United States
Environmental Protection
Agency

SOURCE TESTING FINAL REPORT

Fuel Comparison
Coal Only and Carpet Co-Fire

Office of Research and Development
National Homeland Security
Research Center

SOURCE TESTING FINAL REPORT

Fuel Comparison - Coal Only and Carpet Co-Fire

Lehigh Cement Evansville Plant, Fleetwood, Pennsylvania

Kiln #1 Stack

Volume 1 (Report Text and Appendices 1-3)

November 1-5 and 8-12, 2004

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EPA Office of Research and Development

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1. Introduction

1.1 Summary of Test Program

The Carpet and Rug Institute (CRI), U.S. Department of Energy (DOE), Georgia Institute of Technology School of Chemical and Bio-Molecular Engineering, and the US EPA, co-sponsored by Lehigh Cement Company and the American Society of Mechanical Engineers (ASME), performed a collaborative test program on the feasibility of using cement kilns for the destruction of post-consumer carpet. Industry wants to utilize post-consumer carpet as a fuel to replace costly coal. The objective of this project is to conduct a feasibility test to determine the impact of carpet burning on; kiln fouling, fuel economy, mechanical equipment operation, and stack emissions.

The source sampling program described here was designed to provide the stack emissions portion of the data necessary for the feasibility determination. Specifically, the following emissions determinations from the kiln were required: filterable particulate matter, condensable particulate matter, PM_{10} particulate matter, particle size distribution, HCl, HF^-, HBr, Br^-, Resource Conservation and Recovery Act (RCRA) and 1990 Clean Air Act (CAA) metals (Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mn, Hg, Ni, Se, Ag, Ti), dioxin/furans, sulfur dioxide, nitrogen oxides, and carbon monoxide. In addition, O_2 and CO_2 concentrations were required for stack gas molecular weight calculation. ARCADIS G&M was contracted by CRI to provide these data.

Source testing took place on the Kiln #1 Stack at Lehigh Cement's Evansville Plant at 537 Evansville Road in Fleetwood, Pennsylvania, 19522 on November 1-5 and 8-12, 2004.

1.2 Key Personnel

The key personnel present for all or part of the test program along with their affiliation, role, and contact information can be seen in Table 1-1.

Table 1-1. Key Personnel

Name	Organization	Role	Phone	E-Mail Address
Peter Smith	Lehigh Cement	Alternative Materials Specialist	(610) 366-4647	psmith@lehighcement.com
Charles Bortz	Lehigh Cement	Plant Environmental Coordinator	(610) 926-1024	cbortz@lehighcement.com
Matthew Realff	Georgia Tech	Test Burn Project Manager	(810) 894-1834	matthew.realff@chbe.gatech.edu
Gary Hinshaw	ASME	Test Observer and Data Reviewer	(785) 296-5555	ghinshaw@kdhe.state.ks.us
Dr. Paul Lemieux	US EPA	Test Coordinator/ Work Assignment Manager	(919) 541-0962	Lemieux.Paul@epamail.epa.gov
Robert Small	PA DEP	Test Observer	(717) 772-2305	robsmall@state.pa.us
Gene Stephenson	ARCADIS G & M	Test Engineer	(919) 544-4535	gstephenson@arcadis-us.com

2. Plant and Sampling Location Descriptions

2.1 Process Description and Operation

Lehigh Cement's Evansville Plant operates two identical kilns commissioned in the 1960s. They utilize the Portland cement manufacturing process. Kiln #1 is 520 feet long and transitions from a 15 foot diameter to a 17 foot diameter in the taper section (from the 400 to 430 foot mark). It has six tires (and piers) for support; the drive pier is Pier 4. It can burn a mix of coal, natural gas, and alternative fuels (tires, wood, carpet) and has a capacity of 1900 short tons per day of clinker. A whole-tire mid-kiln injection system was installed at the 250 foot mark in the early 1990s. The kiln normally operates at production rate of approximately 1700 short tons per day. Figure 2-1 is a schematic diagram of Kiln #1. The plant's Title V permit number is 06-05002.

2.2 Control Equipment Description

The control devices are a cyclone, a spray tower, and a baghouse. The cyclone removes large particulate matter prior to the spray tower. The spray tower has 16 water injection lances (8 double tips and 8 single tips). All injection lances have water atomization controls. The baghouse has a total of 2600 bags/cages split into eight compartments with on-demand pulsing.

2.3 Stack Sampling Location

Emissions sampling was conducted at the stack of Kiln #1. Figure 2-2 is a schematic diagram of the sampling location showing sampling ports and traverse points.

The kiln stack has four 6-inch sampling ports installed 90 degrees apart at the 228 foot level. The stack has an inner diameter of 120 inches and has 8 and 10.5 diameters of straight run before and after the test ports respectively. The minimum of twelve traverse points required by EPA Method 1 were used during the test runs.

