF		X		X		X
Long Beach	MB/WW	SD/FF	X	X		X		X
Marion County	MB/WW	SD/FF	X	X	X	X	X	X
Quebec City (Pilot)	MB/WW	SD/FF	X		X	X	X	X
Stanislaus County	MB/WW	SD/FF		X		X		X
Dutchess County	MB/RC	DSI/FF		X		X		X
Alexandria	MB/WW	FSI/ESP		X		X		X

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TABLE 2-1. SUMMARY OF PM, CADMIUM, AND LEAD MEASUREMENTS FROM EXISTING MWC's (Continued)

MWC Name	Combust Type	APCD Type	PM		CD		Pb	
			In	Out	In	Out	In	Out
Dayton	MB/Ref	ESP	X	X	X	X	X	X
Dayton	MB/Ref	DSI/ESP	X	X	X	X	X	X
Dayton	MB/Ref	FSI/ESP	X	X	X	X	X	X
Detroit	RDF	ESP		X		X		X
Honolulu	RDF	SD/ESP		X				X
SEMASS	RDF	SD/ESP	X	X		X		X
West Palm Beach	RDF	SD/ESP	X	X				X
Biddeford	RDF	SD/FF	X	X	X	X	X	X
Mid-Connecticut	RDF	SD/FF	X	X	X	X	X	X
Pigeon Point	MOD/EA	ESP		X				X
St. Croix	MOD/EA	DSI/FF				X		X
Barron County	MOD/SA	ESP		X		X		X
Oneida County	MOD/SA	ESP		X		X		X

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MWC's. The NSP Red Wing MWC data were not included because of problems with significant flue gas turbulence at the inlet sampling location and the lack of a simultaneous period of PM and metals sampling.

Also, data from one of the Dayton MWC ESP conditions and two of the Quebec City MWC ESP test conditions were deleted from the data set because the combustor conditions tested did not represent normal operation.

Testing at 11 other MWC's (as noted in Appendix A) did not include simultaneous PM and metals sampling. However, the PM and metals sampling was generally conducted on the same day and at similar combustor and APCD operating conditions. As a result, PM and metals emissions data from these MWC's are considered acceptable for use in this analysis.

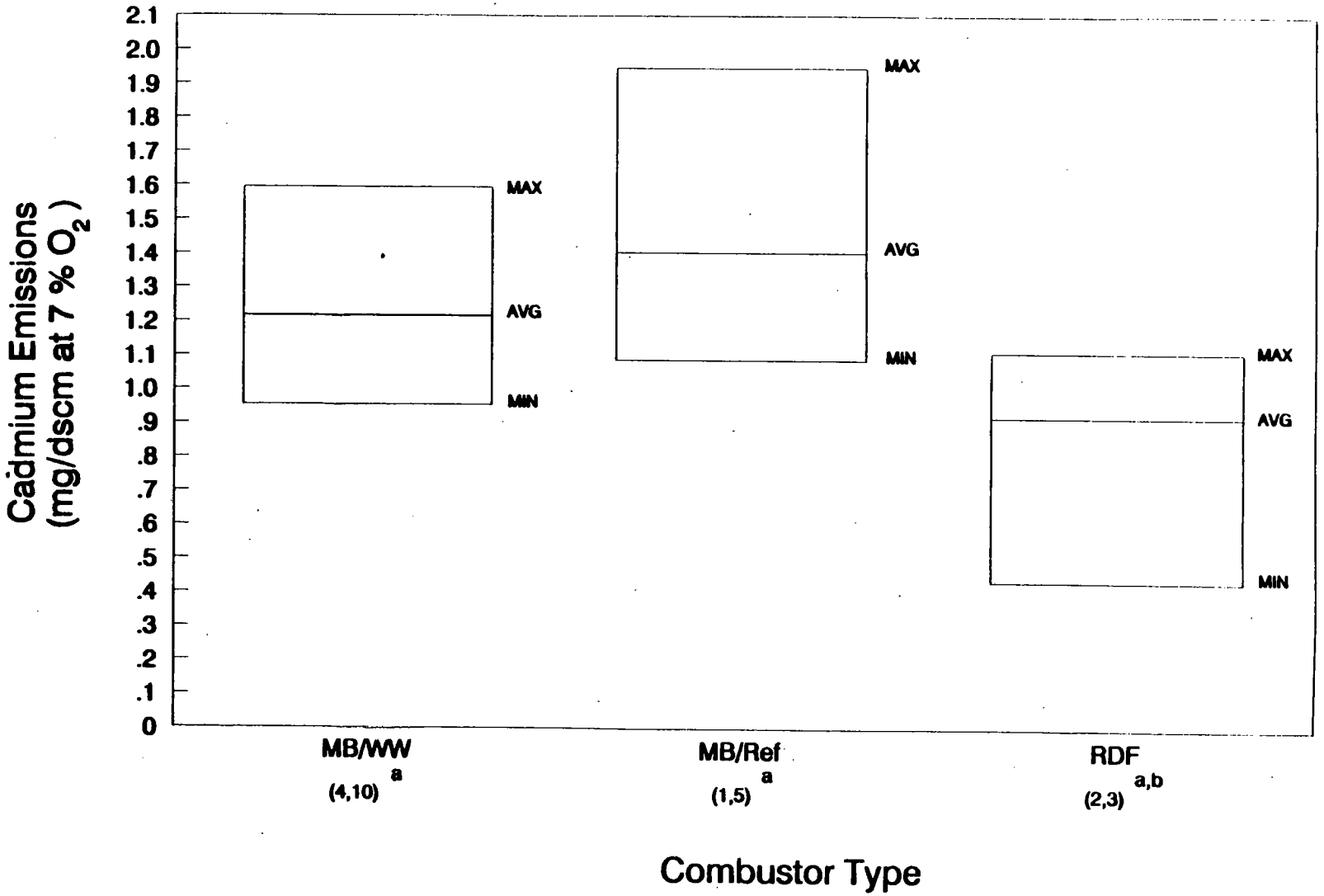
2.2 UNCONTROLLED CADMIUM AND LEAD EMISSIONS

Figures 1 and 2 present the average, minimum, and maximum uncontrolled emissions of cadmium and lead by MWC type from seven MWC's that reported inlet cadmium and lead concentrations. Four of the MWC's are MB/WW's, one is a MB/Ref, and two are RDF's. Because of multiple tests conducted at some of these facilities, there are a total of 18 data sets: 10 from the MB/WW units, five from the MB/Ref unit, and three from the RDF units.

The data include uncontrolled cadmium concentrations ranging from 0.44 to approximately 2.0 mg/dscm, and uncontrolled lead concentrations ranging from 2.6 to 37.4 mg/dscm. Uncontrolled cadmium emissions from each of these three combustor types average 0.93 mg/dscm for RDF, 1.22 mg/dscm for MB/WW, and 1.40 mg/dscm for MB/Ref. Uncontrolled lead emissions average 24.4 mg/dscm for RDF, 29.7 mg/dscm for MB/WW, and 31.9 mg/dscm for MB/Ref. In addition to the data presented in Figures 1 and 2, emissions data collected from two MOD/SA MWC's not equipped with air pollution control show uncontrolled emissions of roughly 1.1 mg/dscm for cadmium and 20 mg/dscm for lead, which falls within the ranges of data from the other combustor types.[1]

Although the average uncontrolled levels of cadmium and lead emissions from these combustors suggest that emissions from RDF and MOD/SA MWC's may be lower than from MB/WW and MB/Ref MWC's, the limited number of data points for different combustor types are such that clear distinctions are not possible. Another

FIGURE 1. UNCONTROLLED CADMIUM EMISSIONS

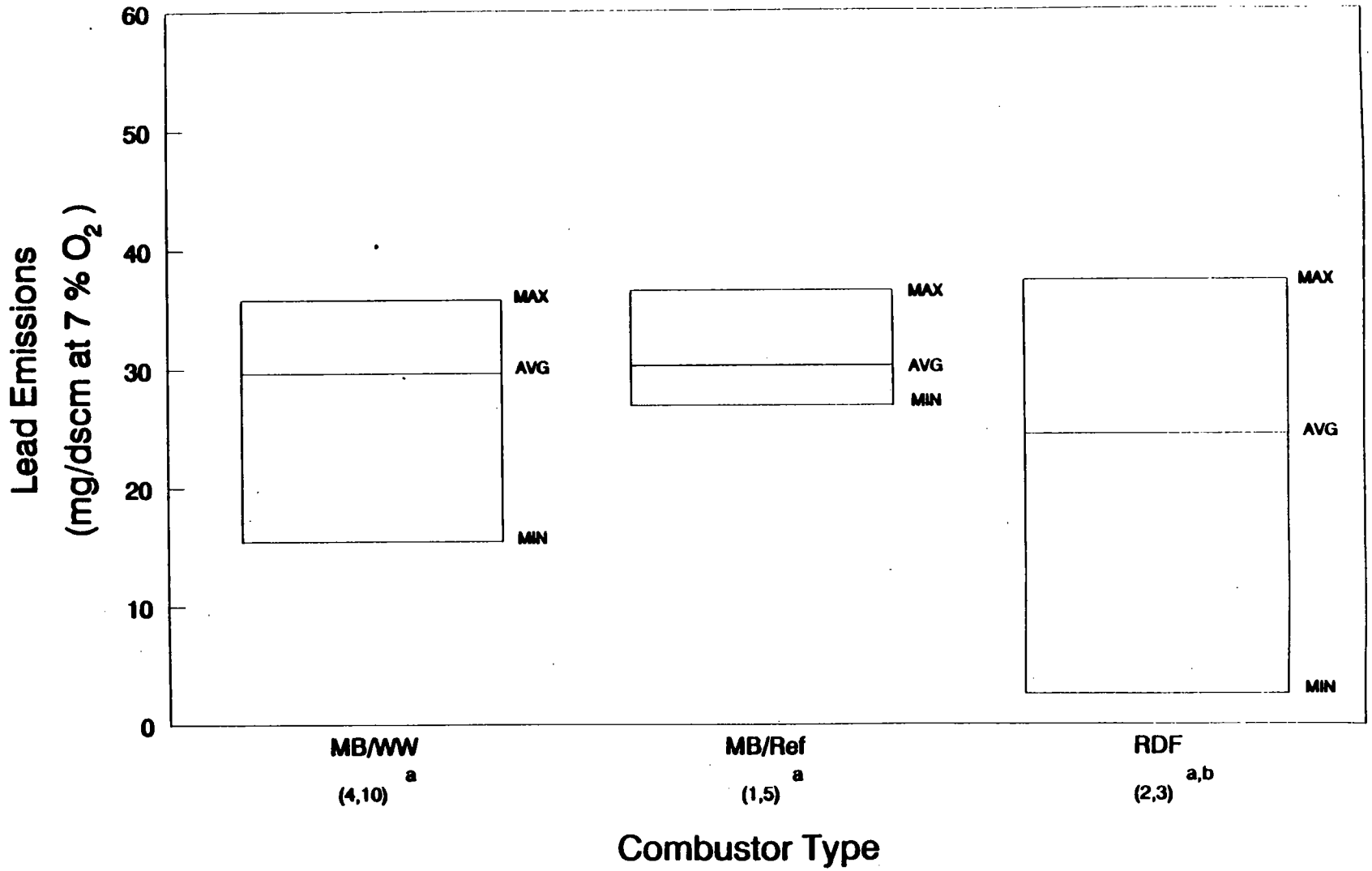


MB/WW - Mass Burn, Waterwall MB/Ref - Mass Burn, Refractory RDF - Refuse Derived Fuel

[a] Indicates number of facilities represented and corresponding number of test averages used to determine range and average.

[b] 13 runs conducted during Mid-Connecticut's parametric testing were represented individually when determining range, but were represented as one test average when calculating overall average.

FIGURE 2. UNCONTROLLED LEAD EMISSIONS



MB/WW - Mass Burn, Waterwall MB/Ref - Mass Burn, Refractory RDF - Refuse Derived Fuel

[a] Indicates number of facilities represented and corresponding number of test averages used to determine range and average.

[b] 13 runs conducted during Mid-Connecticut's parametric testing were represented individually when determining range, but were represented as one test average when calculating overall average.

limitation with the uncontrolled emissions data is the scatter in individual measurements. For example, the minimum cadmium and lead levels presented for RDF units were measured during parametric testing conducted at the Mid-Connecticut MWC and were noticeably lower than the levels measured previously during compliance testing at the same facility. In addition, all of the MB/Ref data are from the Dayton MWC and were collected downstream of the flue gas conditioning chamber. Because of differences in the design of the Dayton combustor relative to other MB/Ref systems and the uncertain impact of the conditioning chamber on measured cadmium and lead levels, the data from this facility may not be representative of other MB/Ref MWC's.

3.0 EMISSIONS FROM ESP-CONTROLLED MWC'S

3.1 OUTLET EMISSIONS

Nine of the facilities in the database are equipped with ESP'S. These include four MB/WW facilities (Hillsborough, Pinellas County, Tulsa, and Quebec City), one MB/Ref (Dayton), one RDF (Detroit), two MOD/SA (Barron County and Oneida County), and one MOD/EA (Pigeon Point). Lead emissions were measured at all nine facilities while cadmium emissions were measured at only six (not measured at Hillsborough, Pigeon Point, or Tulsa).

Average outlet cadmium concentrations at the six facilities range from 0.008 mg/dscm at Pinellas County to 0.092 mg/dscm at Oneida County. Average outlet lead concentrations range from 0.15 mg/dscm at Pinellas County and Pigeon Point to 1.15 mg/dscm at Quebec City. At Detroit, the outlet concentrations of both cadmium and lead were reported as not detectable.

Figures 3 and 4 present outlet PM concentrations measured at these facilities versus outlet cadmium and lead concentrations, respectively. Figure 3 strongly suggests a linear relationship between cadmium and PM emissions over the entire range of the data. Figure 4 suggests a similar relationship between lead and PM emissions, with the exception of Oneida County (Point 7), and Tulsa (Point 4B). The MOD/SA units in place at Oneida County operate at relatively low gas velocities in the primary combustion chamber and have relatively low uncontrolled PM levels (e.g., 0.1 gr of PM per dscf versus 1-3 gr per dscf for other combustor types). Differences in metal volatility due to oxidizing versus reducing conditions also were examined, but do not appear to explain why lead emissions from MOD/SA units may be lower than from other MWC types.

The possible impact of ESP operating temperature on cadmium and lead emissions was also examined. The two MWC's with the lowest cadmium and lead emissions are Pinellas County and Detroit, which also have above average ESP inlet temperatures. At Dayton, tests were conducted at ESP inlet temperatures of roughly 560^{o}F (Points 9A) and 400^{o}F (Point 9B). Comparison of Point 9A versus 9B indicates that the difference in ESP inlet temperature did not influence cadmium or lead emissions. The higher cadmium level of 9A versus 9B results from a higher cadmium level during a single run of the three runs included in Point 9A, rather than a general trend. Based on these data,