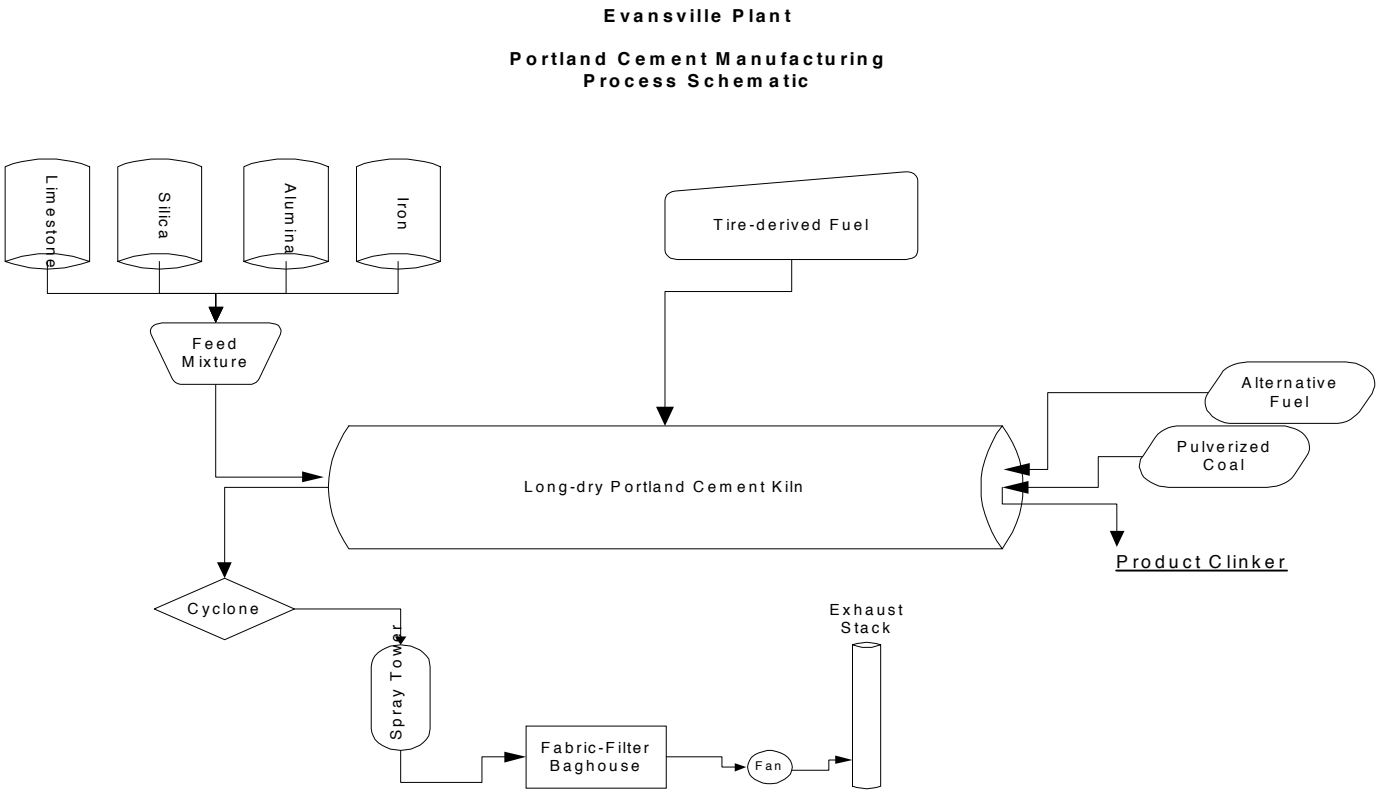

Figure 2-1. Process Schematic

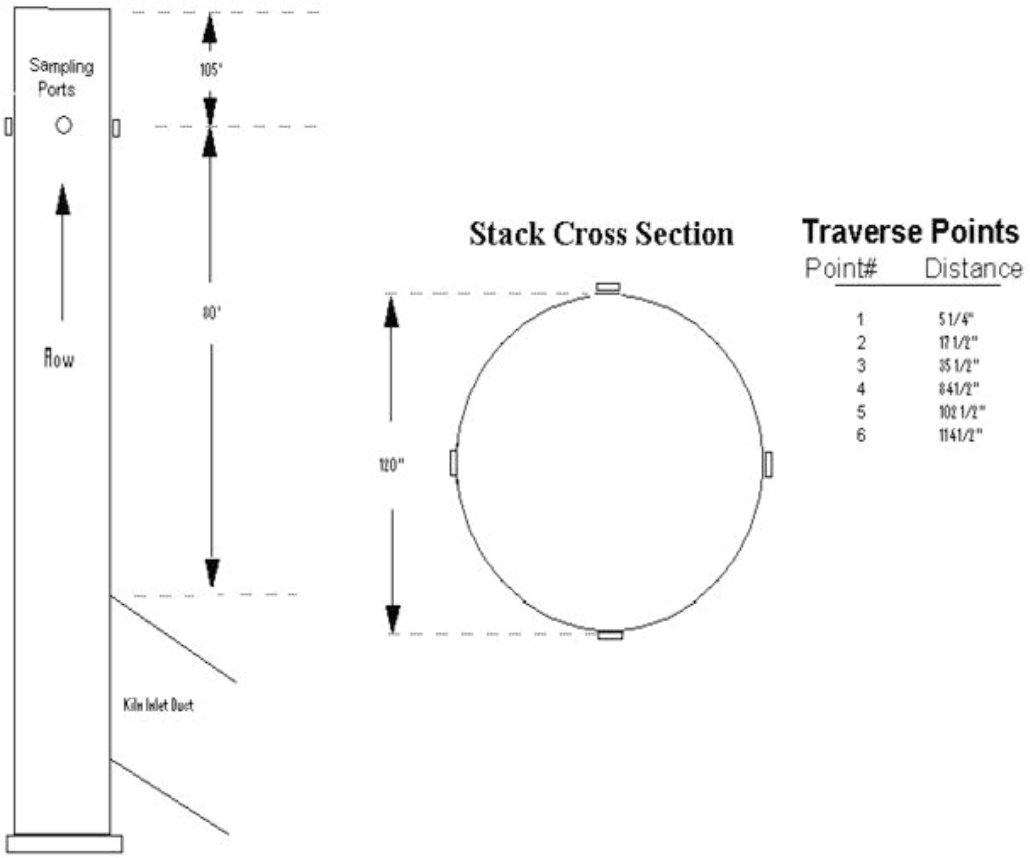

Figure 2-2. Kiln #1 Stack Sampling Location

3. Summary and Discussion of Test Results

3.1 Objectives and Test Matrix

The purpose of the sampling program was to determine the emissions from the #1 Kiln Stack of: filterable particulate matter (FP), condensable particulate matter (CP), PM_{10} particulate matter, particle size distribution (PSD), HCl, Cl^-, HBr, Br^-, RCRA and CAA metals (Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mn, Hg, Ni, Se, Ag), dioxin/furans, sulfur dioxide, nitrogen oxides, and carbon monoxide. In addition, O_2 and CO_2 concentrations were required for stack gas molecular weight calculation. In the QAPP (*Quality Assurance Project Plan - Source Sampling for Post-Consumer Carpet Co-Firing in a Cement Kiln - ASME/Lehigh Cement*), included as Appendix 7, the original intention was to make the above determinations during each of three conditions; coal only, high carpet co-fire and low carpet co-fire. After delays on site, it was determined that the low carpet co-fire condition would be eliminated due to time/funding constraints. The carpet co-fire rate used during the test program was 2.2 long tons per hour. For efficiency reasons (the ability to collect both PM_{10} and condensable particulate simultaneously), CARB Method 501/EPA Method 202 were substituted for Modified EPA Method 201A called for in the QAPP. Table 3-1 presents the test matrix. Although they are not listed below, EPA Methods 1, 2, and 4 were, as with normal practice, performed concurrently with EPA Methods 23, 5/26A, and 29.

Table 3-1. Test Matrix

Date	Kiln Fuel	Method-Run Number	Analyte(s)	Run Period
Nov 5, 2004	Carpet co-fire	EPA M23-1	Dioxins/Furans	09:45-13:35
Nov 5, 2004	Carpet co-fire	EPA M23-2	Dioxins/Furans	09:45-13:35
Nov 5, 2004	Carpet co-fire	EPA M23-3	Dioxins/Furans	16:20-22:08
Nov 5, 2004	Carpet co-fire	CARB M501/EPA M202-Hi1	PM_{10}/PSD/CP	16:25-18:25
Nov 5, 2004	Carpet co-fire	EPA M3A-1	CO_2/O_2	07:49-12:48
Nov 5, 2004	Carpet co-fire	EPA M6C-1	SO_2	07:49-12:48
Nov 5, 2004	Carpet co-fire	EPA M7E-1	NO_X	07:49-12:48
Nov 5, 2004	Carpet co-fire	EPA M10-1	CO	07:49-12:48
Nov 5, 2004	Carpet co-fire	EPA M3A-2	CO_2/O_2	13:09-13:33
Nov 5, 2004	Carpet co-fire	EPA M6C-2	SO_2	13:09-13:33
Nov 5, 2004	Carpet co-fire	EPA M7E-2	NO_X	13:09-13:33
Nov 5, 2004	Carpet co-fire	EPA M10-2	CO	13:09-13:33

Date	Kiln Fuel	Method-Run Number	Analyte(s)	Run Period
Nov 5, 2004	Carpet co-fire	EPA M3A-3	CO_2/O_2	15:34-20:05
Nov 5, 2004	Carpet co-fire	EPA M6C-3	SO_2	15:34-20:05
Nov 5, 2004	Carpet co-fire	EPA M7E-3	NO_X	15:34-20:05
Nov 5, 2004	Carpet co-fire	EPA M10-3	CO	15:34-20:05
Nov 8, 2004	Carpet co-fire	EPA M5/26A-1	FP/HCl/HF^-/HBr/Br^-	08:50-11:14
Nov 8, 2004	Carpet co-fire	EPA M5/26A-2	FP/HCl/HF^-/HBr/Br^-	12:35-15:02
Nov 8, 2004	Carpet co-fire	EPA M5/26A-3*	FP/HCl/HF^-/HBr/Br^-	16:40-18:40
Nov 8, 2004	Carpet co-fire	EPA M29-1	RCRA/CAA Metals	08:50-11:14
Nov 8, 2004	Carpet co-fire	EPA M29-2	RCRA/CAA Metals	12:35-15:03
Nov 8, 2004	Carpet co-fire	EPA M29-3*	RCRA/CAA Metals	16:40-18:40
Nov 8, 2004	Carpet co-fire	EPA M3A-1	CO_2/O_2	08:18-10:10
Nov 8, 2004	Carpet co-fire	EPA M6C-1	SO_2	08:18-10:10
Nov 8, 2004	Carpet co-fire	EPA M7E-1	NO_X	08:18-10:10
Nov 8, 2004	Carpet co-fire	EPA M10-1	CO	08:18-10:10
Nov 8, 2004	Carpet co-fire	EPA M3A-2	CO_2/O_2	12:36-15:03
Nov 8, 2004	Carpet co-fire	EPA M6C-2	SO_2	12:36-15:03
Nov 8, 2004	Carpet co-fire	EPA M7E-2	NO_X	12:36-15:03
Nov 8, 2004	Carpet co-fire	EPA M10-2	CO	12:36-15:03
Nov 8, 2004	Carpet co-fire	EPA M3A-3	CO_2/O_2	16:41-18:07
Nov 8, 2004	Carpet co-fire	EPA M6C-3	SO_2	16:41-18:07
Nov 8, 2004	Carpet co-fire	EPA M7E-3	NO_X	16:41-18:07
Nov 8, 2004	Carpet co-fire	EPA M10-3	CO	16:41-18:07
Nov 8, 2004	Carpet co-fire	EPA M3A-4	CO_2/O_2	18:27-18:41
Nov 8, 2004	Carpet co-fire	EPA M6C-4	SO_2	18:27-18:41
Nov 8, 2004	Carpet co-fire	EPA M7E-4	NO_X	18:27-18:41
Nov 8, 2004	Carpet co-fire	EPA M10-4	CO	18:27-18:41
Nov 9, 2004	Coal Only	EPA M23-4	Dioxins/Furans	07:50-11:18
Nov 9, 2004	Coal Only	EPA M23-5	Dioxins/Furans	07:50-11:18
Nov 9, 2004	Coal Only	EPA M23-6A**	Dioxins/Furans	12:45-13:45
Nov 9, 2004	Coal Only	EPA M3A-1	CO_2/O_2	07:02-11:17
Nov 9, 2004	Coal Only	EPA M6C-1	SO_2	07:02-11:17
Nov 9, 2004	Coal Only	EPA M7E-1	NO_X	07:02-11:17

Date	Kiln Fuel	Method-Run Number	Analyte(s)	Run Period
Nov 9, 2004	Coal Only	EPA M10-1	CO	07:02-11:17
Nov 9, 2004	Coal Only	EPA M3A-2	CO_2/O_2	12:46-13:54
Nov 9, 2004	Coal Only	EPA M6C-2	SO_2	12:46-13:54
Nov 9, 2004	Coal Only	EPA M7E-2	NO_X	12:46-13:54
Nov 9, 2004	Coal Only	EPA M10-2	CO	12:46-13:54
Nov 10, 2004	Coal Only	EPA M23-6	Dioxins/Furans	11:50-15:50
Nov 10, 2004	Coal Only	CARB M501/EPA M202-Base1	PM_{10}/PSD/CP	11:30-17:55
Nov 10, 2004	Coal Only	CARB M501/EPA M202-Base2	PM_{10}/PSD/CP	11:15-17:40
Nov 10, 2004	Coal Only	EPA M3A-1	CO_2/O_2	07:16-10:19
Nov 10, 2004	Coal Only	EPA M6C-1	SO_2	07:16-10:19
Nov 10, 2004	Coal Only	EPA M7E-1	NO_X	07:16-10:19
Nov 10, 2004	Coal Only	EPA M10-1	CO	07:16-10:19
Nov 10, 2004	Coal Only	EPA M3A-2	CO_2/O_2	11:51-13:50
Nov 10, 2004	Coal Only	EPA M6C-2	SO_2	11:51-13:50
Nov 10, 2004	Coal Only	EPA M7E-2	NO_X	11:51-13:50
Nov 10, 2004	Coal Only	EPA M10-2	CO	11:51-13:50
Nov 10, 2004	Coal Only	EPA M3A-3	CO_2/O_2	15:22-16:53
Nov 10, 2004	Coal Only	EPA M6C-3	SO_2	15:22-16:53
Nov 10, 2004	Coal Only	EPA M7E-3	NO_X	15:22-16:53
Nov 10, 2004	Coal Only	EPA M10-3	CO	15:22-16:53
Nov 11, 2004	Coal Only	EPA M5/26A-4	$FP/HCl/HF^-/HBr/Br^-$	08:10-10:35
Nov 11, 2004	Coal Only	EPA M5/26A-5	$FP/HCl/HF^-/HBr/Br^-$	11:40-14:02
Nov 11, 2004	Coal Only	EPA M5/26A-6	$FP/HCl/HF^-/HBr/Br^-$	15:00-17:25
Nov 11, 2004	Coal Only	EPA M29-4	RCRA/CAA Metals	08:10-10:35
Nov 11, 2004	Coal Only	EPA M29-5	RCRA/CAA Metals	11:40-14:02
Nov 11, 2004	Coal Only	EPA M29-6	RCRA/CAA Metals	15:00-17:25
Nov 11, 2004	Coal Only	EPA M3A-1	CO_2/O_2	07:56-09:55
Nov 11, 2004	Coal Only	EPA M6C-1	SO_2	07:56-09:55
Nov 11, 2004	Coal Only	EPA M7E-1	NO_X	07:56-09:55
Nov 11, 2004	Coal Only	EPA M10-1	CO	07:56-09:55
Nov 11, 2004	Coal Only	EPA M3A-2	CO_2/O_2	10:19-12:18

Date	Kiln Fuel	Method-Run Number	Analyte(s)	Run Period
Nov 11, 2004	Coal Only	EPA M6C-2	SO_2	10:19-12:18
Nov 11, 2004	Coal Only	EPA M7E-2	NO_X	10:19-12:18
Nov 11, 2004	Coal Only	EPA M10-2	CO	10:19-12:18
Nov 11, 2004	Coal Only	EPA M3A-3	CO_2/O_2	12:41-14:17
Nov 11, 2004	Coal Only	EPA M6C-3	SO_2	12:41-14:17
Nov 11, 2004	Coal Only	EPA M7E-3	NO_X	12:41-14:17
Nov 11, 2004	Coal Only	EPA M10-3	CO	12:41-14:17
Nov 11, 2004	Coal Only	EPA M3A-4	CO_2/O_2	15:01-17:00
Nov 11, 2004	Coal Only	EPA M6C-4	SO_2	15:01-17:00
Nov 11, 2004	Coal Only	EPA M7E-4	NO_X	15:01-17:00
Nov 11, 2004	Coal Only	EPA M10-4	CO	15:01-17:00
Nov 12, 2004	Carpet co-fire	CARB M501/EPA M202-Hi2	PM_{10}/PSD/CP	10:20-18:35
Nov 12, 2004	Carpet co-fire	CARB M501/EPA M202-Hi3	PM_{10}/PSD/CP	10:20-18:35
Nov 12, 2004	Carpet co-fire	EPA M3A-1	CO_2/O_2	10:46-12:45
Nov 12, 2004	Carpet co-fire	EPA M6C-1	SO_2	10:46-12:45
Nov 12, 2004	Carpet co-fire	EPA M7E-1	NO_X	10:46-12:45
Nov 12, 2004	Carpet co-fire	EPA M10-1	CO	10:46-12:45
Nov 12, 2004	Carpet co-fire	EPA M3A-2	CO_2/O_2	13:04-15:03
Nov 12, 2004	Carpet co-fire	EPA M6C-2	SO_2	13:04-15:03
Nov 12, 2004	Carpet co-fire	EPA M7E-2	NO_X	13:04-15:03
Nov 12, 2004	Carpet co-fire	EPA M10-2	CO	13:04-15:03
Nov 12, 2004	Carpet co-fire	EPA M3A-3	CO_2/O_2	15:21-17:20
Nov 12, 2004	Carpet co-fire	EPA M6C-3	SO_2	15:21-17:20
Nov 12, 2004	Carpet co-fire	EPA M7E-3	NO_X	15:21-17:20
Nov 12, 2004	Carpet co-fire	EPA M10-3	CO	15:21-17:20
Nov 12, 2004	Carpet co-fire	EPA M3A-4	CO_2/O_2	17:38-18:37
Nov 12, 2004	Carpet co-fire	EPA M6C-4	SO_2	17:38-18:37
Nov 12, 2004	Carpet co-fire	EPA M7E-4	NO_X	17:38-18:37
Nov 12, 2004	Carpet co-fire	EPA M10-4	CO	17:38-18:37

*Run shortened to ~65 minutes due to process upset – run was not repeated and was analyzed and reported

**Run shortened to ~55 minutes due to process upset – run was aborted , not analyzed, and repeated on 10 Nov

3.2 Presentation of Results

Table 3-2 presents a summary of particulate, NO_X, and SO_2 emissions results from the test program along with process data. See individual test method results in subsequent subsections. Detailed results can be seen in Appendix 1.