FIGURE 3. CADMIUM OUTLET EMISSIONS FROM MWC'S WITH ESP'S

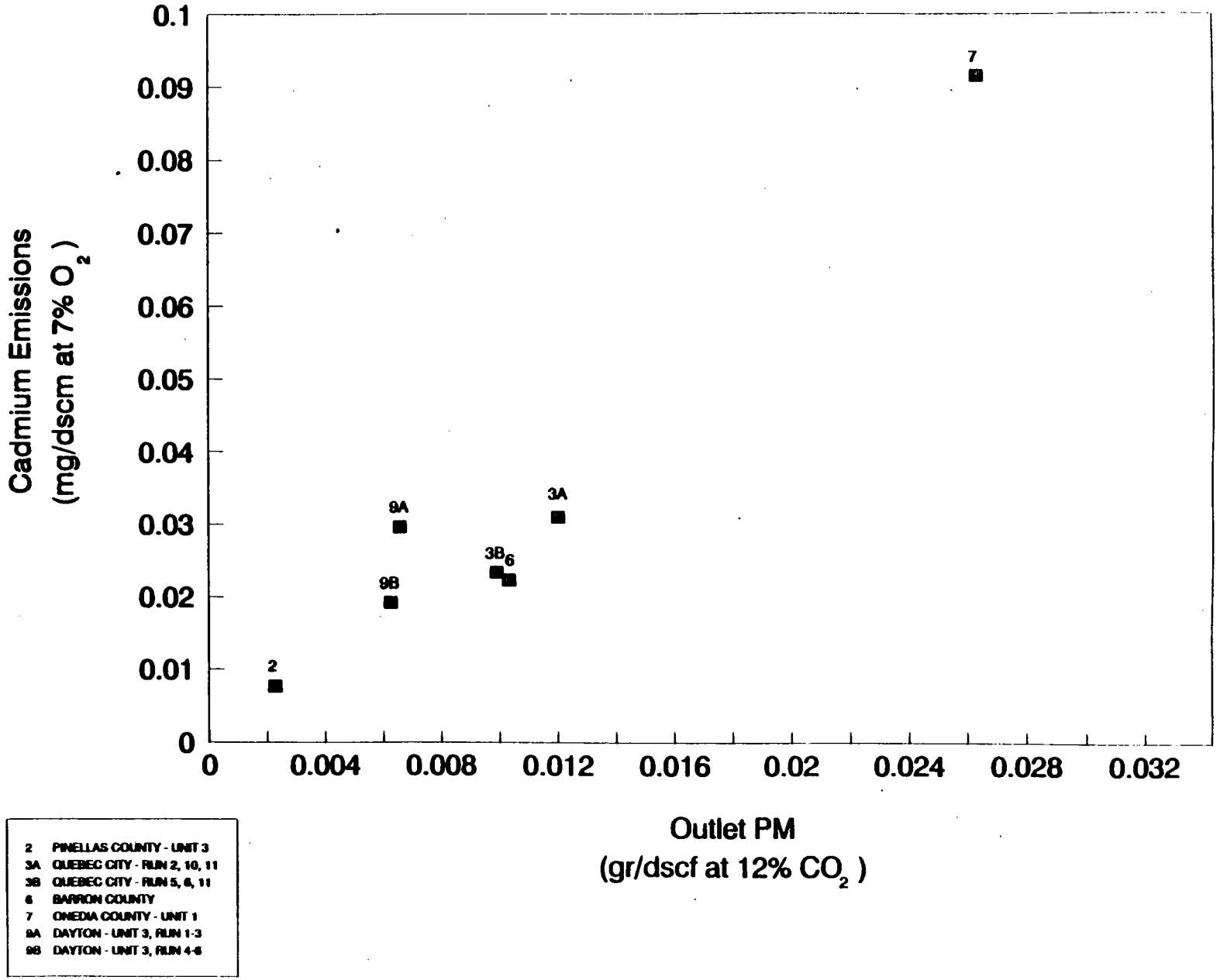
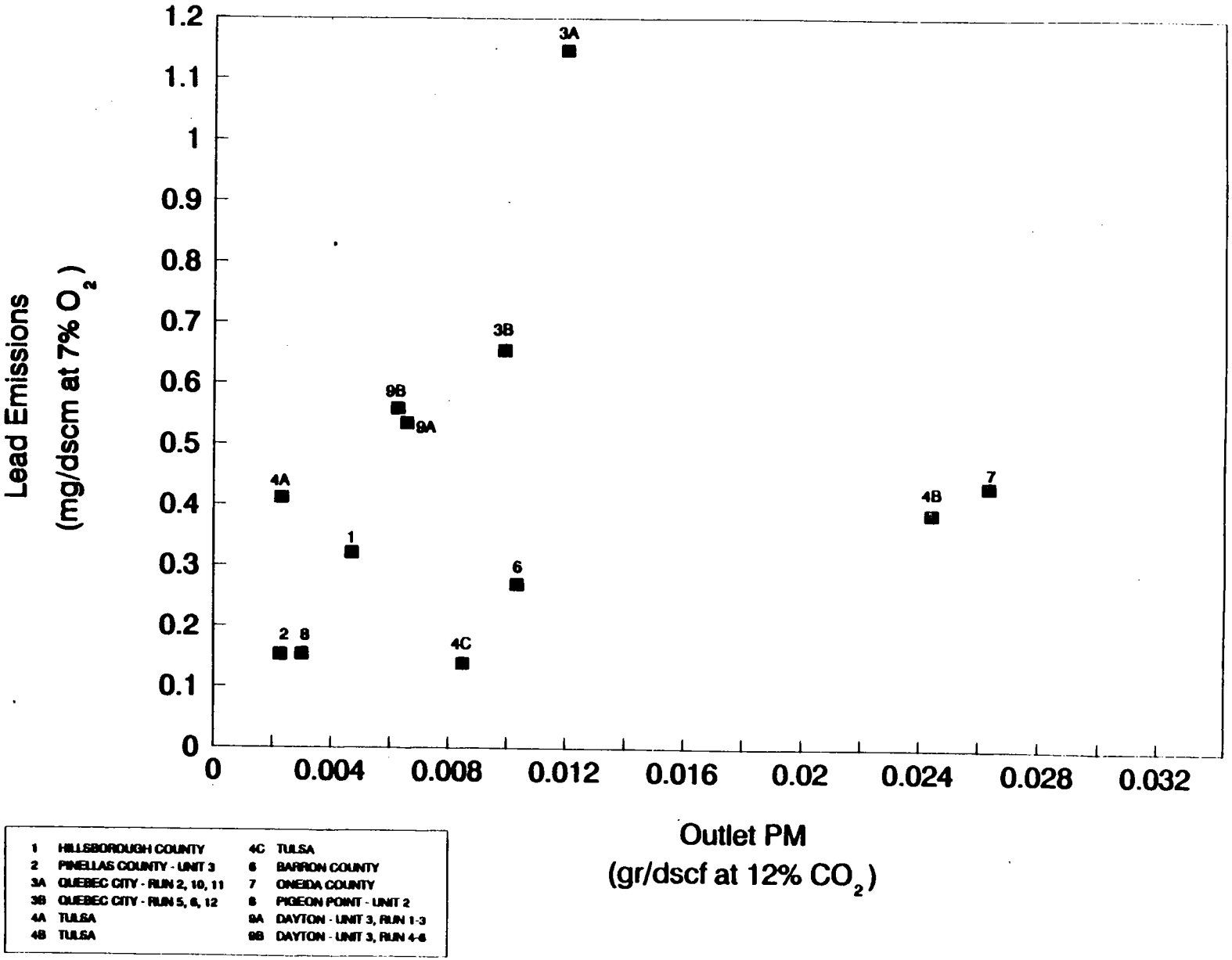


FIGURE 4. LEAD OUTLET EMISSIONS FROM MWC'S WITH ESP'S



differences in ESP operating temperatures over the range of 400-600°F do not appear to affect cadmium and lead emissions.

3.2 PERCENT REDUCTIONS

Dayton is the only MWC equipped with an ESP at which both inlet and outlet concentrations of cadmium, lead, and PM were measured. Figures 5 and 6 show plots of cadmium and lead removal efficiency versus PM removal efficiency. The average removal efficiencies for all three pollutants are relatively high, 98.9 percent for PM, 98.3 percent for cadmium, and between 97.1 and 98.4 percent for lead.

The data presented in Figures 5 and 6 suggest removal efficiencies for cadmium and lead during a given test condition are slightly lower than for PM. The lower removal efficiency for cadmium and lead versus PM may be due to the enrichment of volatile metals onto fine PM, which is less likely to be removed by an ESP than coarser PM.

3.3 SUMMARY

Emissions of cadmium and lead show a strong linear relationship with PM emissions, with the lowest cadmium and lead emissions being associated with the lowest PM emission rates. Examination of ESP inlet temperatures indicates that temperature does not affect cadmium and lead emissions. Comparison of limited data on PM versus cadmium and lead removal efficiencies suggests that removal efficiencies for cadmium and lead are somewhat lower than for PM. At a PM removal efficiency of 99 percent, cadmium and lead removals may be 97-98 percent.

FIGURE 5. CADMIUM REMOVAL EFFICIENCIES FROM MWC'S WITH ESP'S

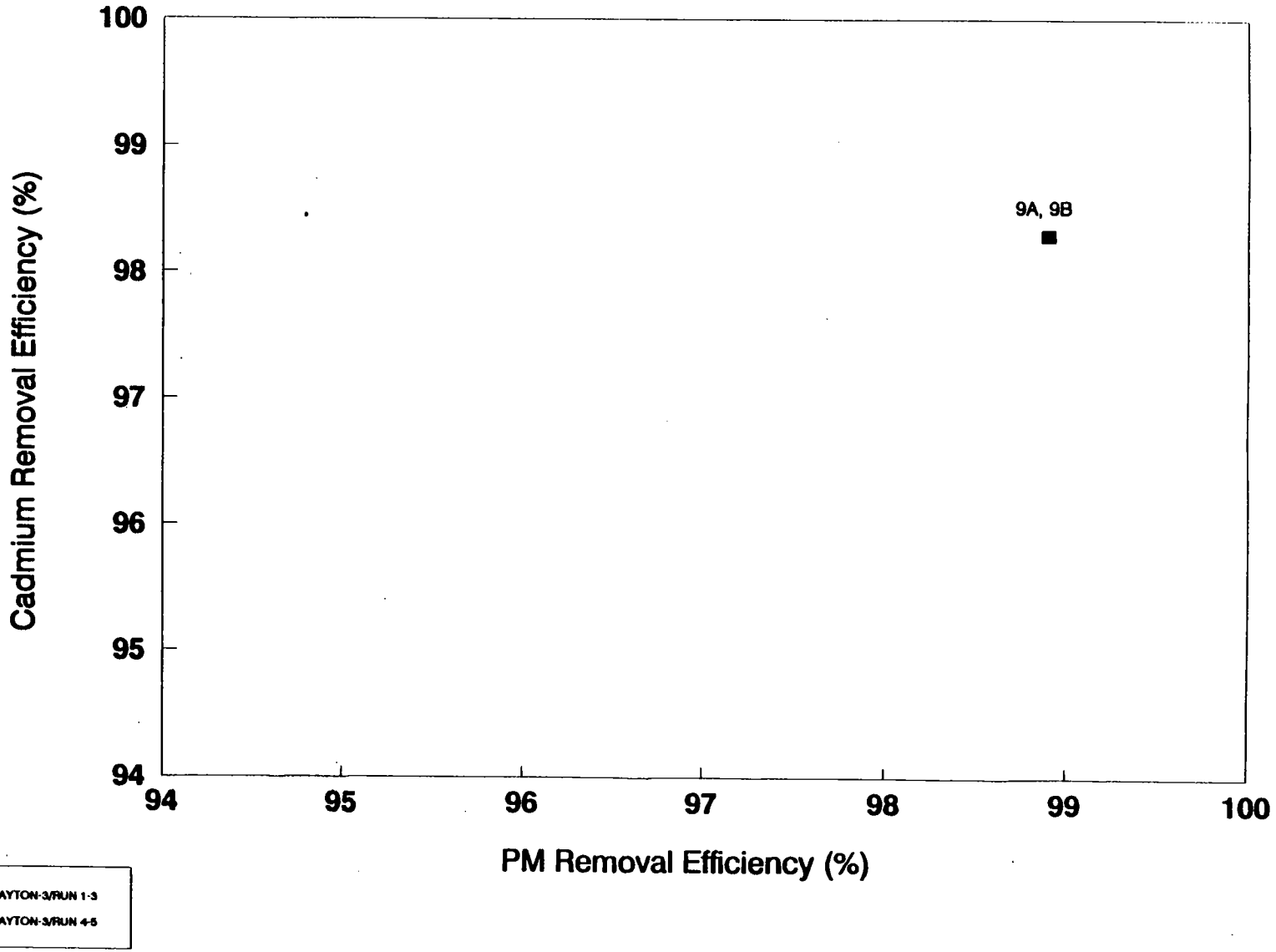
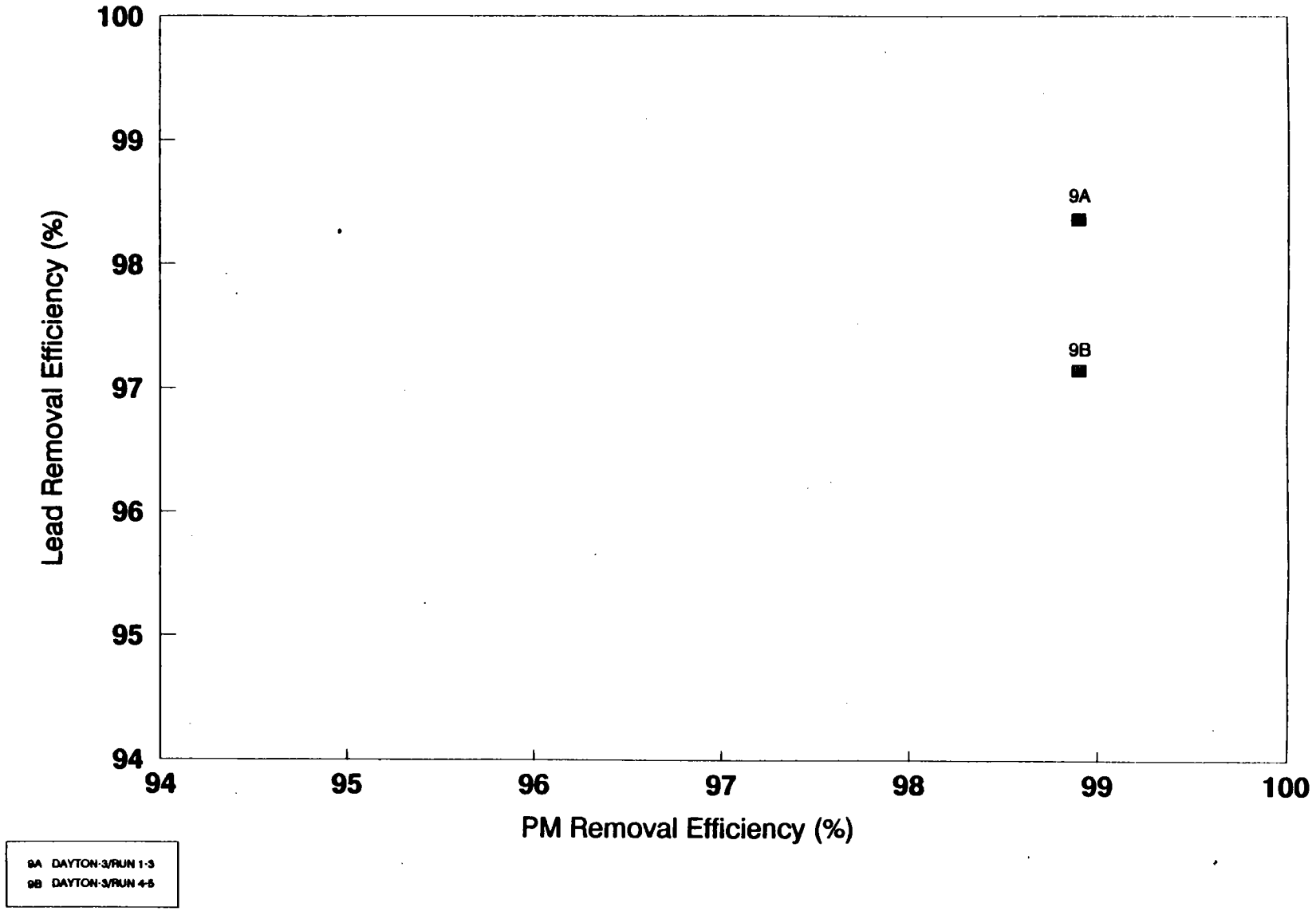


FIGURE 6. LEAD REMOVAL EFFICIENCIES FROM MWC'S WITH ESP'S



4.0 EMISSIONS FROM DSI/ESP AND FSI/ESP-CONTROLLED MWC'S

4.1 OUTLET EMISSIONS

Two of the facilities in the database are equipped with FSI/ESP's (Alexandria and Dayton). Tests were also conducted at the Dayton facility using a DSI/ESP system. The Alexandria facility is a MB/WW combustor, while the Dayton MWC is a MB/Ref combustor. Both facilities reported outlet cadmium, lead, and PM emissions. However, PM levels were not measured during the only set of runs when cadmium was measured at the Alexandria MWC. Therefore, the cadmium data from the Alexandria MWC are not presented graphically.

Figure 7 shows outlet cadmium levels versus PM levels for the Dayton MWC. At Dayton, cadmium emissions range from 0.011 mg/dscm to 0.056 mg/dscm, and PM emissions range from 0.0032 gr/dscf to 0.022 gr/dscf. These levels are within the range of emission from the MWC's equipped with only ESP's. These data suggest that higher outlet cadmium emissions correlate to higher PM emissions, although there are too few data points to confirm these relationships. The average cadmium level measured at the Alexandria MWC was 0.032 gr/dscf, which falls between the three averages from Dayton.

Lead emissions range from 0.12 mg/dscm at the Alexandria MWC (FSI/ESP) to 1.59 mg/dscm at the Dayton MWC (FSI/ESP). Figure 8 shows outlet lead levels versus PM levels for both MWC's. The data appear to have two clusters: the two Dayton FSI/ESP test conditions and Alexandria Unit 2 with lead emissions above 1.0 mg/dscm, and the Dayton DSI/ESP and the remaining Alexandria data below 0.4 mg/dscm. Similar to the data from the MWC's equipped with only ESP's, these data support the conclusion that higher lead emissions are correlated to higher PM levels. At PM levels above 0.02 gr/dscf, lead emissions are above 1.0 mg/dscm, while at PM levels below 0.007 gr/dscf, lead emissions are below 0.4 mg/dscm.