3.2.1 Particulate Results

Particulate emission quantifications were accomplished in three different ways: CARB Method 501 was utilized for PM_{10} and particle size distribution; EPA Method 202 (incorporated as the back half of the CARB Method 501 runs) was used to quantify condensable particulates; and EPA Method 5 (as the front half of EPA Method 26A runs) made filterable particulate determinations. Due to port restrictions and different sampling times, the Method 501/202 testing did not take place simultaneously with the Method 5/26A testing. For this reason they are reported separately below.

3.2.1.1 Filterable PM_{10} Particulate Emissions Results

Table 3-3 presents filterable PM_{10} particulate results. Filterable PM_{10} particulate mass for each run was derived from the sum of the sampling nozzle, PM_{10} cyclone and the Andersen impactor media (including back-up filter). The nozzle and cyclone catch was zero in each case, suggesting that filterable PM_{10} particulate and filterable particulate are functionally the same. As a cautionary note, the Andersen impactor stage catch weights were extremely low even though sampling runs were 2-8 hours long. This has implications for the particle size determinations to be discussed in detail in a later section but, for the purposes of filterable PM_{10} particulate determination, the main point is that the weights are likely to be somewhat imprecise. The results below therefore are probably useful for comparison purposes only.

Table 3-2: Kiln #1 Particulate, NO_X, and SO_2 Emissions Summary

Test Date		11/9/2004	11/9/2004	11/10/2004		11/10/2004	11/10/2004		11/11/2004	11/11/2004	11/11/2004	
Test Run Number		1	2	4	Average	1	2	Average	1	2	3	Average
	Run Description (Supplemental process summary data are listed below)	Dioxin/ Furan EPA M23-4 Coal Only	Dioxin/ Furan EPA M23-5 Coal Only	Dioxin/ Furan EPAM23-6 Coal Only	Dioxin/ Furan Coal Only M23	PM10 CARB M501/EPA M202-Base1 Coal Only	PM10 CARB M501/EPA M202-Base2 Coal Only	PM10 Coal Only M501/202	Filterable PM and Halogens EPA M5/26A-4 Coal Only	Filterable PM and Halogens EPA M5/26A-5 Coal Only	Filterable PM and Halogens EPA M5/26A-6 Coal Only	Filterable PM and Halogens Coal Only M5/26A
	Test Times	7:50-11:18	7:50-11:18	11:50-15:15	-	11:30-17:55	11:15-17:40	-	8:10-10:35	11:40-14:02	15:00-17:27	-
	Test Duration, (minutes)	208	208	205	-	385	385	-	145	142	147	-
	Clinker Production Rate, (tons/hr)	75.6	75.6	72.3	74.5	70.1	70.2	70.2	76.7	69.2	75.1	73.7
	Raw Material Feed Rate, (tons/hr)	117.2	117.2	112.0	115.5	108.7	108.9	108.8	118.8	107.3	116.4	114.2
	Baghouse Inlet Temperature, (°F)	407	407	401	405	402	402	402	406	400	403	403
	Chain Gas Temperature, (°F)	1490	1490	1484	1488	1487	1486	1487	1467	1505	1476	1483
	Coal (tons/hr)	11.3	11.3	10.6	11.0	10.3	10.3	10.3	10.6	10.7	10.6	10.6
	Kiln Amps, (amps)	23.4	23.4	21.7	22.8	21.9	21.9	21.9	21.6	21.9	21.0	21.5
Filterable Particulate, NOx, and SO2 Sampling/Stack Summary Data												
	Oxygen, (%)	4.9	4.9	5.3	5.0	5.0	5.0	5.0	4.9	4.2	4.9	4.7
	Carbon Dioxide, (%)	26.5	26.5	26.3	26.4	26.3	26.3	26.3	26.7	25.3	26.9	26.3
	Stack Gas Temperature, (°F)	396	396	393	395	391	394	393	395	394	396	395
	Stack Gas Moisture, (%)	18.7	20.5	18.6	19.3	20.2	18.8	19.5	20.3	20.2	19.6	20.0
	Volumetric Flowrate, (dscfm)	77,837	76,073	77,510	77,140	68,456	73,875	71,166	74,552	76,163	76,898	75,871
Filterable Particulate Emissions and Recovery Summary Data												
	Amount of Acetone Used to Rinse FH Sample Train, (ml)	100	100	100	100	150	150	150	150	150	150	150
	Amount of H20 Used to Rinse BH Sample Train, (ml) - Inorganic Fraction	NA	NA	NA	NA	N/A	NA	NA	N/A	N/A	N/A	NA
	Amount of MeCl2 Used to Rinse BH Sample Train, (ml) - Organic Fraction	150	150	150	150	N/A	NA	NA	N/A	N/A	N/A	NA
	Filterable Particulate Weight, (mg)	NA	NA	NA	NA	NA	NA	NA	11.5	7.3	1.0	6.6
	Filterable Particulate Weight ≤ 10 µm, (mg)	NA	NA	NA	NA	1.8	5.9	3.9	NA	NA	NA	NA
	Organic Condensable Particulate Weight, (mg)	NA	NA	NA	NA	0.7	0.8	0.8	NA	NA	NA	NA
	Inorganic Condensable Particulate Weight, (mg)	NA	NA	NA	NA	476.6	600.1	538.4	NA	NA	NA	NA
	Total Particulate Weight, (mg)	NA	NA	NA	NA	479.1	606.8	543.0	NA	NA	NA	NA
	Sample Volume, (dscf)	171.6	173.4	169.0	171.3	83.9	89.0	86.5	102.0	107.6	108.8	106.1
	Required Sample Volume, (dscf)	144	144	144	144	N/A	NA	NA	50	50	50	50
	Emission Concentration, (gr/dscf)	NA	NA	NA	NA	3.31E-04	1.02E-03	6.76E-04	1.74E-03	1.05E-03	1.42E-04	9.77E-04
	Allowable Emission Concentration*, (gr/dscf)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	Emission Rate, (lb/hr)	NA	NA	NA	NA	0.2	0.6	0.4	1.1	0.7	0.1	0.6
	Allowable Emission Rate, (lb/hr)	13.3	13.0	13.3	13.2	11.7	12.7	12.2	12.8	13.1	13.2	13.0
	Emission Rate, (lb/ton of Clinker)	NA	NA	NA	NA	2.77E-03	9.22E-03	5.99E-03	1.45E-02	9.86E-03	1.25E-03	8.54E-03
	Isokinetic Ratio, (%)	96.8	96.8	95.7	96.4	96.5	96.6	96.6	90.1	93.0	93.1	92.1
	Permitted Isokinetic Ratio, (%)	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110
NOx Emissions Summary												
	NOx Emission Concentration, (ppmvd)	889	1470	1173	1177	800	809	805	900	766	906	857
	NOx Emission Rate, (lb/hr)	344.6	556.9	452.8	452.3	272.7	297.6	285.1	334.2	290.4	346.8	323.8
	NOx Emission Rate, (lb/ton of Clinker)	4.56	7.36	6.26	6.07	3.89	4.24	4.06	4.36	4.19	4.62	4.40
	Allowable NOx Emission Rate, (lb/ton of Clinker)	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83
SO2 Emissions Summary												
	SO2 Emission Concentration, (ppmvd)	1.5	23.6	34.0	19.7	-3.0	44.0	20.5	5.8	30.0	15.0	16.9
	Allowable SO2 Emission Concentration**, (ppmvd)	500	500	500	500	500	500	500	500	500	500	500
	SO2 Emission Rate, (lb/hr)	1.16	17.90	26.27	15.15	-2.05	32.41	14.54	4.32	22.78	11.51	12.82
	SO2 Emission Rate, (lb/ton of Clinker)	1.54E-02	2.37E-01	3.63E-01	2.03E-01	-2.92E-02	4.61E-01	2.07E-01	5.63E-02	3.29E-01	1.53E-01	1.74E-01