The impact of APCD operating temperature on outlet cadmium and lead emissions was also examined at the Alexandria and Dayton facilities. Both operate between approximately 300 and 400°F. The high and low temperatures were both reported from Dayton. The variations in APCD operating temperature did not noticeably influence the metals emissions. As such, the data do not

FIGURE 7. CADMIUM OUTLET EMISSIONS FROM MWC'S WITH SORBENT INJECTION/ESP'S

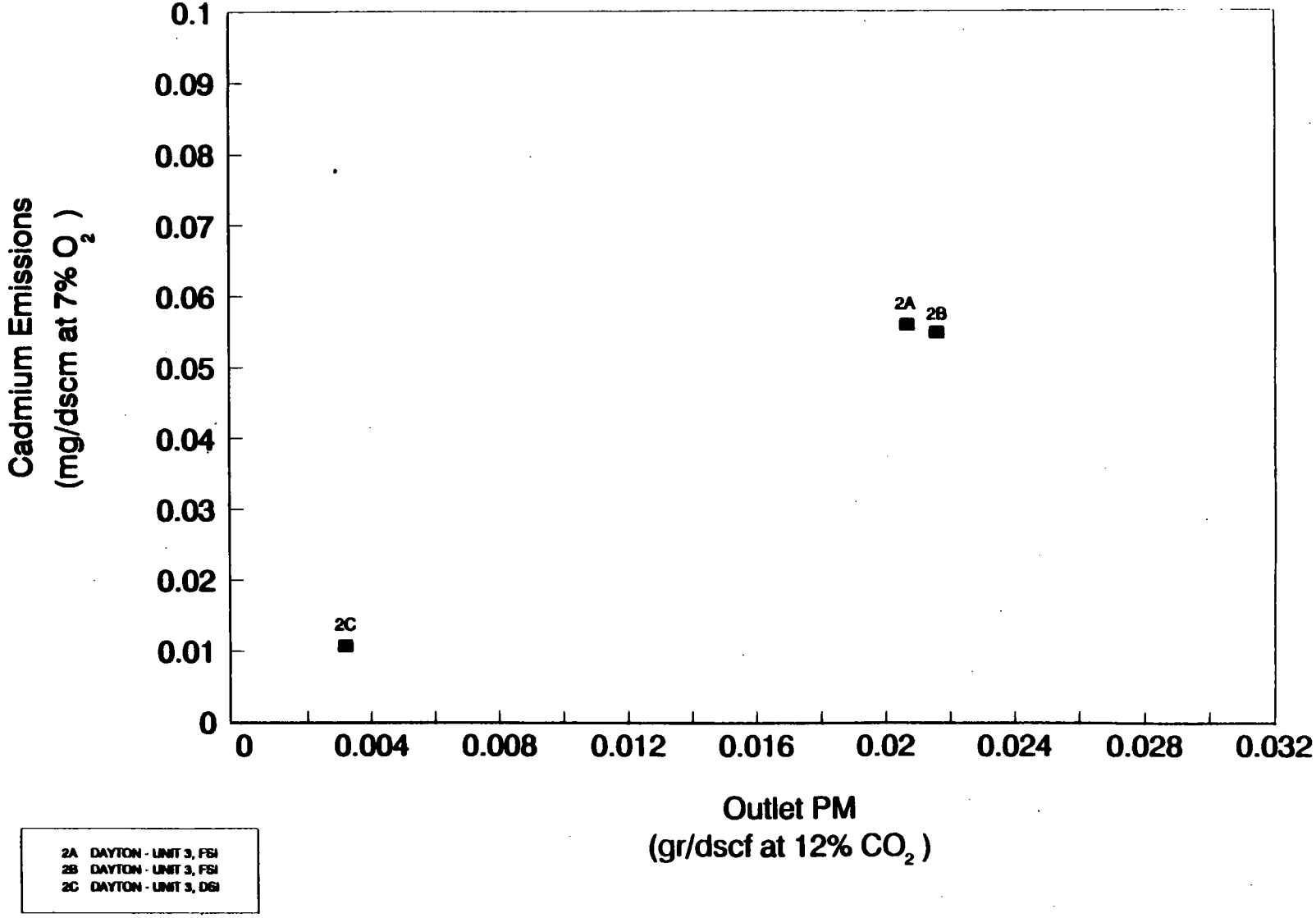
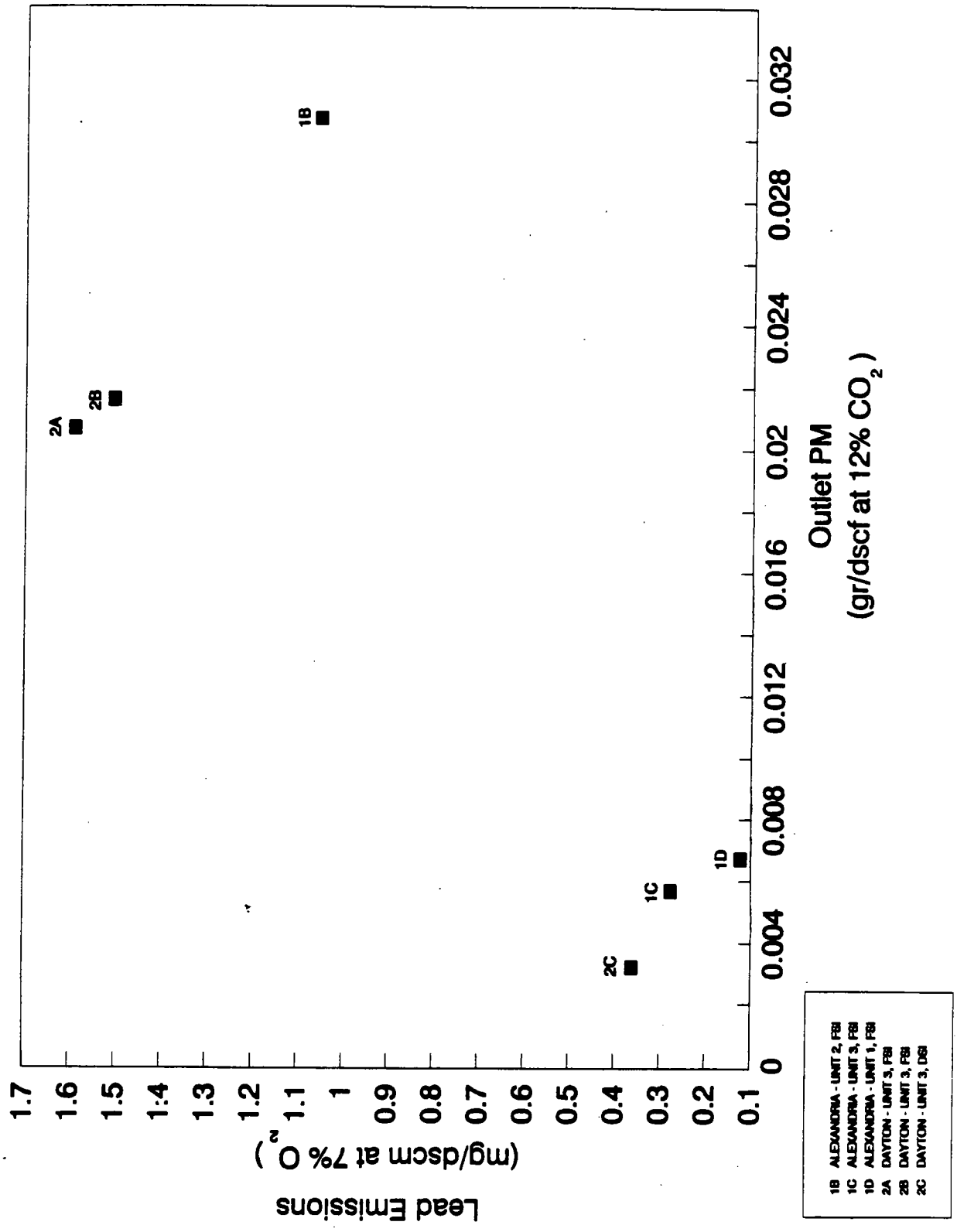


FIGURE 8. LEAD OUTLET EMISSIONS FROM MWC'S WITH SORBENT INJECTION/ESP'S



indicate any relationship between operating temperatures and outlet cadmium and lead emissions.

4.2 PERCENT REDUCTIONS

Inlet PM and metals concentrations were only reported by the Dayton FSI/ESP and DSI/ESP units. Figures 9 and 10 present the cadmium and lead removal efficiencies versus PM removal efficiencies. Particulate matter removal efficiencies were 98.0 percent with FSI/ESP and 99.4 percent with DSI/ESP. Cadmium removal efficiencies were 94.4 percent with FSI/ESP and 99.2 percent with DSI/ESP. Lead removal efficiencies were 93.4 percent with FSI/ESP and 99.0 percent with DSI/ESP. These data suggest that DSI/ESP systems have a higher removal efficiency than FSI/ESP systems. The reason for the higher metals removal efficiency by DSI/ESP systems may reflect additional metals condensation on the DSI sorbent surface or changes in particle resistivity or collection efficiency due to the DSI sorbent. The data also indicate that the emissivity rate (100 - removal efficiency) of cadmium and lead are roughly one to three times higher than the emissivity rates for PM. The emissivity rate for lead is higher than for cadmium, noting, however, that the data are limited.

4.3 SUMMARY

Emission rates for cadmium and lead from MWC's using FSI/ESP's and DSI/ESP's are similar to those from MWC's using only ESP's. Cadmium emissions were all below 0.06 mg/dscm, and lead emissions were below 1.6 mg/dscm.

A DSI/ESP system appears to control metals emissions better than a FSI/ESP system. Possible reasons may be tied to the DSI sorbent (e.g., increased metals condensation on the sorbent surface), as discussed above. Calculated removal efficiencies from the single DSI/ESP system for PM, cadmium, and lead are all above 99 percent. Removal efficiencies from the two FSI/ESP systems are approximately 98 percent for PM, and approximately 93 to 95 percent for cadmium and lead. However, there are too few data to confirm that DSI/ESP units control cadmium, lead, and PM emissions better than FSI/ESP's.

FIGURE 9. CADMIUM REMOVAL EFFICIENCIES FROM MWC'S WITH SORBENT INJECTION/ESP'S

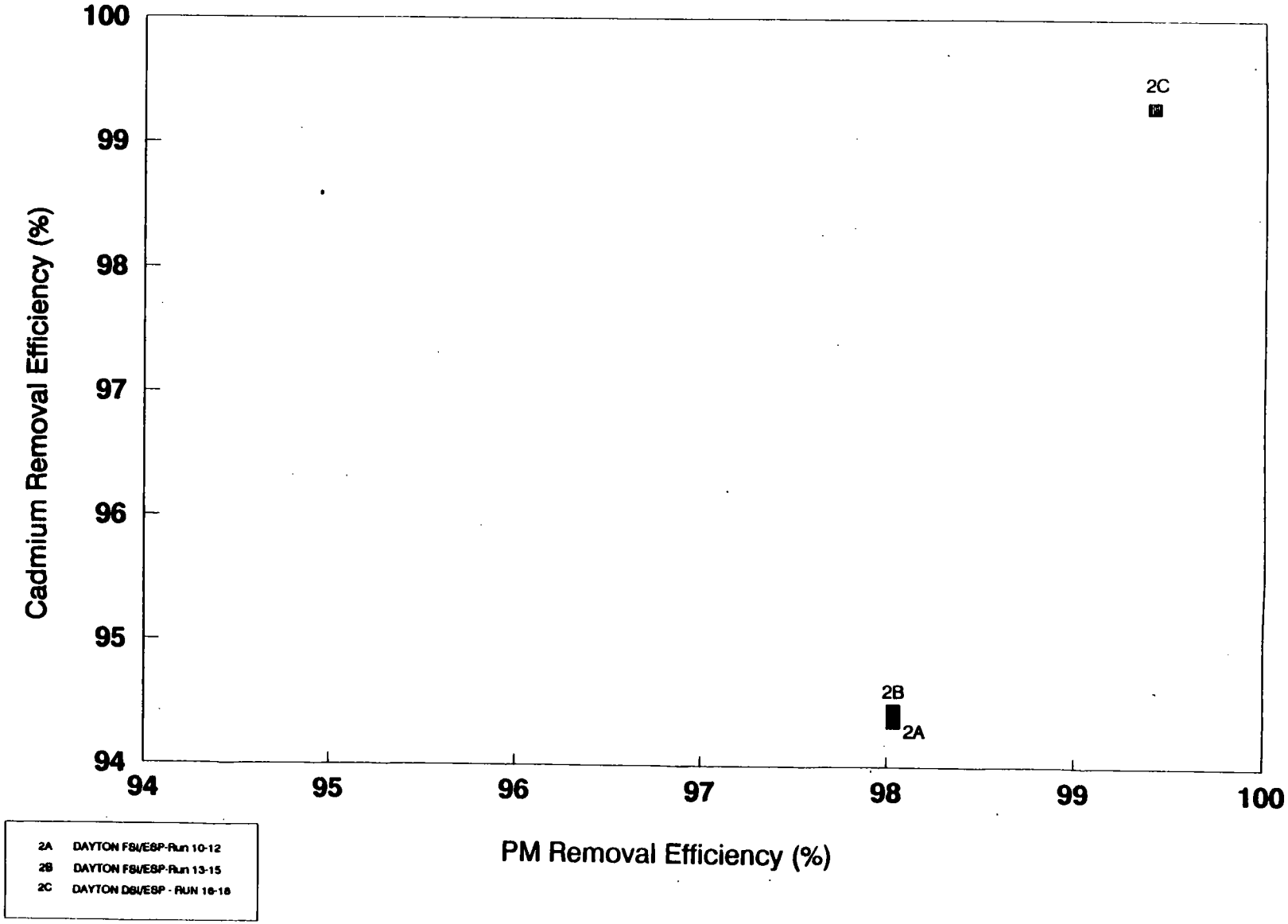
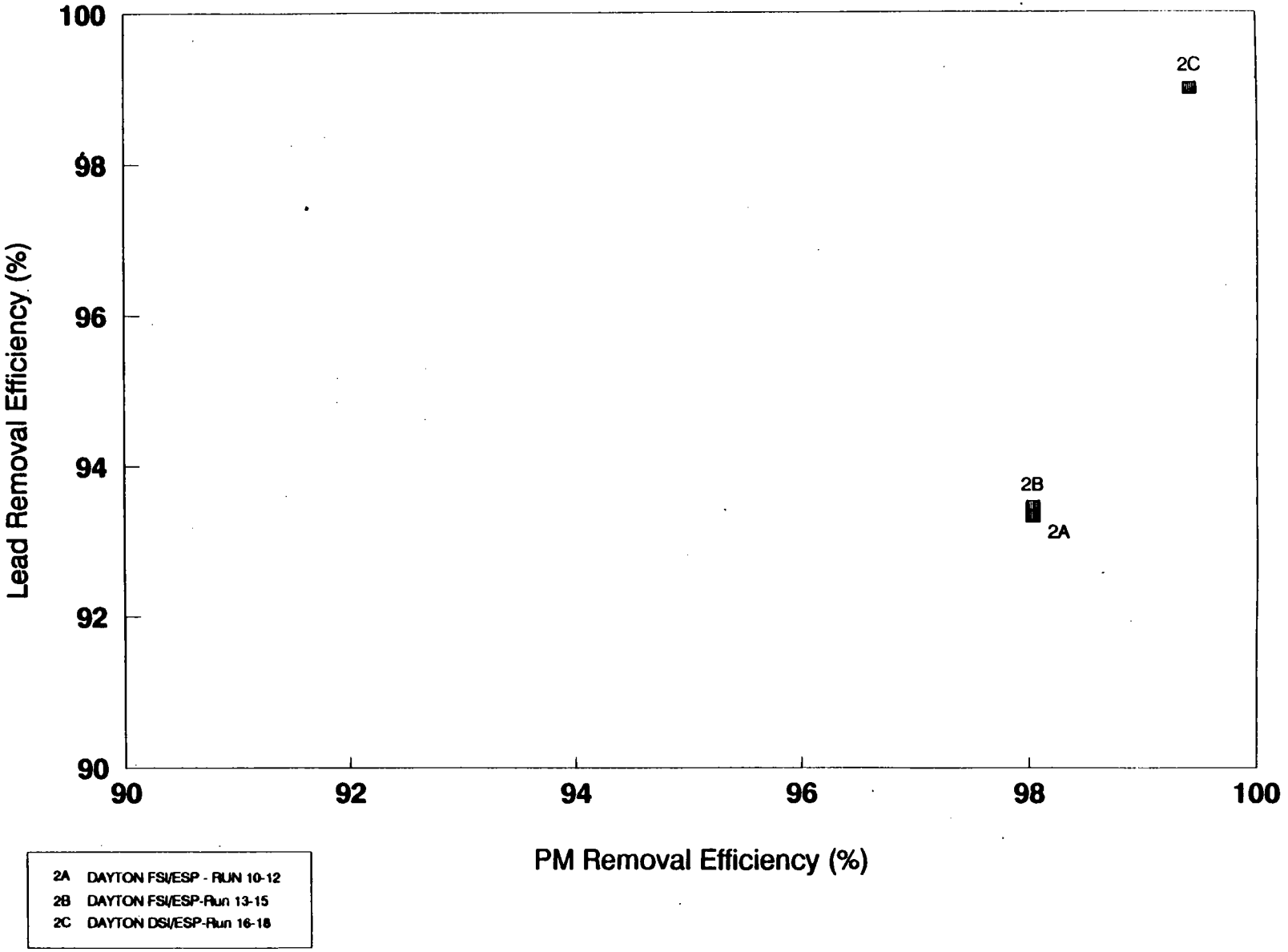


FIGURE 10. LEAD REMOVAL EFFICIENCIES FROM MWC'S WITH SORBENT INJECTION/ESP'S



5.0 EMISSIONS FROM SD/ESP-CONTROLLED MWC'S

5.1 OUTLET EMISSIONS

Seven of the facilities in the database are equipped with SD/ESP's. Four of the seven are MB/WW MWC's (Charleston, Haverhill, Millbury, and Portland), and the remaining three are RDF MWC's (Honolulu, SEMASS, and West Palm Beach). Outlet lead emissions were measured at all seven facilities, but outlet cadmium emissions were measured at only five (not measured at Honolulu or West Palm Beach). Particulate matter emissions were measured simultaneously at six facilities (not measured at Charleston).