Table 3-2 continued: Kiln #1 Particulate, NO_X, and SO_2 Emissions Summary

11/11/2004 1	11/11/2004 2	11/11/2004 3	Average	11/5/2004 1	11/5/2004 2	11/5/2004 3	Average	11/5/2004 1	11/12/2004 2	11/12/2004 3	Average
Metals EPA M29-4 Coal Only	Metals EPA M29-5 Coal Only	Metals EPA M29-6 Coal Only	Metals Coal Only M29	Dioxin/ Furan EPAM23-1 Carpet Cofire	Dioxin/ Furan EPAM23-2 Carpet Cofire	Dioxin/ Furan EPAM23-3 Carpet Cofire	Dioxin/ Furan Carpet CoFire M23	PM10 CARB M501/EPA M202-Hi1 Carpet Cofire	PM10 CARB M501/EPA M202-Hi2 Carpet Cofire	PM10 CARB M501/EPA M202-Hi3 Carpet Cofire	PM10 Carpet Cofire M501/202
8:10-10:35	11:40-14:02	15:00-17:25	-	9:45-13:35	9:45-13:35	16:20-22:08	-	16:25-18:25	10:20-18:35	10:20-18:35	-
145	142	145	-	230	230	348	-	120	495	495	-
76.7	69.2	75.0	73.6	71.0	71.0	73.0	71.7	73.3	73.0	73.0	73.1
118.8	107.3	116.2	114.1	110.1	110.1	113.2	111.1	113.6	113.1	113.1	113.3
406	400	403	403	409	409	409	409	409	411	411	411
1467	1505	1476	1483	1533	1533	1526	1530	1537	1484	1484	1502
10.6	10.7	10.6	10.6	9.4	9.4	9.5	9.4	9.5	9.4	9.4	9.4
21.6	21.9	21.0	21.5	23.2	23.2	22.0	22.8	21.8	21.4	21.4	21.5
4.9	4.2	4.9	4.7	5.0	5.0	4.9	5.0	4.9	5.1	5.1	5.0
26.7	25.3	26.9	26.3	26.2	26.2	26.5	26.3	26.5	26.4	26.4	26.4
396	395	398	396	400	401	402	401	400	397	396	398
19.9	19.6	19.7	19.7	19.8	20.1	20.6	20.2	20.9	21.0	20.8	20.9
74,121	78,500	76,832	76,484	66,034	58,003	72,494	65,510	59,995	72,600	70,114	67,570
100	100	100	100	100	100	100	100	150	150	150	150
N/A	N/A	N/A	NA	NA	NA	NA	NA	N/A	N/A	N/A	N/A
N/A	N/A	N/A	NA	150	150	150	150	N/A	N/A	N/A	N/A
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	1.9	5.4	4.5	3.9
NA	NA	NA	NA	NA	NA	NA	NA	1.5	0.6	0.5	0.9
NA	NA	NA	NA	NA	NA	NA	NA	138.4	188.4	319.5	215.4
NA	NA	NA	NA	NA	NA	NA	NA	141.8	194.4	324.5	220.2
111.1	123.4	117.9	117.5	198.8	199.6	173.7	190.7	34.7	130.0	138.7	101.2
72	72	72	72	144	144	144	144	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	8.40E-04	6.40E-04	5.00E-04	6.60E-04
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NA	NA	NA	NA	NA	NA	NA	NA	0.4	0.4	0.3	0.4
12.7	13.5	13.2	13.1	11.3	9.9	12.4	11.2	10.3	12.4	12.0	11.6
NA	NA	NA	NA	NA	NA	NA	NA	5.92E-03	5.47E-03	4.12E-03	5.17E-03
95.5	98.5	97.8	97.3	91.5	102.2	105.2	99.6	99.0	105.2	109.4	
90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110
900	766	906	857	866	436	585	629	585	585	585	585
332.2	299.3	346.5	326.5	284.9	125.8	211.2	205.2	174.8	211.5	204.2	196.8
4.33	4.32	4.62	4.43	4.01	1.77	2.89	2.86	2.38	2.90	2.80	2.69
8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83
5.8	30.0	15.0	16.9	398.2	305.6	320.5	341.4	320.5	320.5	320.5	320.5
500	500	500	500	500	500	500	500	500	500	500	500
4.29	23.48	11.50	12.92	262.14	176.71	231.63	222.99	191.69	231.97	224.02	215.89
5.60E-02	3.39E-01	1.53E-01	1.75E-01	3.69E+00	2.49E+00	3.17E+00	3.11E+00	2.61E+00	3.18E+00	3.07E+00	2.95E+00

Table 3-2 continued: Kiln #1 Particulate, NOX, and SO2 Emissions Summary

11/8/2004 1 Filterable PM and Halogens EPA M5/26A-1 Carpet Cofire	11/8/2004 2 Filterable PM and Halogens EPA M5/26A-2 Carpet Cofire	11/8/2004 3 Filterable PM and Halogens EPA M5/26A-3 Carpet Cofire	Average Filterable PM and Halogens Carpet Cofire M5/26A	11/8/2004 1 Metals EPA M29-1 Carpet Cofire	11/8/2004 2 Metals EPA M29-2 Carpet Cofire	11/8/2004 3 Metals EPA M29-3 Carpet Cofire	Average Metals Carpet Cofire M29
8:50-11:14	12:35-15:02	16:40-18:40	-	8:50-11:14	12:35-15:03	16:40-18:40	-
144	147	120	-	144	148	120	-
75.4	72.8	72.2	73.5	75.4	72.8	72.2	73.5
116.9	112.9	111.9	113.9	116.9	112.9	111.9	113.9
405	401	415	407	405	401	415	407
1470	1497	1524	1497	1470	1497	1524	1497
9.6	9.7	9.7	9.7	9.6	9.7	9.7	9.7
24.1	22.6	22.8	23.2	24.1	22.6	22.8	23.2
5.3	5,0	5.5	5.4	5.3	5.0	5.5	5.3
25.7	26.2	26.1	26.0	25.7	26.2	26.1	26.0
404	404	405	404	406	404	404	405
19.0	19.3	19.2	19.2	19.7	20.0	20.9	20.2
80,885	79,881	81,659	80,808	77,408	78,744	75,050	77,067
150	150	150	150	100	100	100	100
N/A	N/A	N/A	NA	N/A	N/A	N/A	NA
N/A	N/A	N/A	NA	N/A	N/A	N/A	NA
6.9	6.6	9.3	7.6	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
116.3	114.8	64.7	98.6	120.7	122.2	59.4	100.8
50	50	50	50	72	72	72	72
9.15E-04	8.87E-04	2.22E-03	1.34E-03	NA	NA	NA	NA
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.6	0.6	1.6	0.9	NA	NA	NA	NA
13.9	13.7	14.0	13.9	13.3	13.5	12.9	13.2
8.42E-03	8.35E-03	2.15E-02	1.28E-02	NA	NA	NA	NA
94.7	94.6	96.3	95.2	99.4	98.9	93.2	97.2
90-110	90-110	90-110	90-110	90-110	90-110	90-110	90-110
990	732	929	884	990	732	929	884
398.7	291.4	377.8	355.7	381.6	287.2	347.3	339.2
5.29	4.00	5.24	4.84	5.06	3.94	4.81	4.62
8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83
22.8	71.5	32.1	42.1	22.8	71.5	32.1	42.1
500	500	500	500	500	500	500	500
18.39	56.94	26.16	33.95	17.59	56.13	24.05	32.38
2.44E-01	7.82E-01	3.63E-01	4.62E-01	2.33E-01	7.71E-01	3.33E-01	4.41E-01

Table 3-3. Kiln #1 Stack Filterable PM_{10} Particulate Emissions Results

Run 1 Coal Only – Nov 10, 2004, 11:30-17:55	
Concentration (gr/dscf)	3.31×10^{-4}
Concentration (mg/dscm)	0.76
Emissions, lb/hr	0.19
Run 2 Coal Only - Nov 10, 2004, 11:15-17:40	
Concentration (gr/dscf)	1.02×10^{-3}
Concentration (mg/dscm)	2.34
Emissions, lb/hr	0.65
Average Coal Only	
Concentration (gr/dscf)	**6.77×10^{-4}**
Concentration (mg/dscm)	**1.55**
Emissions, lb/hr	**0.42**
Run 1 Carpet Co-Fire - Nov 5, 2004, 16:25-18:25	
Concentration (gr/dscf)	8.44×10^{-4}
Concentration (mg/dscm)	1.93
Emissions, lb/hr	0.43
Run 2 Carpet Co-Fire - Nov 12, 2004, 10:20-18:35	
Concentration (gr/dscf)	6.41×10^{-4}
Concentration (mg/dscm)	1.47
Emissions, lb/hr	0.40
Run 3 Carpet Co-Fire - Nov 12, 2004, 10:20-18:35	
Concentration (gr/dscf)	5.00×10^{-4}
Concentration (mg/dscm)	1.15
Emissions, lb/hr	0.30
Average Carpet Co-Fire	
Concentration (gr/dscf)	**6.62×10^{-4}**
Concentration (mg/dscm)	**1.51**
Emissions, lb/hr	**0.38**

3.2.1.2 Condensable Particulate Emissions Results

Condensable particulate emissions results can be seen in Table 3-4. The samples were collected by EPA Method 202 installed as the back half of the CARB Method 501 PM_{10} particulate runs reported above. Condensable particulate emissions were further divided into organic and inorganic fractions by the EPA Method 202 laboratory analysis procedures.