The average outlet cadmium concentrations range from 0.004 mg/dscm at Portland to 0.038 mg/dscm at Haverhill. Figure 11 shows outlet cadmium versus PM levels at the four facilities where both emissions were measured. The plot shows substantial scatter without any apparent relationship. However, all of the PM levels are less than 0.015 gr/dscf, and all but one are less than 0.010 gr/dscf. Although there does not appear to be a relationship between cadmium and PM at these PM levels, the cadmium levels are similar to those measured at MWC's equipped with only ESP's that have similar PM emissions (discussed in Section 3.1).

The average outlet lead concentrations range from 0.024 mg/dscm at West Palm Beach to 0.49 mg/dscm at Haverhill. Figure 12 shows outlet lead emissions versus PM levels at six facilities reporting both pollutants. However, the data do not suggest any apparent relationship between the two. Outlet lead concentrations are consistent with MWC's having ESP's with similar PM concentrations.

Analysis of the emissions data indicate that cadmium and lead emissions may be related to the number of fields in an ESP unit. For example, the Millbury MWC which reported high metals and PM emissions is the only unit with a 3-field ESP. On the other hand, Portland and Honolulu, both of which have 5-field ESP's, have lower metals and PM emissions. However, the emissions levels from SEMASS, another 5-field ESP, approach the levels measured at Millbury. In addition, the West Palm Beach unit, which is equipped with a 4-field ESP, had very low metals and PM emissions, but was operating only 3 fields during the compliance test. These data suggest that the number of ESP

FIGURE 11. CADMIUM OUTLET EMISSIONS FROM MWC'S WITH SD/ESP'S

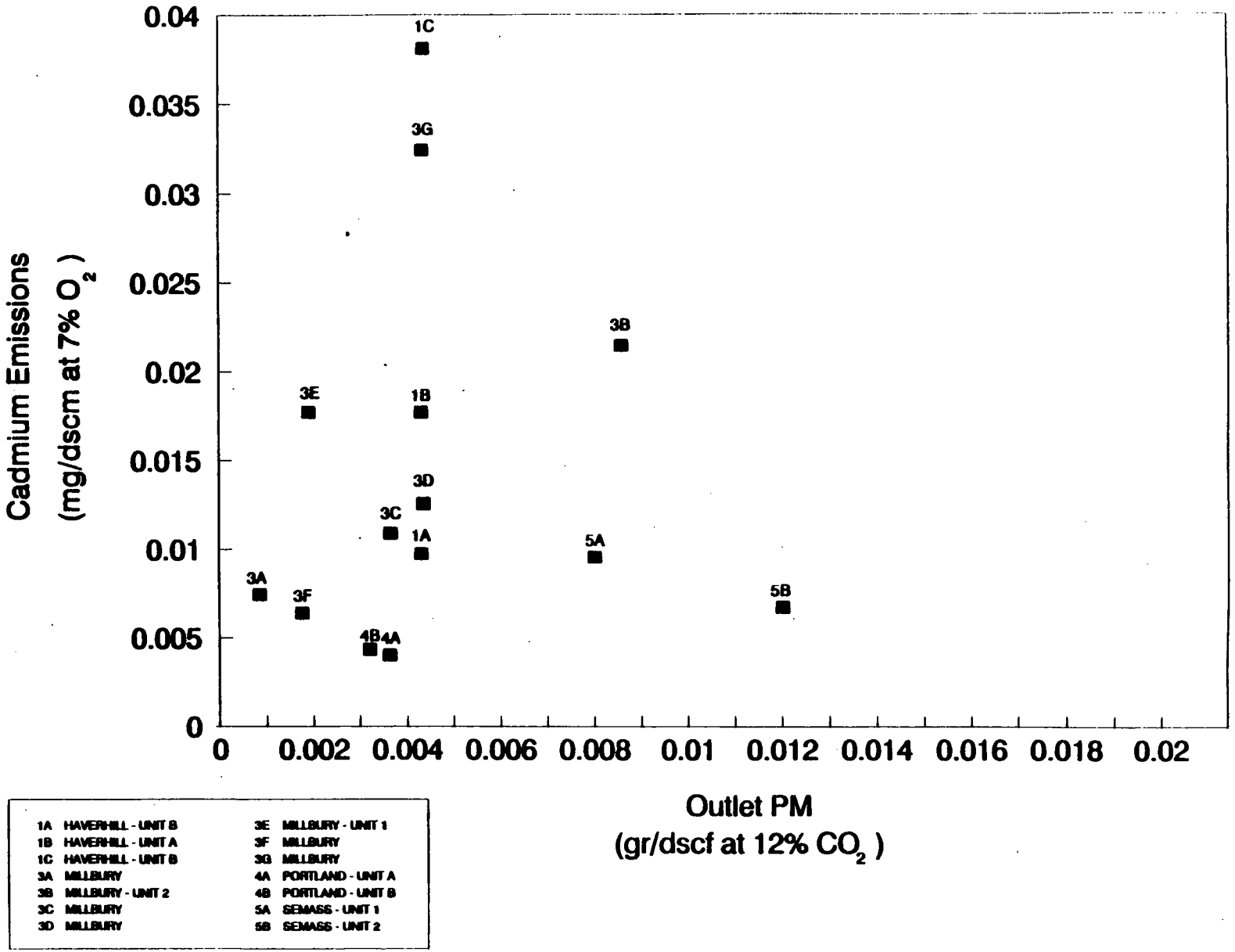
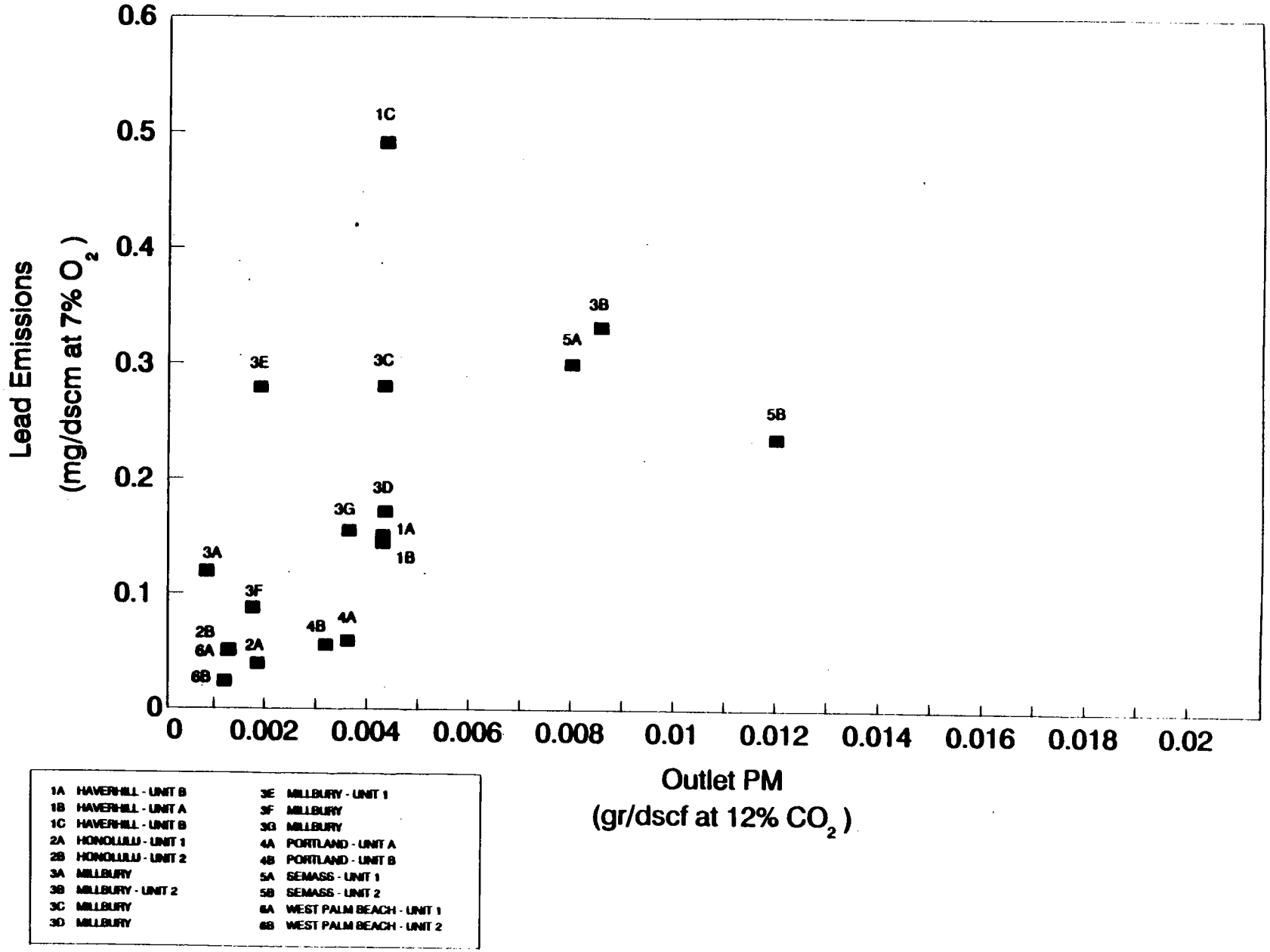


FIGURE 12. LEAD OUTLET EMISSIONS FROM MWC'S WITH SD/ESP'S



fields may affect metals and PM emission rates, but other factors also contribute.

The impact of SD/ESP operating temperature on cadmium and lead emissions was also examined. Six of the facilities reported operating temperature data (not reported at Charleston). The six were operating between 240 and 308°F at the time of testing. The Millbury MWC, which measured the highest cadmium and high lead emissions, conducted tests at the lowest operating temperature, 240°F. The Portland SD/ESP operated at the highest temperature, 308°F, and reported low lead and cadmium emissions. The other three units operated over a relatively narrow temperature range of 275 to 300°F. Based on the data, the ESP inlet temperature did not influence cadmium or lead emissions. Because uncontrolled metals concentrations were not measured at any of these MWC's, the percent control of metals across the SD/ESP and the impact of temperature on metals removal efficiency cannot be determined.

5.2 PERCENT REDUCTIONS

The seven MWC's that use SD/ESP's did not report inlet concentrations for cadmium or lead. Therefore, the percent reduction capabilities could not be reviewed.

5.3 SUMMARY

Emissions of cadmium and lead from MWC's using SD/ESP's are similar to those from MWC's having only ESP's with similar outlet PM levels. All of the SD/ESP systems achieved PM emissions of less than 0.015 gr/dscf and have cadmium emissions of less than 0.040 mg/dscm and lead emissions of less than 0.50 mg/dscm. Several of the units, however, had emission levels of less than 0.005 gr/dscf for PM, 0.020 mg/dscm for cadmium, and 0.20 mg/dscm for lead.

6.0 EMISSIONS FROM DSI/FF-CONTROLLED MWC'S

6.1 OUTLET EMISSIONS

Six of the facilities in the database are equipped with DSI/FF's. Four of the six are MB/WW MWC's (Concord, Burnaby, Quebec City pilot-scale APCD, and Wurzburg), one is an MB/RC MWC (Dutchess County Unit 1), and one is a MOD/EA MWC (St. Croix). Lead emissions were measured at all six facilities, but cadmium emissions were only measured at five MWC's (not measured at Concord), and PM emissions were only measured at four (not measured at Quebec City or St. Croix). Figure 13 and 14 present the cadmium and lead data for those facilities measuring metals and PM. Test data collected from Dutchess County Unit 2 were not included in the analysis due to reported fabric filter operating problems during testing.

The average outlet cadmium concentrations range from not detectable at Quebec City to 0.006 mg/dscm at Wurzburg. Figure 13 shows outlet cadmium and PM emissions at the three facilities measuring both pollutants. Outlet PM emissions from each of these three facilities were less than 0.010 gr/dscf. At these low PM emission rates, no relationship is apparent between cadmium and PM emissions.

The average outlet lead concentrations range from 0.003 mg/dscm at Quebec City to 0.078 mg/dscm at Burnaby. Figure 14 shows outlet lead emissions at four facilities. As in the case of cadmium emissions, no relationship between lead and PM emissions is apparent. When compared to the outlet emissions from MWC's with ESP's and SD/ESP's, cadmium and lead outlet emissions from DSI/FF's appear to be as low or lower for the same PM ranges.

The impact of DSI/FF operating temperature on cadmium and lead emissions was also examined. Five of the facilities reported temperature levels, and they ranged from approximately 225 to 430°F. Comparison of the metals emission data indicates that control levels are not tied to temperature variations. For example, during the Quebec City pilot tests where temperature was varied between approximately 230 and 400°F, removal efficiencies for cadmium and lead were all greater than 99 percent. Since all of the cadmium and lead emissions data were low for all the DSI/FF systems (Cd <0.006 mg/dscm, Pb <0.08 mg/dscm), variations due to temperatures entering the FF are not observed.

FIGURE 13. CADMIUM OUTLET EMISSIONS FROM MWC'S WITH SORBENT INJECTION/FF'S

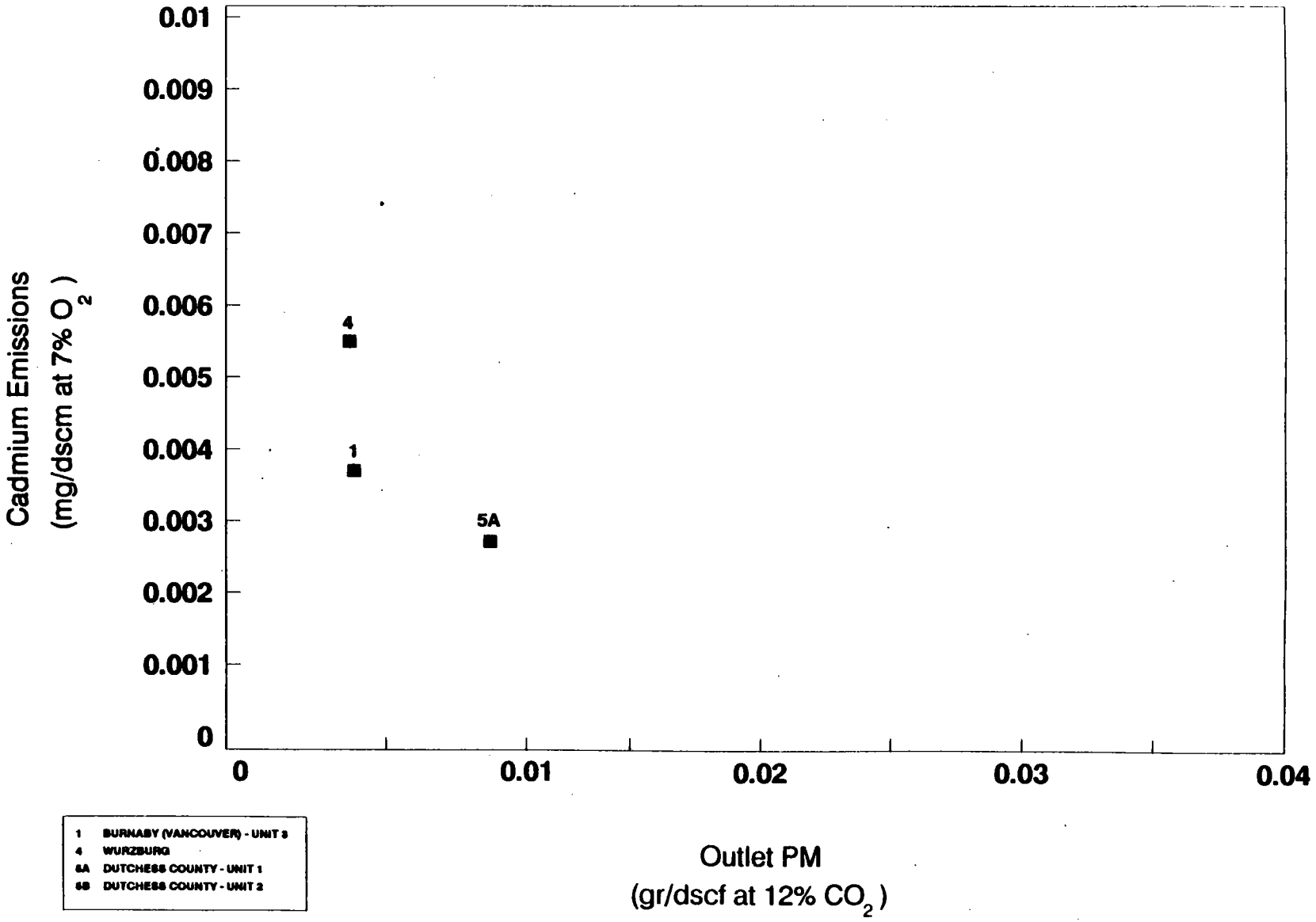
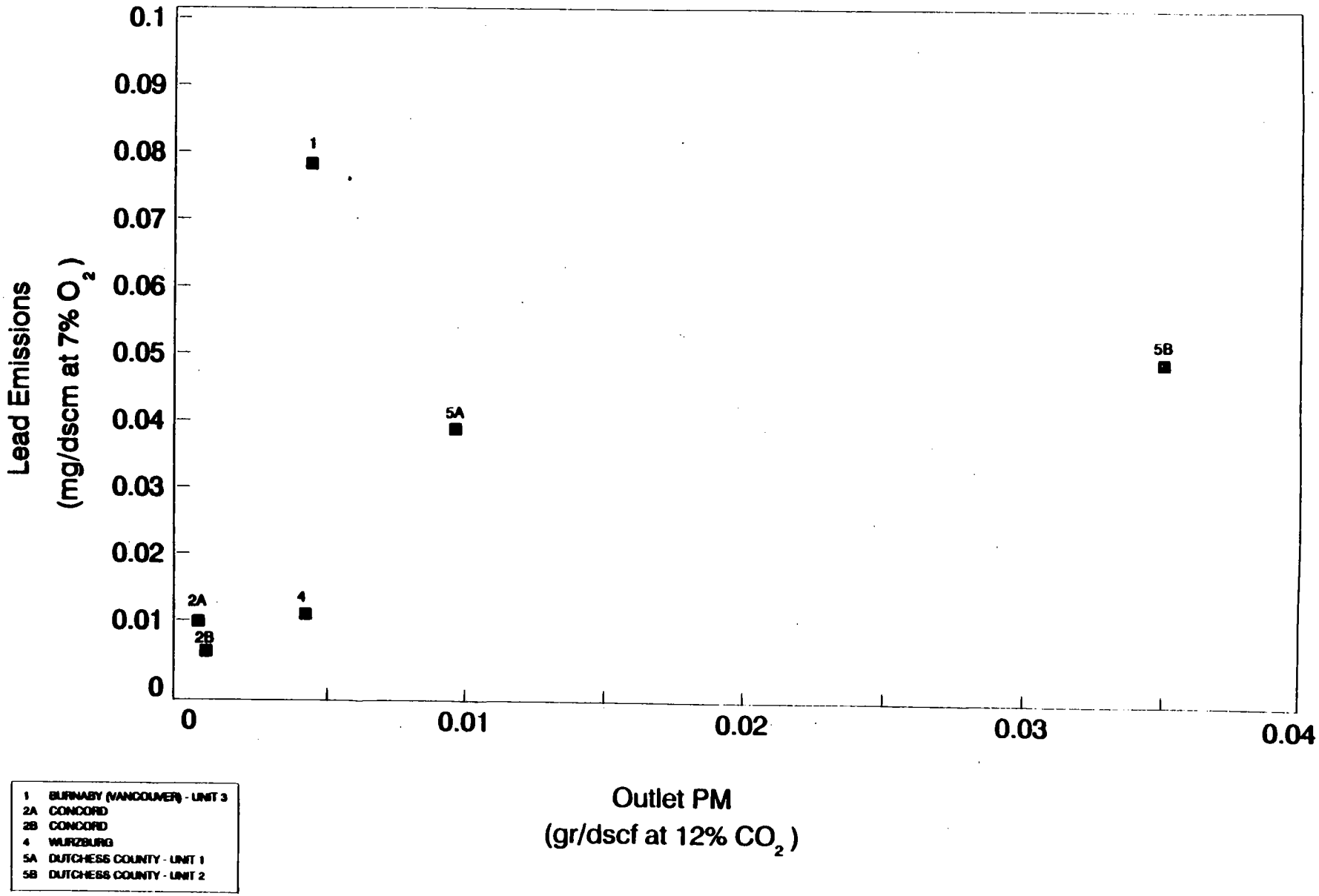


FIGURE 14. LEAD OUTLET EMISSIONS FROM MWC'S WITH SORBENT INJECTION/FF'S



6.2 PERCENT REDUCTIONS

Inlet cadmium and lead concentrations were measured at two of the MWC's equipped with DSI/FF's (Vancouver and Quebec City pilot scale unit), but inlet PM concentrations were not measured at any of them. Therefore, cadmium and lead removal efficiencies could not be plotted against PM removal efficiency. Based on the two data sets, removal efficiencies for both cadmium and lead exceeded 99.7 percent.

6.3 SUMMARY

Outlet cadmium emissions from the DSI/FF-equipped facilities were less than 0.006 mg/dscm and outlet lead emissions were less than 0.08 mg/dscm, corresponding to removal efficiencies exceeding 99 percent. The four units measuring PM emissions reported levels of less than 0.010 gr/dscm. Within the range of the available data, no relationship between PM and metals is apparent. The data also indicate that DSI/FF removal efficiency for cadmium and lead is higher than for ESP and ESP-related APCD's.

7.0 EMISSIONS FROM SD/FF-CONTROLLED MWC'S

7.1 OUTLET EMISSIONS

Sixteen of the facilities in the database are equipped with SD/FF's. Fourteen of the 16 use MB/WW combustors. The remaining two (Biddeford and Mid-Connecticut) are RDF combustors. Outlet lead emissions were measured at all 16 MWC's, and cadmium emissions were measured at 14 (not measured at Huntsville and Indianapolis). Particulate matter was reported at 14 facilities, as well (not measured at Quebec City pilot test and Commerce).

The average outlet cadmium concentrations range from not detectable at Babylon, Gloucester, Mid-Connecticut, and Quebec City pilot to 0.018 mg/dscm at Biddeford, Bridgeport, Hempstead, and Long Beach. Figure 15 shows outlet cadmium emissions versus PM levels at the seven facilities where both were measured. Figure 15 does not suggest any relationship between cadmium and PM levels. However, all but one PM data point were lower than 0.015 gr/dscf, and all but two were below 0.007 gr/dscf. The exceptions were Marion County, which measured 0.016 gr/dscf, and Fairfax, which measured 0.009 gr/dscf.

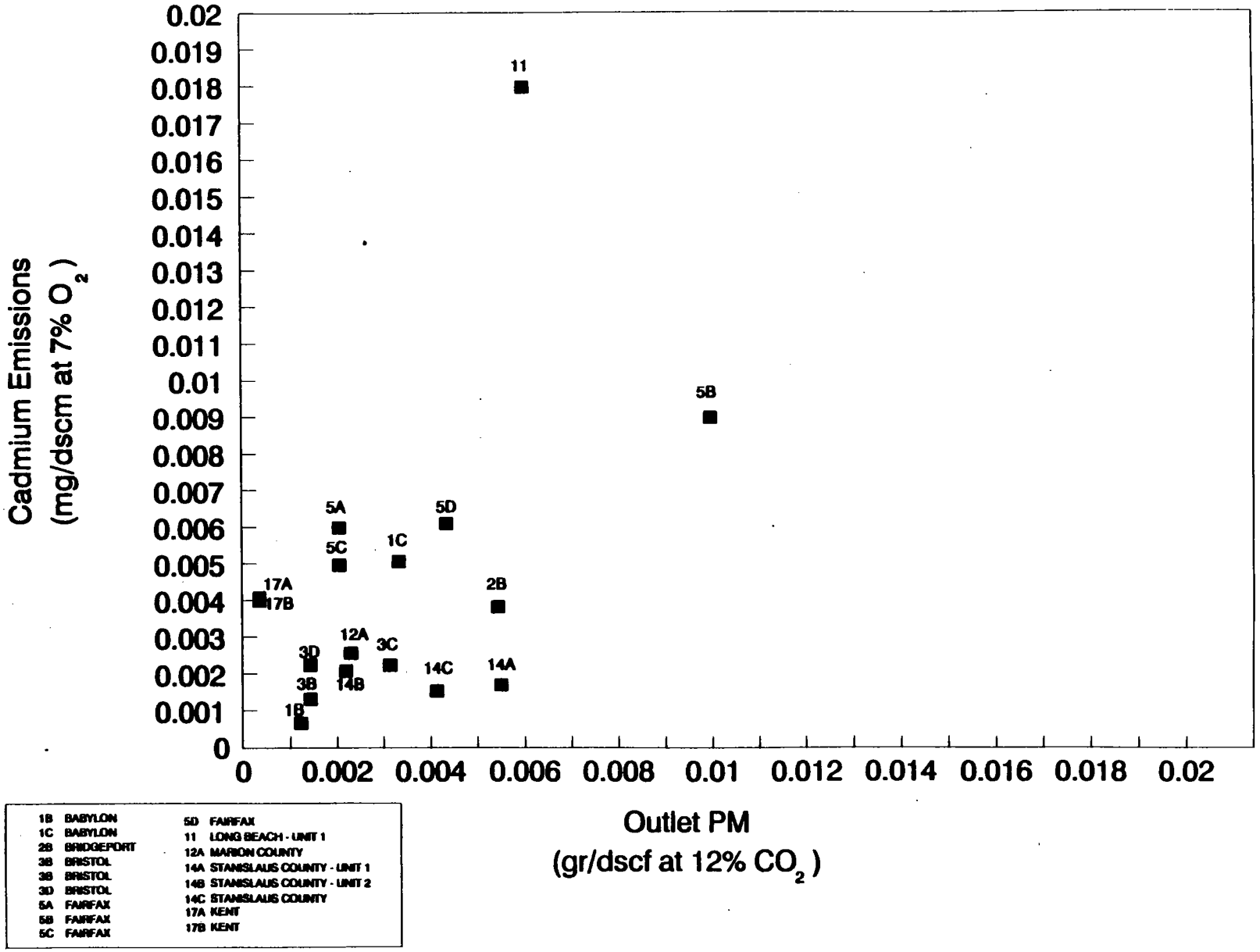
The average outlet lead concentrations range from not detectable at Mid-Connecticut to 0.16 mg/dscm at Biddeford. Figure 16 shows outlet lead concentrations versus PM emissions at the 14 facilities where both were measured. As in the case for cadmium emissions, Figure 16 does not suggest any relationship between lead emissions and PM levels.

The impact of SD/FF operating temperature on cadmium and lead emissions was also examined. However, half of the MWC's with SD/FF's did not report operating temperatures. For those that did, temperatures ranged from 272-318^{o}F. Although no clear patterns are distinguishable, higher temperatures generally indicate higher lead and cadmium concentrations. However, emissions of these metals from all of the SD/FF-equipped facilities are low.

7.2 PERCENT REDUCTIONS

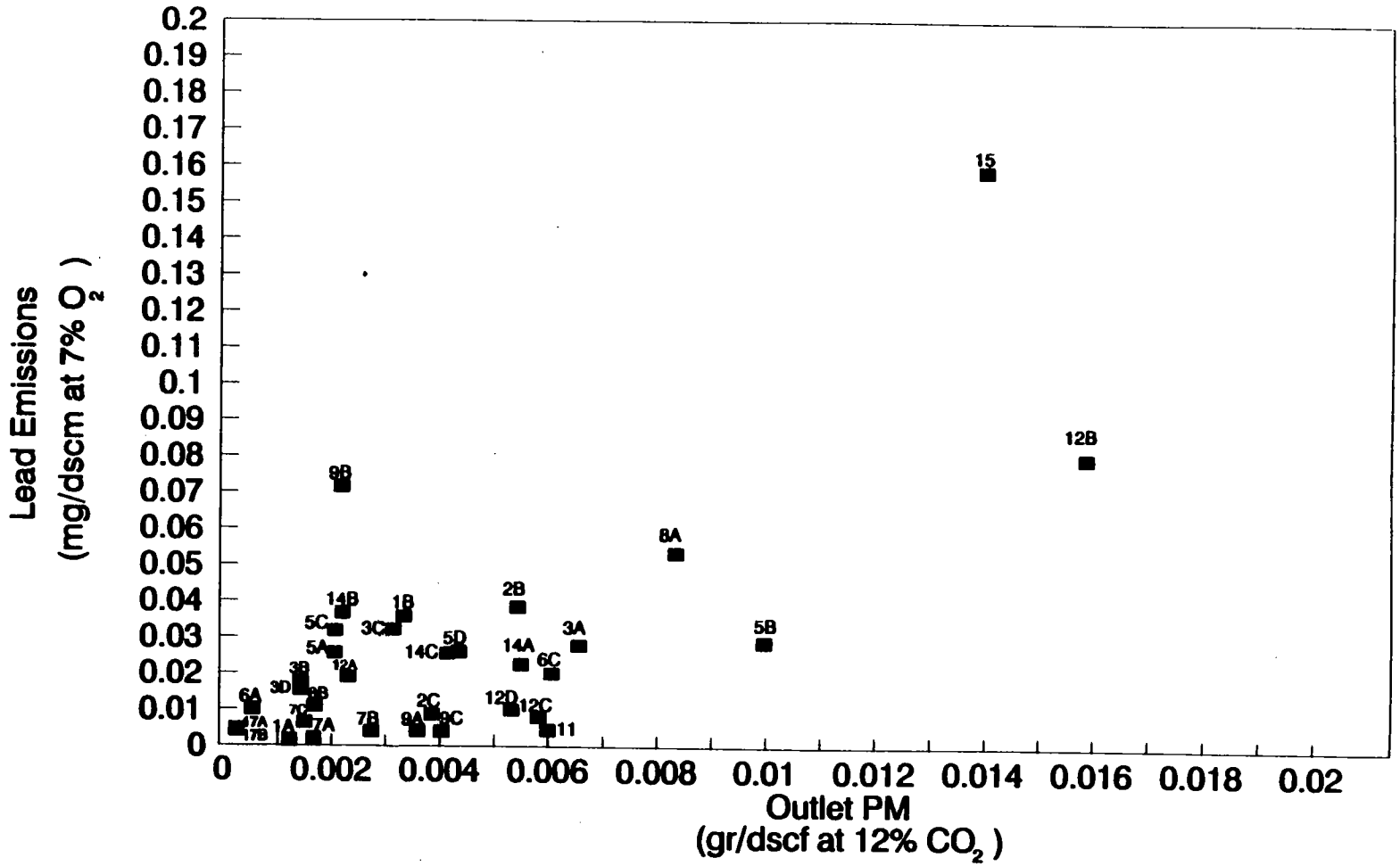
Five of the 16 SD/FF-equipped MWC's reported inlet cadmium and lead concentrations. In almost all cases, the removal efficiencies for both metals were greater than 99 percent. For the two plants (Biddeford and Mid-Connecticut) that also reported both inlet and outlet PM levels, a plot of lead removal

FIGURE 15. CADMIUM OUTLET EMISSIONS FROM MWC'S WITH SD/FF'S



* 13 runs conducted during parametric testing at Mid-Connecticut resulted in cadmium levels of 0. The PM levels ranged from 0.0012 gr/dscf to 0.0033 gr/dscf .

FIGURE 16. LEAD OUTLET EMISSIONS FROM MWC'S WITH SD/FF'S



1A	BABYLON - UNIT 2	5B	FAIRFAX	8A	HUNTSVILLE	12D	MARION COUNTY
1B	BABYLON	5C	FAIRFAX	8B	HUNTSVILLE	14A	STANISLAUS COUNTY - UNIT 1
2B	BRIDGEPORT	5D	FAIRFAX	9A	INDIANAPOLIS - UNIT 1	14B	STANISLAUS COUNTY - UNIT 2
2C	BRIDEPORT	6A	GLOUCESTER	9B	INDIANAPOLIS	14C	STANISLAUS COUNTY
3A	BRISTOL	6B	GLOUCESTER	9C	INDIANAPOLIS	15	BIDDEFORD
3B	BRISTOL	6C	GLOUCESTER	11	LONG BEACH - UNIT 1	17A	KENT
3C	BRISTOL	7A	HEMPSTEAD - UNIT 1	12A	MARION COUNTY - UNIT 1	17B	KENT
3D	BRISTOL	7B	HEMPSTEAD - UNIT 2	12B	MARION COUNTY		
5A	FAIRFAX	7C	HEMPSTEAD - UNIT 3	12C	MARION COUNTY		

* 13 runs conducted during parametric testing at Mid-Connecticut resulted in lead levels ranging from 0.029 mg/dscm to 0.091 mg/dscm. The PM levels ranged from 0.0012 gr/dscf to 0.0033 gr/dscf.