3.2.1.3 Total Particulate Emissions Results

Total particulate emissions results can be seen in Table 3-5. Total particulate is calculated by summing the particulate from all fractions of the CARB Method 501 and adding it to the sum of the organic and inorganic fractions of the EPA Method 202.

3.2.1.4 Particle Size Distribution Results

Particle size distribution determinations were made by an analysis of the Andersen impactor data for each CARB Method 501 run. There is uncertainty associated with the results due to the fact that the individual impactor stage particulate catches were very light compared with the stage catch weights recommended by the impactor manufacturer for a successful particle size distribution determination. It is recommended that each stage collect a mass of 2-10 milligrams. Most stages collected a mass much less than that and some collected less than was found on the blank impactor media. For this reason, the data must be considered to be of limited usefulness. It is believed that the fact that no particulate was caught on either the sampling nozzles or the PM_{10} cyclones is a good indication that no particulate matter greater than 10 μm in aerodynamic diameter escapes the baghouse.

Particle size distribution results can be usefully presented graphically as a plot of mean particle size diameter vs. the log of the calculated number of particles (assuming a particle density of one gram per cubic centimeter) on each stage. These plots are presented in Figures 3-1 through 3-5 below. The sampling dates and times in these figures are the sames as for Tables 3-3 through 3-5. The lines connecting points on the graphs are meant merely to focus the eye and not to necessarily imply any actual properties of the data.

Table 3-4. Kiln #1 Stack Condensable Particulate Emissions Results

Run 1 Coal Only - Nov 10, 2004, 11:30-17:55	**Organic**	**Inorganic**
Concentration (gr/dscf)	1.29×10^{-4}	8.76×10^{-2}
Concentration (mg/dscm)	0.294	200.5
Emissions, lb/hr	0.0755	51.4
Run 2 Coal Only - Nov 10, 2004, 11:15-17:40	**Organic**	**Inorganic**
Concentration (gr/dscf)	1.39×10^{-4}	1.04×10^{-1}
Concentration (mg/dscm)	0.317	238.0
Emissions, lb/hr	0.0878	65.9
Average Coal Only	**Organic**	**Inorganic**
Concentration (gr/dscf)	**1.34×10^{-4}**	**9.59×10^{-2}**
Concentration (mg/dscm)	**0.306**	**219.2**
Emissions, lb/hr	**0.0817**	**58.6**
Run 1 Carpet Co-Fire - Nov 5, 2004, 16:25-18:25	**Organic**	**Inorganic**
Concentration (gr/dscf)	6.66×10^{-4}	6.15×10^{-2}
Concentration (mg/dscm)	1.52	140.7
Emissions, lb/hr	0.3427	31.6
Run 2 Carpet Co-Fire - Nov 12, 2004, 10:20-18:35	**Organic**	**Inorganic**
Concentration (gr/dscf)	7.12×10^{-5}	2.24×10^{-2}
Concentration (mg/dscm)	0.16	51.2
Emissions, lb/hr	0.0443	13.9
Run 3 Carpet Co-Fire - Nov 12, 2004, 10:20-18:35	**Organic**	**Inorganic**
Concentration (gr/dscf)	5.56×10^{-5}	3.55×10^{-2}
Concentration (mg/dscm)	0.13	81.3
Emissions, lb/hr	0.0334	21.4
Average Carpet Co-Fire	**Organic**	**Inorganic**
Concentration (gr/dscf)	**2.64×10^{-4}**	**3.98×10^{-2}**
Concentration (mg/dscm)	**0.60**	**91.9**
Emissions, lb/hr	**0.1401**	**22.3**

Table 3-5. Kiln #1 Stack Total Particulate Emissions Results

Run 1 Coal Only - Nov 10, 2004, 11:30-17:55	
Concentration (gr/dscf)	8.81×10^{-2}
Concentration (mg/dscm)	201.5
Emissions, lb/hr	51.7
Run 2 Coal Only - Nov 10, 2004, 11:15-17:40	
Concentration (gr/dscf)	1.05×10^{-1}
Concentration (mg/dscm)	240.6
Emissions, lb/hr	66.6
Average Coal Only	
Concentration (gr/dscf)	**9.66×10^{-2}**
Concentration (mg/dscm)	**221.1**
Emissions, lb/hr	**59.1**
Run 1 Carpet Co-Fire - Nov 5, 2004, 16:25-18:25	
Concentration (gr/dscf)	6.30×10^{-2}
Concentration (mg/dscm)	144.1
Emissions, lb/hr	32.4
Run 2 Carpet Co-Fire - Nov 12, 2004, 10:20-18:35	
Concentration (gr/dscf)	2.31×10^{-2}
Concentration (mg/dscm)	52.8
Emissions, lb/hr	14.4
Run 3 Carpet Co-Fire - Nov 12, 2004, 10:20-18:35	
Concentration (gr/dscf)	3.61×10^{-2}
Concentration (mg/dscm)	82.6
Emissions, lb/hr	21.7
Average Carpet Co-Fire	
Concentration (gr/dscf)	**4.07×10^{-2}**
Concentration (mg/dscm)	**93.2**
Emissions, lb/hr	**22.8**