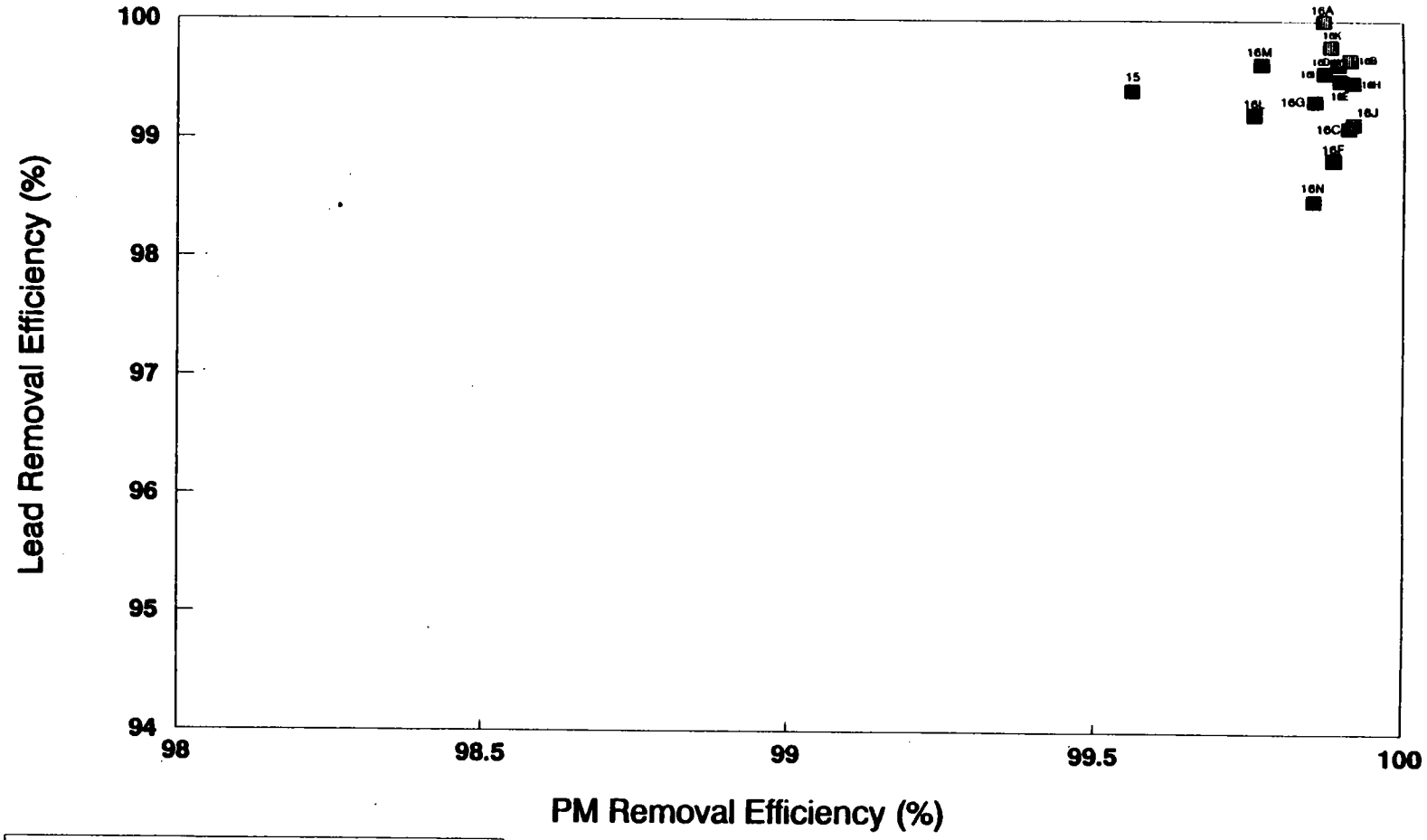
efficiencies versus PM removal efficiencies is shown in Figure 17. For the Biddeford MWC, a 99.6 percent PM removal efficiency corresponded to a 99.4 percent lead removal efficiency. For the Mid-Connecticut MWC, parametric test results show PM removal efficiencies greater than 99.7 percent and lead removal efficiencies greater than 98.5 percent, with the majority greater than 99 percent. Due to the high removal efficiencies, specific trends between increased PM and lead removal are not noticeable.

The cadmium removal efficiencies from the Biddeford and Mid-Connecticut plants were not plotted against PM removal efficiencies. The cadmium levels were recorded as non-detects, which, when considered to be zero, correspond to 100 percent removal efficiencies.

7.3 SUMMARY

Emissions from the MWC's using SD/FF's are all below 0.02 mg/dscm for cadmium and 0.16 mg/dscm for lead, with most less than 0.007 mg/dscm and 0.08 mg/dscm, respectively. The majority of PM emissions are less than 0.007 gr/dscf. Removal efficiencies for all three pollutants are generally above 99.4 percent. These data indicate that SD/FF are more efficient at removing PM, cadmium, and lead than ESP's and ESP-related devices, and are comparable to DSI/FF removal efficiencies.

FIGURE 17. LEAD REMOVAL EFFICIENCIES FROM MWC'S WITH SD/FF'S



8.0 SUMMARY OF DATA

Tables 8-1 and 8-2 summarize the cadmium and lead outlet emissions data for each control technology category. The minimum, maximum, and median values measured are presented. Also, minimum percent removal efficiencies for those facilities that measured both inlet and outlet emissions are shown.

The cadmium and lead emissions data are presented graphically versus PM emissions in Figures 18 and 19. As shown in both of these figures, the data for the FF-equipped plants as a group have the lowest metals emissions. The data for the ESP-equipped plants are more scattered than the data for FF-equipped plants. At similar PM emission rates, metals emissions from ESP- versus FF-equipped plants can be up to five times higher for cadmium and up to 12 times higher for lead.

The data, therefore, indicate better control for cadmium and lead by FF-equipped control systems.

TABLE 8-1. CADMIUM EMISSIONS DATA[a]

Control Technology	Minimum (mg/dscm)	Maximum (mg/dscm)	Median (mg/dscm)	Percent Reduction (%)
ESP	ND[b]	0.092	0.021	> 98
DSI/ESP	0.011	0.056	0.044	> 94[c]
SD/ESP	0.004	0.038	0.011	NA[d]
DSI/FF	ND	0.006	0.002	> 99
SD/FF	ND	0.018	0.002	> 99

[a]All concentrations corrected to 7 percent O_2, on a daily basis.

[b]Non-detect.

[c]Duct sorbent injection data > 99 percent.

[d]Not available. Assumed to be at least as great as other ESP-equipped system.

TABLE 8-2. LEAD EMISSIONS DATA[a]

Control Technology	Minimum (mg/dscm)	Maximum (mg/dscm)	Median (mg/dscm)	Percent Reduction (%)
ESP	ND	1.15	0.32	> 97
DSI/ESP	0.12	1.59	0.71	> 93[c]
SD/ESP	0.024	0.49	0.15	NA[d]
DSI/FF	0.003	0.078	0.010	> 99
SD/FF	ND	0.16	0.010	> 99

[a]All concentrations corrected to 7 percent O_2, on a daily basis.

[b]Non-detect.

[c]Duct sorbent injection data > 99 percent.

[d]Not available. Assumed to be at least as great as other ESP-equipped systems.

FIGURE 18. CADMIUM OUTLET EMISSIONS

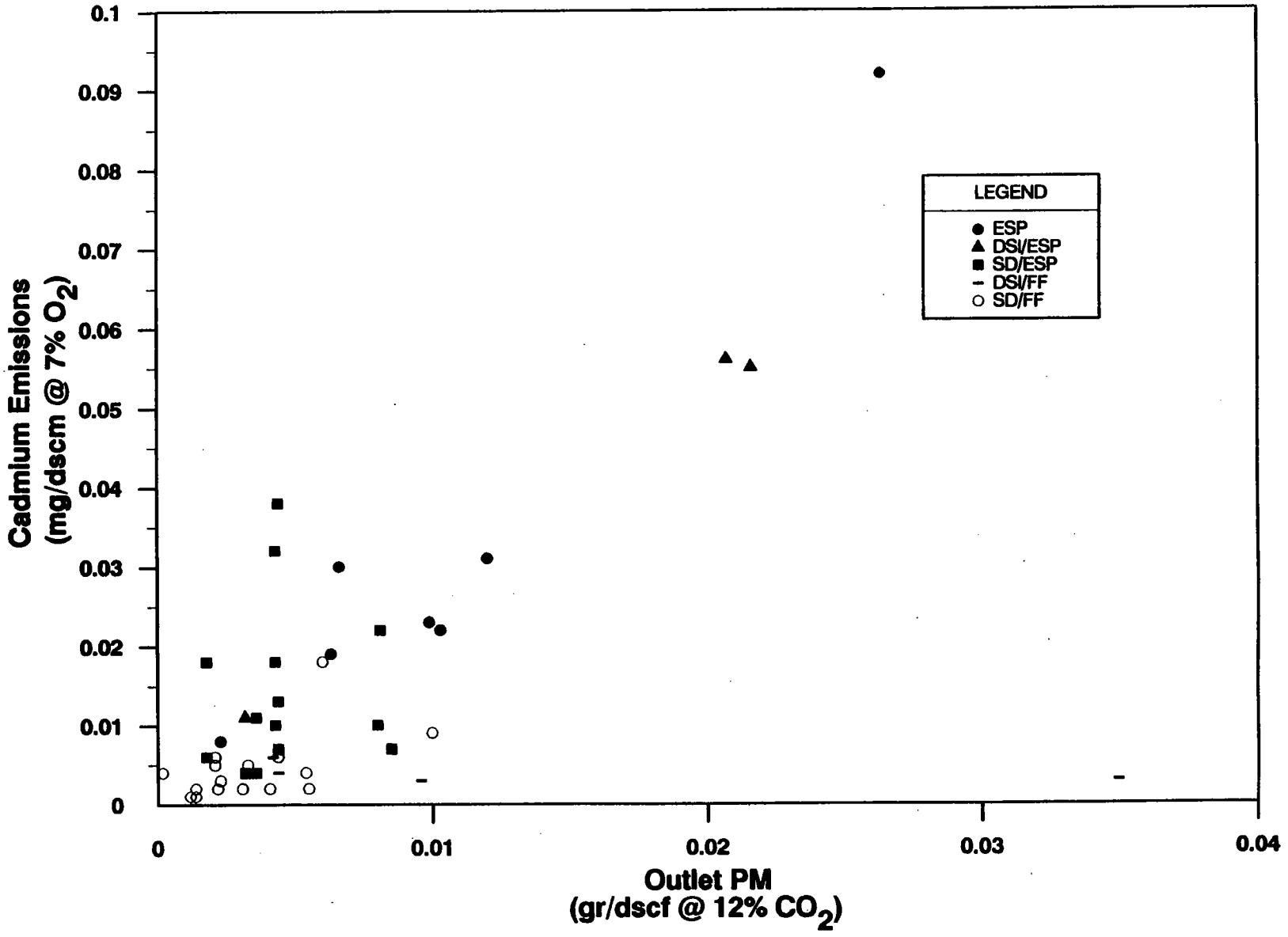


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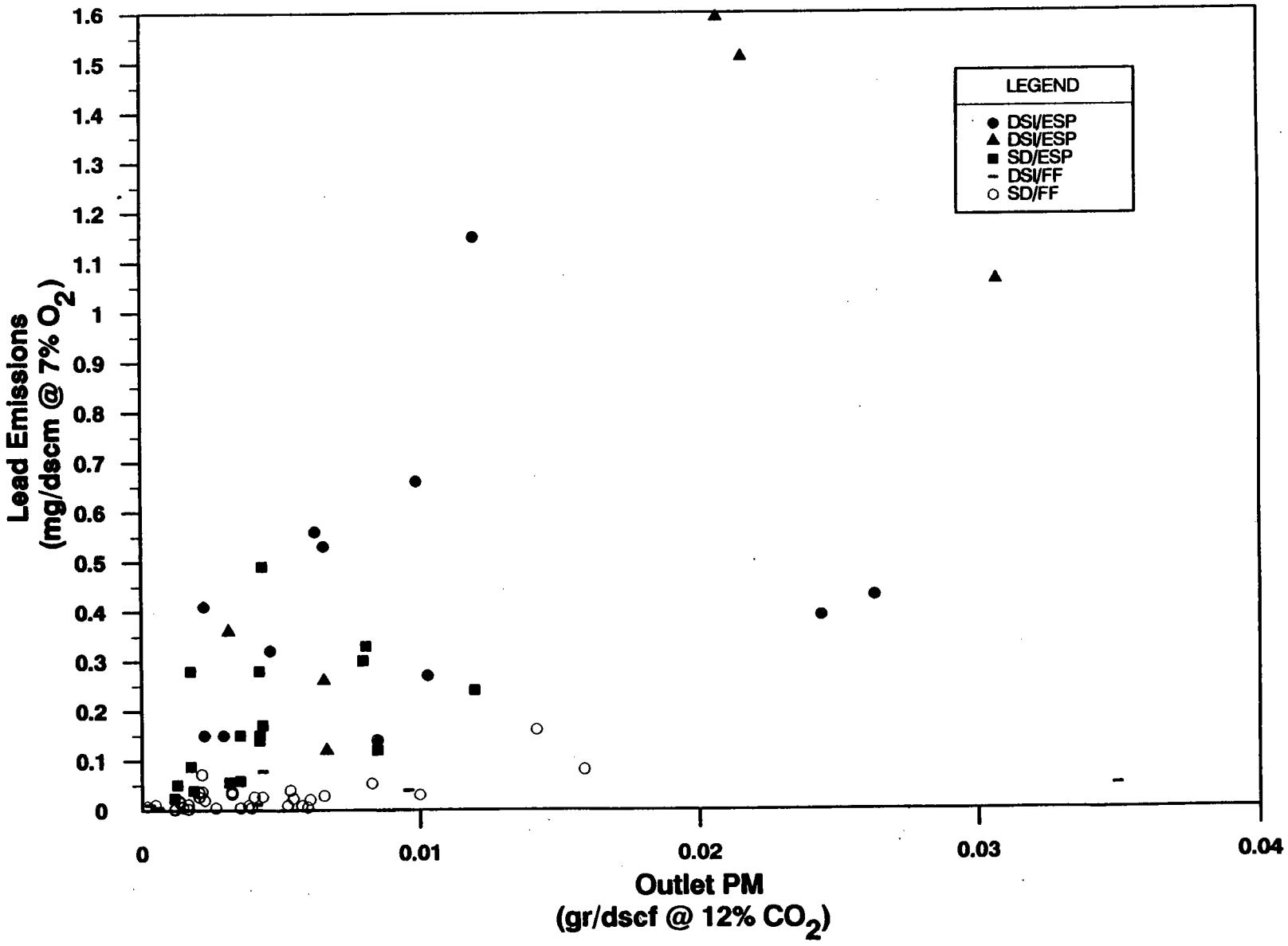
FIGURE 19. LEAD OUTLET EMISSIONS



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APPENDIX A
CADMIUM AND LEAD DATABASE

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Hillsborough	3	400	1	MB/WW	ESP	--	NM (b)	NM	NM	0.0046	NM	0.48 (c)			
			2	MB/WW	ESP	--	NM	NM	NM	0.0051	NM	0.054			
			3	MB/WW	ESP	--	NM	NM	NM	0.0044	NM	0.43			
Average						--	NM	NM	NM	0.0047	NM	0.32			
Pinellas County	3	1000	3-1	MB/WW	ESP	539	NM	NM	NM	0.0024	0.009	0.12			
			3-2	MB/WW	ESP	541	NM	NM	NM	0.0018	0.007	0.23			
			3-3	MB/WW	ESP	549	NM	NM	NM	0.0026	0.007	0.11			
Average Unit 3						543	NM	NM	NM	0.0023	0.008	0.15			
Quebec City	4	250	2,10,11 (d)	MB/WW	ESP	406	NM	NM	NM	0.0120	0.031	1.15			
Quebec City	4	250	5,6,12 (d)	MB/WW	ESP	417	NM	NM	NM	0.0099	0.023	0.66			
Tulsa	2	375	1	MB/WW	ESP	362 (e)	NM	NM	NM	NM	NM	0.42 (c)			
			2	MB/WW	ESP	383 (e)	NM	NM	NM	NM	NM	0.49			
			3	MB/WW	ESP	379 (e)	NM	NM	NM	NM	NM	0.33			
Average						375 (e)	NM	NM	NM	0.0023 (f)	NM	0.41			
Tulsa	2	375	1	MB/WW	ESP	--	NM	NM	NM	0.0281	0.40 (c)	NM			
			2	MB/WW	ESP	--	NM	NM	NM	0.0211	0.46	NM			
			3	MB/WW	ESP	--	NM	NM	NM	0.0241	0.30	NM			
Average						--	NM	NM	NM	0.0244	0.39	NM			
Tulsa	2	375	1	MB/WW	ESP	--	NM	NM	NM	0.0080	0.10 (c)	NM			
			2	MB/WW	ESP	--	NM	NM	NM	0.0101	0.22	NM			
			3	MB/WW	ESP	--	NM	NM	NM	0.0074	0.10	NM			
Average						--	NM	NM	NM	0.0085	0.14	NM			
Detroit	3	1100	12-1	RDF	ESP	600 (g)	NM	NM	NM	NM	ND (h)	ND			
			12-2	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
			12-3	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
Average Unit 12						600 (g)	NM	NM	NM	0.0021 (f)	ND	ND			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Detroit	3	1100	13-1	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
			13-2	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
			13-3	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
Average Unit 13						600 (g)	NM	NM	NM	0.0028 (f)	ND	ND			
Detroit	3	1100	11-1	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
			11-2	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
			11-3	RDF	ESP	600 (g)	NM	NM	NM	NM	ND	ND			
Average Unit 11						600 (g)	NM	NM	NM	0.0045 (f)	ND	ND			
Barron County	2	50	1	MOD/SA	ESP	437 (i)	NM	NM	NM	0.0110	0.019	0.24			
			2	MOD/SA	ESP	444 (i)	NM	NM	NM	0.0100	0.024	0.29			
			3	MOD/SA	ESP	448 (i)	NM	NM	NM	0.0100	0.024	0.29			
Average						443 (i)	NM	NM	NM	0.0103	0.022	0.27			
Oneida County	4	50	1-1	MOD/SA	ESP	NM	NM	NM	NM	0.0130	0.089	0.64			
			1-2	MOD/SA	ESP	NM	NM	NM	NM	0.0330	0.079	0.31			
			1-3	MOD/SA	ESP	NM	NM	NM	NM	0.0330	0.11	0.35			
Average Unit 1							NM	NM	NM	0.0263	0.092	0.43			
Pigeon Point	5	120	2-1	MOD/EA	ESP	403 (j)	NM	NM	NM	NM	NM	0.19			
			2-2	MOD/EA	ESP	413 (j)	NM	NM	NM	NM	NM	0.13			
			2-3	MOD/EA	ESP	415 (j)	NM	NM	NM	NM	NM	0.15			
Average Unit 2						410 (j)	NM	NM	NM	0.0030 (f)	NM	0.15			
Dayton	3	300	3-1	MB/REF	ESP	567	0.376	0.5	27.7	0.0030	0.011	0.32	99.20	97.90	98.80
			3-2	MB/REF	ESP	548	0.568	2.5	67.3	0.0110	0.054	0.97	98.10	97.80	98.60
			3-3	MB/REF	ESP	564	0.983	2.9	13.2	0.0057	0.024	0.31	99.40	99.20	97.70
Average Unit 3						560	0.642	1.95	36.1	0.0066	0.030	0.53	98.90	98.30	98.37
Dayton	3	300	3-4	MB/REF	ESP	402	0.59	1.5	15.6	0.0038	0.016	0.60	99.40	98.90	96.20
			3-5	MB/REF	ESP	400	0.527	0.9	27.1	0.0087	0.022	0.52	98.40	97.60	98.10
			3-6	MB/REF	ESP	400	0.578	1.5	56.5	0.1050 (k)	0.28 (k)	22.64 (k)	81.80 (k)	81.50 (k)	59.90 (k)

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Average Unit 3						401	0.565	1.3	33.1	0.0063	0.019	0.56	98.90	98.25	97.15
Alexandria	3	325	M1	MB/WW	PSI/ESP	326	NM	NM	NM	NM	0.024 (c)	0.57 (c)			
			M2	MB/WW	PSI/ESP	330	NM	NM	NM	NM	0.032	0.70			
			M3	MB/WW	PSI/ESP	344	NM	NM	NM	NM	0.041	0.94			
Average Unit 1						333	NM	NM	NM	NM	0.032	0.73			
Alexandria	3	325	1	MB/WW	PSI/ESP	370	NM	NM	NM	0.0160	NM	0.45 (c)			
			3	MB/WW	PSI/ESP	392	NM	NM	NM	0.0460	NM	1.78			
			4	MB/WW	PSI/ESP	376	NM	NM	NM	0.0300	NM	0.94			
Average Unit 2						379	NM	NM	NM	0.0307	NM	1.06			
Alexandria	3	325	1	MB/WW	PSI/ESP	361	NM	NM	NM	0.0054	NM	0.22 (c)			
			2	MB/WW	PSI/ESP	368	NM	NM	NM	0.0048	NM	0.15			
			3	MB/WW	PSI/ESP	368	NM	NM	NM	0.0097	NM	0.42			
Average Unit 3						366	NM	NM	NM	0.0066	NM	0.26			
Alexandria	3	325	1	MB/WW	PSI/ESP	—	NM	NM	NM	0.0079	NM	0.13 (c)			
			2	MB/WW	PSI/ESP	—	NM	NM	NM	0.0063	NM	0.082			
			3	MB/WW	PSI/ESP	—	NM	NM	NM	0.0059	NM	0.16			
Average Unit 1						—	NM	NM	NM	0.0067	NM	0.12			
Dayton	3	300	3-10	MB/REF	PSI/ESP	397	0.72	1.1	34.6	0.0240	0.078	1.79	96.70	91.50	93.70
			3-11	MB/REF	PSI/ESP	391	1.37	1.2	21.9	0.0210	0.056	1.35	98.50	94.60	93.00
			3-12	MB/REF	PSI/ESP	395	1.49	1.2	24.4	0.0170	0.034	1.64	98.90	97.00	93.30
Average Unit 3						394	1.19	1.2	26.9	0.0207	0.056	1.59	98.03	94.37	93.33
Dayton	3	300	3-13	MB/REF	PSI/ESP	297	1.06	0.9	18.6	0.0300	0.079	2.18	97.20	89.80	86.70
			3-14	MB/REF	PSI/ESP	301	1.07	1.4	40.0	0.0280	0.076	2.11	97.40	94.50	94.70
			3-15	MB/REF	PSI/ESP	296	1.25	1.0	22.1	0.0068	0.010	0.23	99.50	99.10	99.00
Average Unit 3						298	1.13	1.1	26.9	0.0216	0.055	1.51	98.03	94.47	93.47
Dayton	3	300	3-16	MB/REF	DSI/ESP	306	0.604	1.3	35.7	0.0018	0.008	0.31	99.70	99.42	99.15
			3-17	MB/REF	DSI/ESP	305	0.596	1.7	33.9	0.0039	0.013	0.38	99.35	99.20	98.89
			3-18	MB/REF	DSI/ESP	306	0.481	1.6	39.3	0.0039	0.012	0.40	99.19	99.27	98.97

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (s)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Average Unit 3						306	0.560	1.5	36.3	0.0032	0.011	0.36	99.41	99.30	99.00
Burnaby (Vancouver)	3	265	3-1	MB/WW	DSI/FF	295 (l)	NM	1.5	38.2	0.0043	0.004	0.085		99.71	99.78
			3-2	MB/WW	DSI/FF	295 (l)	NM	1.1	33.1	0.0040	0.004	0.075		99.66	99.77
			3-3	MB/WW	DSI/FF	295 (l)	NM	0.8	19.8	0.0048	0.003	0.075		99.65	99.62
Average Unit 3						295 (l)	NM	1.2	30.4	0.0044	0.004	0.078		99.67	99.72
Concord	2	250	1	MB/WW	DSI/FF	--	NM	NM	NM	0.0004	NM	0.009			
			2	MB/WW	DSI/FF	--	NM	NM	NM	0.0002	NM <	0.006			
			3	MB/WW	DSI/FF	--	NM	NM	NM	0.0004	NM	0.015			
Average						--	NM	NM	NM	0.0003	NM	0.010			
Concord	2	250	1	MB/WW	DSI/FF	--	NM	NM	NM	0.0006	NM <	0.006			
			2	MB/WW	DSI/FF	--	NM	NM	NM	0.0004	NM <	0.006			
			3	MB/WW	DSI/FF	--	NM	NM	NM	0.0008	NM <	0.005			
Average						--	NM	NM	NM	0.0006	NM	0.005			
Quebec City (pilot)			5	MB/WW	DSI/FF	400	NM	1.0	35.7	NM	0.001	0.005		99.90	99.98
			6	MB/WW	DSI/FF	400	NM	1.0	33.9	NM	ND	0.007		100.00	99.98
Average						400	NM	1.0	34.8	NM	0.001	0.006		99.95	99.98
Quebec City (pilot)			1	MB/WW	DSI/FF	285	NM	NM	NM	NM	ND	0.010			
			2	MB/WW	DSI/FF	287	NM	2.0	36.9	NM	ND	0.008		100.00	99.98
			11	MB/WW	DSI/FF	284	NM	1.0	31.3	NM	ND	0.001		100.00	100.00
Average						285	NM	1.5	34.1	NM	ND	0.006		100.00	99.99
Quebec City (pilot)			3	MB/WW	DSI/FF	250	NM	1.3	44.5	NM	0.0004	0.003		99.97	99.99
			4	MB/WW	DSI/FF	250	NM	NM	NM	NM	0.0004	0.003			
Average						250	NM	1.3	44.5	NM	0.0004	0.003		99.97	99.99
Quebec City (pilot)			12	MB/WW	DSI/FF	229	NM	1.3	41.1	NM	0.0004	0.004		99.97	99.99
			13	MB/WW	DSI/FF	232	NM	1.0	30.6	NM	NM	NM			
Average						231	NM	1.1	35.9	NM	0.0004	0.004		99.97	99.99