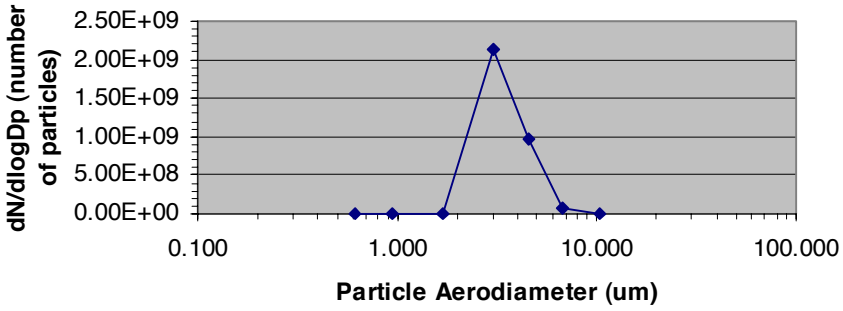

Figure 3-1. Particle Size Distribution, Coal Only – Run 1, 10 November 2004

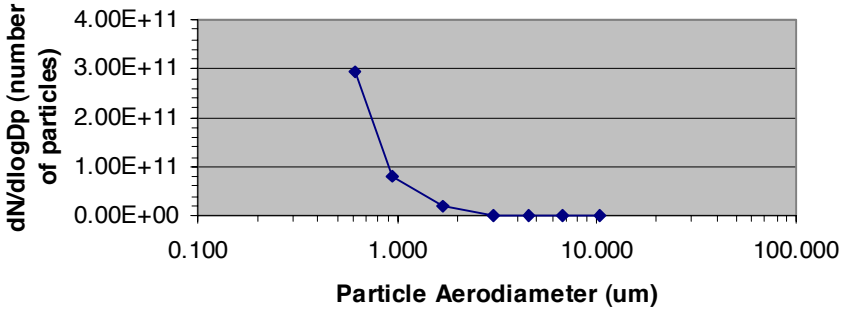

Figure 3-2. Particle Size Distribution, Coal Only – Run 2, 10 November 2004

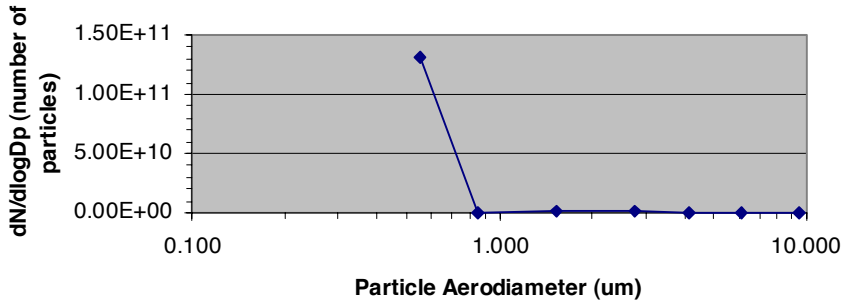

Figure 3-3. Particle Size Distribution, Coal Only – Run 1, 5 November 2004

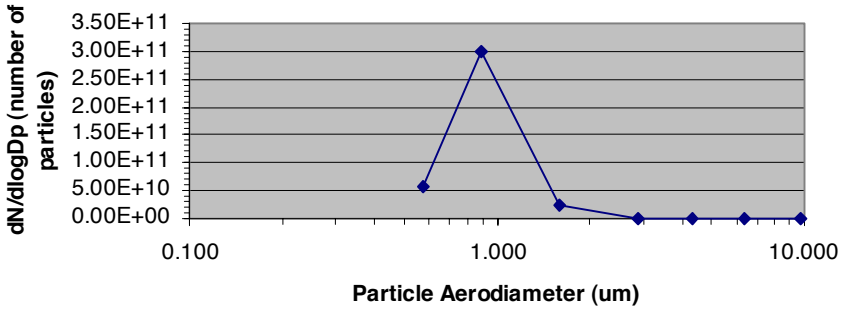

Figure 3-4. Particle Size Distribution, Coal Only – Run 2, 12 November 2004

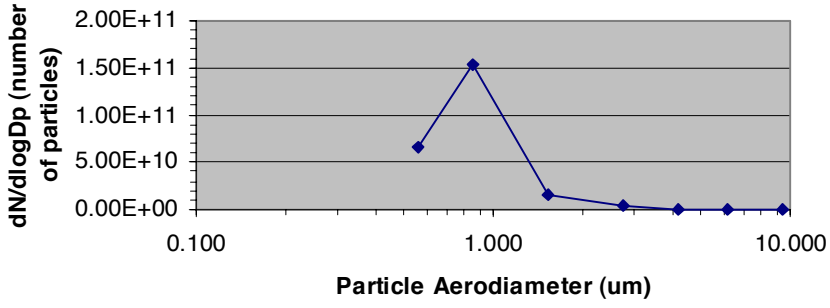

Figure 3-5. Particle Size Distribution, Coal Only – Run 3, 12 November 2004

3.2.1.5 Filterable Particulate Emissions Results

Filterable particulate determinations were made by the use of EPA Method 5 installed as the front half of an EPA Method 26A sampling train. These results are presented in Table 3-6.

3.2.2 Metals Emissions Results

Metals emissions were determined by EPA Method 29. Results are presented in Table 3-7.

3.2.3 HCl, Cl^-, HBr, and Br^- Emissions Results

HCl, Cl^-, HBr, and Br^- emissions results, as determined by EPA Method 26A, are presented in Table 3-8.

Table 3-6. Kiln #1 Stack Filterable Particulate Emissions Results

Run 1 Coal Only - Nov 11, 2004, 08:10-10:35	
Concentration (gr/dscf)	1.74×10^{-3}
Concentration (mg/dscm)	3.98
Emissions, lb/hr	1.11
Run 2 Coal Only - Nov 11, 2004, 11:40-14:02	
Concentration (gr/dscf)	1.05×10^{-3}
Concentration (mg/dscm)	2.39
Emissions, lb/hr	0.68
Run 3 Coal Only - Nov 11, 2004, 15:00-17:25	
Concentration (gr/dscf)	1.42×10^{-4}
Concentration (mg/dscm)	0.32
Emissions, lb/hr	0.094
Average Coal Only	
Concentration (gr/dscf)	**9.76×10^{-4}**
Concentration (mg/dscm)	**2.23**
Emissions, lb/hr	**0.63**
Run 1 Carpet Co-Fire - Nov 8, 2004, 08:50-11:14	
Concentration (gr/dscf)	9.15×10^{-4}
Concentration (mg/dscm)	2.09
Emissions, lb/hr	0.64
Run 2 Carpet Co-Fire - Nov 8, 2004, 12:35-15:02	
Concentration (gr/dscf)	8.87×10^{-4}
Concentration (mg/dscm)	2.03
Emissions, lb/hr	0.61
Run 3 Carpet Co-Fire - Nov 8, 2004, 16:40-18:40	
Concentration (gr/dscf)	2.22×10^{-3}
Concentration (mg/dscm)	5.07
Emissions, lb/hr	1.55
Average Carpet Co-Fire	
Concentration (gr/dscf)	**1.34×10^{-3}**
Concentration (mg/dscm)	**3.07**
Emissions, lb/hr	**0.93**

Table 3-7. Kiln #1 Stack Metals Emissions Results

	Emission Rate, mg/dscm			
Metal	**Run 1, Coal Only - Nov 11, 2004, 08:10-10:35**	**Run 2, Coal Only - Nov 11, 2004, 11:40-14:02**	**Run 3, Coal Only - Nov 11, 2004, 15:00-17:25**	**Average, Coal Only**
Antimony	0.0000	0.0000	0.0000	0.0000
Arsenic	0.0000	0.0000	0.0000	0.0000
Barium	0.0000	0.0000	0.0000	0.0000
Beryllium	0.0000	0.0000	0.0000	0.0000
Cadmium	0.0003	0.0002	0.0009	0.0005
Chromium	0.0016	0.0013	0.0226	0.0085
Cobalt	0.0000	0.0000	0.0000	0.0000
Lead	0.0016	0.0018	0.0025	0.0020
Manganese	0.0023	0.0658	0.0033	0.0238
Mercury	0.0178	0.0289	0.0213	0.0227
Nickel	0.0014	0.0011	0.0055	0.0027
Selenium	0.0138	0.0579	0.0204	0.0307
Silver	0.0000	0.0000	0.0000	0.0000
Thallium	0.0249	0.0219	0.0317	0.0262
Antimony	0.0000	0.0000	0.0000	0.0000
Arsenic	0.0000	0.0000	0.0000	0.0000
Barium	0.0000	0.0000	0.0000	0.0000
Beryllium	0.00001	0.00002	0.00004	0.00002
Cadmium	0.00036	0.00075	0.00030	0.00047
Chromium	0.0031	0.0017	0.0034	0.0027
Cobalt	0.0000	0.0000	0.0000	0.0000
Lead	0.0012	0.0017	0.0017	0.0015
Manganese	0.0597	0.0605	0.0080	0.0427
Mercury	0.0204	0.0259	0.0351	0.0271
Nickel	0.0019	0.0019	0.0026	0.0021
Selenium	0.0154	0.0306	0.0217	0.0226
Silver	0.0000	0.0000	0.0000	0.0000
Thallium	0.0166	0.0247	0.0316	0.0243

Table 3-8. Kiln #1 Stack HCl, Cl^-, HBr, and Br^- Emissions Results

	Emission Rate, mg/dscm			
Analyte	**Run 1, Coal Only - Nov 11, 2004, 08:10-10:35**	**Run 2, Coal Only - Nov 11, 2004, 11:40-14:02**	**Run 3, Coal Only - Nov 11, 2004, 15:00-17:25**	**Average, Coal Only**
HCl	3.44	8.43	6.59	6.15
Cl^-	1.38	0.66*	1.41	1.15
HBr	0.00	0.00	0.00	0.00
Br^-	0.00	0.00	0.00	0.00
Analyte	**Run 1, Carpet Co-Fire - Nov 8, 2004, 08:50-11:14**	**Run 2, Carpet Co-Fire - Nov 8, 2004, 12:35-15:02**	**Run 3, Carpet Co-Fire - Nov 8, 2004, 16:40-18:40**	**Average, Carpet Co-Fire**
HCl	6.01	5.51	2.72	4.75
Cl^-	1.72	0.91*	0.03*	0.89
HBr	0.00	0.00	0.00	0.00
Br^-	0.00	0.00	0.00	0.00

*** - number is approximate as chromatographic interference prevented complete resolution of chlorine**

3.2.4 Dioxins and Furans Emissions Results

Dioxin and furan emissions results, as determined by EPA Method 23, are presented in Tables 3-9 through 3-14. Test dates and times for Tables 3-11 through 3-14 are the same as those for Tables 3-9 and 3-10.