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Wurzburg	2	330	1	MB/WW	DSI/FF	365	NM	NM	NM	0.0042	0.006	0.011			
Dutchess County	2	250	1-1	MB/RC	DSI/FF	426 (m)	NM	NM	NM	NM	0.002	0.033			
			1-2	MB/RC	DSI/FF	435 (m)	NM	NM	NM	NM	0.003	0.040			
			1-3	MB/RC	DSI/FF	428 (m)	NM	NM	NM	NM	0.004	0.044			
Average Unit 1						430 (m)	NM	NM	NM	0.0096 (f)	0.003	0.039			
Dutchess County	2	250	2-1	MB/RC	DSI/FF	352 (m)	NM	NM	NM	NM	0.001	0.023			
			2-2	MB/RC	DSI/FF	367 (m)	NM	NM	NM	NM	0.004	0.075			
			2-3	MB/RC	DSI/FF	377 (m)	NM	NM	NM	NM	0.003	0.049			
Average Unit 2						365 (m)	NM	NM	NM	0.0350 (f)	0.003	0.049			
St. Croix	3	114	1	MOD/EA	DSI/FF	223 (m)	NM	NM	NM	NM	0.004	0.026			
			2	MOD/EA	DSI/FF	223 (m)	NM	NM	NM	NM	0.003	0.017			
			3	MOD/EA	DSI/FF	223 (m)	NM	NM	NM	NM	ND	0.012			
Average						223 (m)	NM	NM	NM	NM	0.002	0.018			
Haverhill	3	550	B-1	MB/WW	SD/ESP	--	NM	NM	NM	0.0028	0.010 (c)	0.14 (c)			
			B-2	MB/WW	SD/ESP	--	NM	NM	NM	0.0027	0.011	0.10			
			B-3	MB/WW	SD/ESP	--	NM	NM	NM	0.0074	0.008	0.22			
Average Unit B						--	NM	NM	NM	0.0043	0.010	0.15			
Haverhill	3	550	A-1	MB/WW	SD/ESP	285	NM	NM	NM	0.0041	0.031 (c)	0.033 (c)			
			A-2	MB/WW	SD/ESP	285	NM	NM	NM	0.0045	0.013	0.22			
			A-3	MB/WW	SD/ESP	285	NM	NM	NM	0.0043	0.009	0.18			
Average Unit A						285	NM	NM	NM	0.0043	0.018	0.14			
Haverhill	3	550	B-1	MB/WW	SD/ESP	285	NM	NM	NM	0.003	0.045 (c)	0.44 (c)			
			B-2	MB/WW	SD/ESP	285	NM	NM	NM	0.005	0.046	0.44			
			B-3	MB/WW	SD/ESP	285	NM	NM	NM	0.0051	0.024	0.59			
Average Unit B						285	NM	NM	NM	0.0044	0.038	0.49			
Millbury	2	750	1-1	MB/WW	SD/ESP	254	NM	NM	NM	0.0026	0.017	0.23			
			1-2	MB/WW	SD/ESP	256	NM	NM	NM	0.0014	0.021	0.34			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
			1-3	MB/WW	SD/ESP	255	NM	NM	NM	0.0015	0.015	0.26			
			1-4	MB/WW	SD/ESP	244	NM	NM	NM	NM	NM	NM			
			1-5	MB/WW	SD/ESP	243	NM	NM	NM	NM	NM	NM			
			1-6	MB/WW	SD/ESP	243	NM	NM	NM	NM	NM	NM			
Average Unit 1						249	NM	NM	NM	0.0018	0.018	0.28			
Millbury	2	750	2-1	MB/WW	SD/ESP	240	NM	NM	NM	0.0190	0.041	0.71			
			2-2	MB/WW	SD/ESP	240	NM	NM	NM	0.0029	0.012	0.14			
			2-3	MB/WW	SD/ESP	240	NM	NM	NM	0.0025	0.011	0.13			
Average Unit 2						240	NM	NM	NM	0.0081	0.022	0.33			
Millbury	2	750	1	MB/WW	SD/ESP	--	NM	NM	NM	0.0043	0.013	0.16			
			2	MB/WW	SD/ESP	--	NM	NM	NM	0.0038	0.010	0.17			
			3	MB/WW	SD/ESP	--	NM	NM	NM	0.0028	0.010	0.13			
Average						--	NM	NM	NM	0.0036	0.011	0.15			
Millbury	2	750	1	MB/WW	SD/ESP	--	NM	NM	NM	0.0055	0.010	0.15			
			2	MB/WW	SD/ESP	--	NM	NM	NM	0.0035	0.012	0.15			
			3	MB/WW	SD/ESP	--	NM	NM	NM	0.0040	0.016	0.21			
Average						--	NM	NM	NM	0.0044	0.013	0.17			
Millbury	2	750	1	MB/WW	SD/ESP	--	NM	NM	NM	0.0018	0.007	0.10			
			2	MB/WW	SD/ESP	--	NM	NM	NM	0.0017	0.006	0.088			
			3	MB/WW	SD/ESP	--	NM	NM	NM	0.0018	0.006	0.075			
Average						--	NM	NM	NM	0.0018	0.006	0.088			
Millbury	2	750	1	MB/WW	SD/ESP	--	NM	NM	NM	0.0017	0.011	0.15			
			2	MB/WW	SD/ESP	--	NM	NM	NM	0.00042	0.007	0.13			
			3	MB/WW	SD/ESP	--	NM	NM	NM	0.00043	0.004	0.078			
Average						--	NM	NM	NM	0.00085	0.007	0.12			
Millbury	2	750	1	MB/WW	SD/ESP	--	NM	NM	NM	0.0048	0.018	0.26			
			2	MB/WW	SD/ESP	--	NM	NM	NM	0.0040	0.060	0.34			
			3	MB/WW	SD/ESP	--	NM	NM	NM	0.0042	0.019	0.25			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration PM (gr/dscf at 12% CO2)	Inlet Concentration Cd (mg/dscm at 7%O2)	Inlet Concentration Pb (mg/dscm at 7%O2)	Outlet Concentration PM (gr/dscf at 12% CO2)	Outlet Concentration Cd (mg/dscm at 7%O2)	Outlet Concentration Pb (mg/dscm at 7%O2)	Removal Efficiency (%) PM	Cd	Pb
Average						--	NM	NM	NM	0.0043	0.032	0.28			
Portland	2	250	A-4	MB/WW	SD/ESP	287 (a)	NM	NM	NM	0.0032	0.002	0.025			
			A-5	MB/WW	SD/ESP	309 (a)	NM	NM	NM	0.0038	0.004	0.068			
			A-6	MB/WW	SD/ESP	328 (a)	NM	NM	NM	0.0039	0.006	0.085			
Average Unit A						308 (a)	NM	NM	NM	0.0036	0.004	0.059			
Portland	2	250	B-1	MB/WW	SD/ESP	284 (a)	NM	NM	NM	0.0042	0.005	0.061			
			B-2	MB/WW	SD/ESP	286 (a)	NM	NM	NM	0.0032	0.005	0.063			
			B-3	MB/WW	SD/ESP	285 (a)	NM	NM	NM	0.0022	0.003	0.044			
Average Unit B						285 (a)	NM	NM	NM	0.0032	0.004	0.056			
Honolulu	4	2-300, 2-900	1-1	RDF	SD/ESP	307 (a)	NM	NM	NM	0.0010	NM	0.050			
			1-2	RDF	SD/ESP	296 (a)	NM	NM	NM	0.0027	NM	0.035			
			1-3	RDF	SD/ESP	296 (a)	NM	NM	NM	NM	NM	0.033			
Average Unit 1						300 (a)	NM	NM	NM	0.0019	NM	0.039			
Honolulu	4	2-300, 2-900	2-1	RDF	SD/ESP	297 (a)	NM	NM	NM	0.0008	NM	0.043			
			2-2	RDF	SD/ESP	295 (a)	NM	NM	NM	0.0007	NM	0.051			
			2-3	RDF	SD/ESP	292 (a)	NM	NM	NM	0.0023	NM	0.060			
Average Unit 2						293 (a)	NM	NM	NM	0.0013	NM	0.051			
Semass	2	900	1-1	RDF	SD/ESP	287 (a)	NM	NM	NM	NM	0.005	0.18			
			1-2	RDF	SD/ESP	288 (a)	NM	NM	NM	NM	0.007	0.21			
			1-3	RDF	SD/ESP	287 (a)	NM	NM	NM	NM	0.017	0.51			
Average Unit 1						287 (a)	NM	NM	NM	0.0080 (f)	0.010	0.30			
Semass	2	900	2-2	RDF	SD/ESP	293 (a)	NM	NM	NM	NM	0.007	0.22			
			2-3	RDF	SD/ESP	292 (a)	NM	NM	NM	NM	0.006	0.27			
			2-4	RDF	SD/ESP	293 (a)	NM	NM	NM	NM	0.008	0.22			
Average Unit 2						293 (a)	3.86 (f)	NM	NM	0.0120 (f)	0.007	0.24			
West Palm Beach	2	1000	1-1	RDF	SD/ESP	275 (a)	1.92	NM	NM	0.0007	NM	0.080			
			1-2	RDF	SD/ESP	280 (a)	4.2	NM	NM	0.0028	NM	0.048			
			1-3	RDF	SD/ESP	276 (a)	1.87	NM	NM	0.0003	NM	0.023			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Average Unit 1						277 (a)	2.66	NM	NM	0.0013	NM	0.050			
West Palm Beach	2	1000	2-1	RDF	SD/ESP	280 (a)	NM	NM	NM	0.0017	NM	0.028			
			2-2	RDF	SD/ESP	273 (a)	NM	NM	NM	0.0011	NM	0.029			
			2-3	RDF	SD/ESP	282 (a)	NM	NM	NM	0.0008	NM	0.015			
Average Unit 2						278 (a)	NM	NM	NM	0.0012	NM	0.024			
Babylon	2	375	2-1	MB/WW	SD/FF	319 (a)	NM	NM	NM	0.0013	ND	0.001			
			2-2	MB/WW	SD/FF	318 (a)	NM	NM	NM	0.0008	ND	0.003			
			2-3	MB/WW	SD/FF	316 (a)	NM	NM	NM	0.0016	ND	0.001			
Average Unit 2						318 (a)	NM	NM	NM	0.0012	ND	0.001			
Babylon	2	375	1	MB/WW	SD/FF	--	NM	NM	NM	0.0013	0.001 (c)	0.001 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0008	0.001	0.002			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0016	0.001	0.001			
Average						--	NM	NM	NM	0.0012	0.001	0.001			
Babylon	2	375	1	MB/WW	SD/FF	--	NM	NM	NM	0.0025	0.005 (c)	0.044 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0019	0.005	0.041			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0056	0.005	0.022			
Average						--	NM	NM	NM	0.0033	0.005	0.036			
Bridgeport	3	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0007	ND	ND			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0011	ND	ND			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0004	ND	ND			
Average						--	NM	NM	NM	0.0007	ND	ND			
Bridgeport	3	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0010	ND	0.005			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0130	0.006	0.103			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0022	0.005	0.012			
Average						--	NM	NM	NM	0.0054	0.004	0.040			
Bridgeport	3	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0074	ND	0.027			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0035	ND	ND			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0007	ND	ND			
Average						--	NM	NM	NM	0.0039	ND	0.009			
Bridgeport	3	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0022	NM	ND			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0009	NM	ND			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0025	NM	ND			
Average						--	NM	NM	NM	0.0019	NM	ND			
Bridgeport	3	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0004	NM	ND			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0009	NM	ND			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0006	NM	ND			
Average						--	NM	NM	NM	0.0007	NM	ND			
Bridgeport	3	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0008	NM	ND			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0008	NM	ND			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0005	NM	ND			
Average						--	NM	NM	NM	0.0007	NM	ND			
Bristol	2	325	1	MB/WW	SD/FF	--	NM	NM	NM	0.0113	NM	0.056 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0053	NM	0.019			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0031	NM	0.009			
Average						--	NM	NM	NM	0.0066	NM	0.028			
Bristol	2	325	1	MB/WW	SD/FF	--	NM	NM	NM	0.0019	0.003 (c)	0.017 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0014	0.000	0.008			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0010	0.001	0.021			
Average						--	NM	NM	NM	0.0014	0.001	0.015			
Bristol	2	325	1	MB/WW	SD/FF	--	NM	NM	NM	0.0032	0.001 (c)	0.074 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0034	0.002	0.003			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0028	0.004	0.020			
Average						--	NM	NM	NM	0.0031	0.002	0.032			
Bristol	2	325	1	MB/WW	SD/FF	--	NM	NM	NM	0.0014	0.001 (c)	0.033 (c)			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0010	0.003	0.007			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0019	0.003	0.013			
Average						--	NM	NM	NM	0.0014	0.002	0.018			
Commerce	1	380	1-3	MB/WW	SD/FF	--	NM	1.4	4.1	NM	0.001	0.002		99.96	99.96
			1-5	MB/WW	SD/FF	--	NM	1.9	25.0	NM	0.000	0.001		99.98	100.00
			1-9	MB/WW	SD/FF	--	NM	1.5	22.7	NM	0.005	0.004		99.69	99.98
Average						--	NM	1.6	17.3	NM	0.002	0.002		99.87	99.98
Commerce	1	380	1-13	MB/WW	SD/FF	--	NM	1.3	6.8	NM	0.001	0.004		99.96	99.94
			1-16	MB/WW	SD/FF	--	NM	0.02	22.4	NM	0.000	0.003		98.24	99.99
			1-18	MB/WW	SD/FF	--	NM	1.2	19.0	NM	0.017 (o)	0.340 (o)		98.64 (o)	98.21 (o)
			29	MB/WW	SD/FF	--	NM	1.3	13.9	NM	0.0004	0.002		99.97	99.99
Average						--	NM	0.96	15.5	NM	0.0004	0.003		99.39	99.97
Fairfax	4	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0028	0.006 (c)	0.027 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0014	0.005	0.023			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0020	0.006	0.028			
Average						--	NM	NM	NM	0.0021	0.006	0.026			
Fairfax	4	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0099	0.008 (c)	0.028 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0110	0.010	0.028			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0090	0.009	0.030			
Average						--	NM	NM	NM	0.0100	0.009	0.029			
Fairfax	4	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0021	NM	0.035 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0017	0.006 (c)	0.035			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0024	0.004	0.036			
Average						--	NM	NM	NM	0.0021	0.005	0.035			
Fairfax	4	750	1	MB/WW	SD/FF	--	NM	NM	NM	0.0042	0.006 (c)	0.025 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0045	0.006	0.025			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0047	0.006	0.027			
Average						--	NM	NM	NM	0.0044	0.006	0.026			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Gloucester	1	575	1	MB/WW	SD/FF	--	NM	NM	NM	0.0007	ND	0.016			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0002	ND	0.002			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0007	ND	0.012			
Average						--	NM	NM	NM	0.0005	ND	0.010			
Gloucester	1	575	1	MB/WW	SD/FF	--	NM	NM	NM	0.0034	ND	0.003			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0002	ND	0.001			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0014	ND	0.002			
Average						--	NM	NM	NM	0.0017	ND	0.002			
Gloucester	1	575	1	MB/WW	SD/FF	--	NM	NM	NM	0.0046	ND	0.021			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0101	ND	0.018			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0035	ND	0.021			
Average						--	NM	NM	NM	0.0061	ND	0.020			
Hempstead	3	773	1-1	MB/WW	SD/FF	--	NM	NM	NM	0.0012	ND	0.002			
			1-2	MB/WW	SD/FF	--	NM	NM	NM	0.0009	ND	0.002			
			1-3	MB/WW	SD/FF	--	NM	NM	NM	0.0016	ND	0.001			
Average Unit 1						310 (p)	NM	NM	NM	0.0012	ND	0.002			
Hempstead	3	773	2-1	MB/WW	SD/FF	--	NM	NM	NM	0.0045	ND	0.001			
			2-2	MB/WW	SD/FF	--	NM	NM	NM	0.0018	ND	0.003			
			2-3	MB/WW	SD/FF	--	NM	NM	NM	0.0020	ND	0.009			
Average Unit 2						310 (p)	NM	NM	NM	0.0027	ND	0.004			
Hempstead	3	773	3-1	MB/WW	SD/FF	--	NM	NM	NM	0.0012	ND	0.002			
			3-2	MB/WW	SD/FF	--	NM	NM	NM	0.0012	ND	0.003			
			3-3	MB/WW	SD/FF	--	NM	NM	NM	0.0022	ND	0.014			
Average Unit 3						310 (p)	NM	NM	NM	0.0015	ND	0.006			
Huntsville	2	345	1	MB/WW	SD/FF	--	NM	NM	NM	0.0097	NM	0.055 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0082	NM	0.057			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0071	NM	0.049			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration PM (gr/dscf at 12% CO2)	Inlet Concentration Cd (mg/dscm at 7%O2)	Inlet Concentration Pb (mg/dscm at 7%O2)	Outlet Concentration PM (gr/dscf at 12% CO2)	Outlet Concentration Cd (mg/dscm at 7%O2)	Outlet Concentration Pb (mg/dscm at 7%O2)	Removal Efficiency (%) PM	Cd	Pb
Average						--	NM	NM	NM	0.0083	NM	0.053			
Huntsville	2	345	1	MB/WW	SD/FF	--	NM	NM	NM	0.0022	NM	0.012 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0018	NM	0.012			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0011	NM	0.009			
Average						--	NM	NM	NM	0.0017	NM	0.011			
Indianapolis	3	787	1-1	MB/WW	SD/FF	309 (a)	NM	NM	NM	NM	NM	0.004			
			1-2	MB/WW	SD/FF	308 (a)	NM	NM	NM	NM	NM	0.004			
			1-3	MB/WW	SD/FF	304 (a)	NM	NM	NM	NM	NM	0.004			
Average Unit 1						307 (a)	NM	NM	NM	0.0036 (f)	NM	0.004			
Indianapolis	3	787	1	MB/WW	SD/FF	--	NM	NM	NM	0.0019	NM	0.044 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0024	NM	0.11			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0022	NM	0.063			
Average						--	NM	NM	NM	0.0022	NM	0.072			
Indianapolis	3	787	1	MB/WW	SD/FF	--	NM	NM	NM	0.0064	NM	0.004 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0021	NM	0.004			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0036	NM	0.004			
Average						--	NM	NM	NM	0.0040	NM	0.004			
Kent	2	313	1	MB/WW	SD/FF	--	NM	NM	NM	0.0002	0.004 (c)	0.007 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0001	0.004	0.007			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0002	0.003	0.007			
Average						--	NM	NM	NM	0.0002	0.004	0.007			
Kent	2	313	1	MB/WW	SD/FF	--	NM	NM	NM	0.0003	0.004 (c)	0.007 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0001	0.004	0.007			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0001	0.003	0.007			
Average						--	NM	NM	NM	0.0002	0.004	0.007			
Long Beach	3	460	1-1	MB/WW	SD/FF	291	1.63	NM	NM	0.0047	0.011	0.014			
			1-2	MB/WW	SD/FF	300	1.82	NM	NM	0.0057	0.010	ND			
			1-3	MB/WW	SD/FF	302	1.29	NM	NM	0.0076	0.034	ND			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb
Average						298	1.58	NM	NM	0.0060	0.018	0.005			
Marion County	2	275	1-4	MB/WW	SD/FF	271	NM	1.2	16.8	NM	0.018 (q)	0.19 (q)		98.47 (q)	98.87 (q)
			1-5	MB/WW	SD/FF	272	NM	1.2	19.9	NM	0.003	0.015		99.76	99.92
			1-6	MB/WW	SD/FF	272	NM	1.0	24.8	NM	0.002	0.022		99.76	99.91
Average						272	0.881 (f)	1.1	20.5	.0023 (f)	0.003	0.019	99.70	99.76	99.92
Marion County	2	275	1	MB/WW	SD/FF	--	NM	NM	NM	0.0211	NM	0.19 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0129	NM	0.017			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0136	NM	0.037			
Average						--	NM	NM	NM	0.0159	NM	0.080			
Marion County	2	275	1	MB/WW	SD/FF	--	NM	NM	NM	0.0030	NM	0.010 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0101	NM	0.003			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0044	NM	0.011			
Average						--	NM	NM	NM	0.0058	NM	0.008			
Marion County	2	275	1	MB/WW	SD/FF	--	NM	NM	NM	0.0035	NM	0.010 (c)			
			2	MB/WW	SD/FF	--	NM	NM	NM	0.0035	NM	0.009			
			3	MB/WW	SD/FF	--	NM	NM	NM	0.0090	NM	0.010			
Average						--	NM	NM	NM	0.0053	NM	0.010			
Quebec City (pilot)			7	MB/WW	SD/FF	280	2.43	1.2	25.5	NM	ND	0.002		100.00	99.99
			8	MB/WW	SD/FF	283	2.61	1.2	34.5	NM	ND	ND		100.00	100.00
Average						282	2.52	1.2	30.0	NM	ND	0.001		100.00	100.00
Quebec City (pilot)			9	MB/WW	SD/FF	285	NM	1.2	36.5	NM	ND	0.005		100.00	99.99
			10	MB/WW	SD/FF	283	NM	1.1	31.4	NM	ND	0.007		100.00	99.98
Average						284	NM	1.2	34.0	NM	ND	0.006		100.00	99.98
Stanislaus County	2	400	1-14	MB/WW	SD/FF	297 (r)	NM	NM	NM	NM	0.004	0.040			
			1-16	MB/WW	SD/FF	291 (r)	NM	NM	NM	NM	0.001	0.008			
			1-19	MB/WW	SD/FF	296 (r)	NM	NM	NM	NM	0.0002	0.020			

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration PM (gr/dscf at 12% CO2)	Inlet Concentration Cd (mg/dscm at 7% O2)	Inlet Concentration Pb (mg/dscm at 7% O2)	Outlet Concentration PM (gr/dscf at 12% CO2)	Outlet Concentration Cd (mg/dscm at 7% O2)	Outlet Concentration Pb (mg/dscm at 7% O2)	Removal Efficiency (%) PM	Removal Efficiency (%) Cd	Removal Efficiency (%) Pb
Average Unit 1						295 (r)	NM	NM	NM	0.0055 (f)	0.002	0.023			
Stanislaus County	2	400	2-38	MB/WW	SD/FF	297	NM	NM	NM	NM	0.002	0.043			
			2-40	MB/WW	SD/FF	287	NM	NM	NM	NM	0.002	0.036			
			2-42	MB/WW	SD/FF	287	NM	NM	NM	NM	0.002	0.031			
Average Unit 2						290	NM	NM	NM	0.0022 (f)	0.002	0.037			
Stanislaus County	2	400	1	MB/WW	SD/FF	—	NM	NM	NM	0.0042	0.002 (c)	0.026 (c)			
			2	MB/WW	SD/FF	—	NM	NM	NM	0.0036	0.001	0.028			
			3	MB/WW	SD/FF	—	NM	NM	NM	0.0046	0.002	0.024			
Average						—	NM	NM	NM	0.0041	0.002	0.026			
Biddeford	2	300	A-1	RDF	SD/FF	277	3.23	1.0	26.4	0.0095	ND	0.15	99.71	100.00	99.45
			A-2	RDF	SD/FF	278	2.85	1.1	27.4	0.0140	ND	0.16	99.51	100.00	99.44
			A-3	RDF	SD/FF	279	3.53	1.3	28.2	0.0190	ND	0.18	99.46	100.00	99.37
Average						278	3.20	1.1	27.4	0.0142	ND	0.16	99.56	100.00	99.42
Mid-Connecticut	3	675	1	RDF	SD/FF	274	2.57	0.9	43.4	0.0021	NM	ND	99.92		100.00
			2	RDF	SD/FF	276	2.25	1.2	31.4	0.0041	NM	ND	99.82		100.00
			3	RDF	SD/FF	278	4.78 (e)	NM	NM	0.0059	NM	ND	99.88		
Average						276	2.41	1.1	37.4	0.0040	NM	ND	99.87		100.00
Mid-Connecticut	3	675	11-5	RDF	SD/FF	252	1.95	0.5 (c)	14.3 (c)	0.0017	ND	0.047 (c)	99.91	100.00	99.67
			11-10	RDF	SD/FF	253	1.98	0.6	4.8	0.0018	ND	0.043	99.91	100.00	99.10
			11-2	RDF	SD/FF	253	2.38	0.6	12.7	0.0025	ND	0.045	99.89	100.00	99.64
			11-7	RDF	SD/FF	255	1.85	0.5	5.9	0.0019	ND	0.029	99.90	100.00	99.51
			11-12	RDF	SD/FF	285	1.48	0.6	4.0	0.0017	ND	0.047	99.89	100.00	98.84
			11-13	RDF	SD/FF	285	1.4	0.5	11.5	0.0034	ND	0.091	99.76	100.00	99.21
			11-6	RDF	SD/FF	286	1.45	0.4	7.2	0.0012	ND	0.037	99.92	100.00	99.49
			11-14	RDF	SD/FF	286	1.62	0.7	10.2	0.0021	ND	0.044	99.87	100.00	99.57
			11-8	RDF	SD/FF	287	2.08	0.8	4.6	0.0017	ND	0.040	99.92	100.00	99.14
			11-3	RDF	SD/FF	327	2.03	0.6	14.7	0.0024	ND	0.031	99.88	100.00	99.79
			11-11	RDF	SD/FF	330	1.74	0.6	8.3	0.0025	ND	0.055	99.86	100.00	99.33
			11-4	RDF	SD/FF	331	1.43	0.5	10.1	0.0033	ND	0.037	99.77	100.00	99.63
			11-9	RDF	SD/FF	339	1.7	0.7	2.6	0.0025	ND	0.039	99.85	100.00	98.50

TABLE A-1. MWC LEAD AND CADMIUM

MWC Name	# of Units	Capacity per Unit (tpd)	Run # (a)	Combustor Type	APCD Type	PM Control Device Inlet Temp. (F)	Inlet Concentration			Outlet Concentration			Removal Efficiency (%)		
							PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM (gr/dscf at 12% CO2)	Cd (mg/dscm at 7%O2)	Pb (mg/dscm at 7%O2)	PM	Cd	Pb

(a) Run number consists of unit number followed by the run number for that unit.
(b) NM = Not measured.
(c) All Cd and Pb data are corrected to 12% CO2.
(d) Results are averages for runs listed.
(e) Temperature estimated from a measured value at the ESP outlet and an assumed temperature drop across the ESP (20 F).
(f) Results from separate PM testing.
(g) Temperature estimated to be 600 F based on facility information.
(h) ND = Not detected. Considered as zero when calculating averages. Test averages of ND not used in graphs.
(i) Temperature estimated from a measured value at the ESP outlet and an assumed temperature drop across the ESP (40 F).
(j) Temperature estimated from a measured value at the ESP outlet and an assumed temperature drop across the ESP (38 F).
(k) Not included in average because first field of ESP was unstable during test.
(l) Temperature estimated based on stack temperature data and normal operating temperatures at the FF outlet.
(m) Temperature estimated from a measured value at the ESP outlet and an assumed temperature drop across the ESP (10 F).
(n) Temperature estimated from a measured value at the ESP outlet and an assumed temperature drop across the ESP (15 F).
(o) Baghouse had disconnected bag during test. Results not representative and not included in average.
(p) Temperature not reported. Average based on other runs during same test campaign.
(q) Fabric filter bypassed during test run for 5 minutes. Emissions measured are higher than normally expected.
(r) Temperature monitor at FF inlet malfunctioned. Temperatures estimated from measured at stack and assumed temperature drom across FF (10 F).
(s) Includes sootblowing. Not included in average.