Table 3-9: Dioxins and Furans Emission Data Summary, Kiln No. 1 Exhaust Stack-Coal Only Testing using EPA M23

Test Date	11/09/2004	11/09/04	11/10/04	Average
Test Run Number	1	2	3	N/A
Test Times	07:50-11:18	07:50-11:18	11:50-15:15	N/A
Elapsed Sampling Time	180	180	180	180
Required Sampling Time	**240**			N/A
Process Data Summary				N/A
Sampling/Stack Data				N/A
O_2 Concentration, (% by volume, dry)	4.9	4.9	5.3	5.0
CO_2 Concentration, (% by volume, dry)	26.5	26.5	26.3	26.4
Sample Volume, (dscf)	171.607	173.375	168.972	171.3
Required Sample Volume, (dscf)	**144**			N/A
Stack Gas Moisture, (%)	18.7	20.5	18.6	19.3
Stack Gas Temperature, (°F)	396	396	393	395
Volumetric Flow Rate, (dscfm)	77,837	76,073	77,510	77,140
Isokinetic Rate, (%)	96.8	96.8	95.7	96.4
Permitted Isokinetic Rate, (%)	**90-110**			N/A
Total Toxic Equivalent Dioxins/Furans as 2,3,7,8-TCDD Emission Results				N/A
Total D/F Emission Catch, (ng)	0.0353	0.0311	0.0418	0.0361
D/F Emission Rate, (lb/hr)	2.12×10^{-9}	1.80×10^{-9}	2.54×10^{-9}	2.15×10^{-9}
D/F Emission Concentration, (ng/DSCM)	7.26×10^{-3}	6.33×10^{-3}	8.74×10^{-3}	7.44×10^{-3}
D/F Emission Concentration, (ng/DSCM @ 7% O_2)	6.31×10^{-3}	5.52×10^{-3}	7.80×10^{-3}	6.54×10^{-3}
Allowable D/F Emission Concentration, (ng/DSCM @ 7% O_2)	N/A	N/A	N/A	
Total Dioxins/Furans (D/F) Emission Results				N/A
Total D/F Emission Catch, (ng)	14.45	12.64	12.89	13.33
D/F Emission Rate, (lb/hr)	8.67×10^{-7}	7.34×10^{-7}	7.82×10^{-7}	7.94×10^{-7}
D/F Emission Concentration, (ng/DSCM)	2.97	2.57	2.69	2.74
D/F Emission Concentration, (ng/DSCM @ 7% O_2)	2.58	2.24	2.40	2.41
Allowable D/F Emission Concentration, (ng/DSCM @ 7% O_2)	N/A	N/A	N/A	

Table 3-10: Dioxins and Furans Emission Data Summary, Kiln No. 1 Exhaust Stack-Co-fire Testing using EPA M23

Test Date	11/05/04	11/05/04	11/05/04	Average
Test Run Number	1	2	3	N/A
Test Times	09:45-13:35	09:45-13:35	16:20-22:08	N/A
Elapsed Sampling Time	180	180	180	180
Required Sampling Time	240			N/A
Process Data Summary				N/A
Sampling/Stack Data				N/A
O_2 Concentration, (% by volume, dry)	5.0	5.0	4.9	5.0
CO_2 Concentration, (% by volume, dry)	26.2	26.2	26.5	26.3
Sample Volume, (dscf)	198.821	199.635	173.702	190.719
Required Sample Volume, (dscf)	144			N/A
Stack Gas Moisture, (%)	19.8	20.1	20.6	20.2
Stack Gas Temperature, (°F)	400	401	402	401
Volumetric Flow Rate, (dscfm)	66,034	58,003	72,494	65,510
Isokinetic Rate, (%)	91.5	102.2	105.2	99.6
Permitted Isokinetic Rate, (%)	90-110			N/A
Total Toxic Equivalent Dioxins/Furans as 2,3,7,8-TCDD Emission Results				N/A
Total D/F Emission Catch, (ng)	0.0050	0.0121	0.0104	0.0092
D/F Emission Rate, (lb/hr)	2.20×10^{-10}	4.66×10^{-10}	5.74×10^{-10}	4.20×10^{-10}
D/F Emission Concentration, (ng/DSCM)	8.91×10^{-4}	2.51×10^{-3}	2.11×10^{-3}	1.72×10^{-3}
D/F Emission Concentration, (ng/DSCM @ 7% O_2)	7.78×10^{-4}	2.20×10^{-3}	1.83×10^{-3}	1.60×10^{-3}
Allowable D/F Emission Concentration, (ng/DSCM @ 7% O_2)	N/A	N/A	N/A	
Total Dioxins/Furans (D/F) Emission Results				N/A
Total D/F Emission Catch, (ng)	3.79	4.14	3.28	3.74
D/F Emission Rate, (lb/hr)	1.67×10^{-7}	1.59×10^{-7}	1.81×10^{-7}	1.69×10^{-7}
D/F Emission Concentration, (ng/DSCM)	0.673	0.732	0.667	0.661
D/F Emission Concentration, (ng/DSCM @ 7% O_2)	0.588	0.642	0.579	0.603
Allowable D/F Emission Concentration, (ng/DSCM @ 7% O_2)	N/A	N/A	N/A	

Table 3-11. Coal Only Dioxin/Furan Run-by-Run Emission Rates and Concentrations

	Base-M23-1				Base-M23-2				Base-M23-3		
	Concentration		Emission Rate		Concentration		Emission Rate		Concentration		Em
Pollutant	g/hr	ng/dscm	lb/hr	lb/ton	g/hr	ng/dscm	lb/hr	lb/ton	g/hr	ng/dscm	lb/hr
Dioxins											
2,3,7,8-TCDD	1.38E-07	1.04E-03	3.04E-10	#DIV/0!	1.06E-07	8.23E-04	2.34E-10	#DIV/0!	1.12E-07	8.48E-04	2.46E-
Other TCDD	3.45E-06	2.61E-02	7.62E-09	#DIV/0!	3.55E-06	1.02E-01	7.83E-09	#DIV/0!	1.37E-05	1.04E-01	3.03E-0
1,2,3,7,8-PeCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+
Other PeCDD	4.14E-07	3.13E-03	9.12E-10	#DIV/0!	1.52E-07	1.18E-03	3.35E-10	#DIV/0!	4.35E-06	3.30E-02	9.59E-0
1,2,3,4,7,8-HxCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+
1,2,3,6,7,8-HxCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	1.52E-07	1.15E-03	3.35E-
1,2,3,7,8,9-HxCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+
Other HxCDD	2.99E-07	2.26E-03	6.60E-10	#DIV/0!	1.49E-07	1.15E-03	3.28E-10	#DIV/0!	1.93E-06	1.46E-02	4.25E-0
1,2,3,4,6,7,8-HpCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	8.89E-07	6.75E-03	1.96E-0
Other HpCDD	1.96E-07	1.49E-03	4.33E-10	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	9.88E-07	7.50E-03	2.18E-0
1,2,3,4,6,7,8,9-OCDD	4.44E-07	3.35E-03	9.78E-10	#DIV/0!	2.87E-07	2.22E-03	6.33E-10	#DIV/0!	1.47E-06	1.12E-02	3.24E-0
Total CDD	4.95E-06	3.74E-02	1.09E-08	#DIV/0!	4.25E-06	1.07E-01	9.36E-09	#DIV/0!	2.36E-05	1.79E-01	5.21E-0
Furans											
2,3,7,8-TCDF	5.52E-06	4.18E-02	1.22E-08	#DIV/0!	4.66E-06	3.60E-02	1.03E-08	#DIV/0!	3.72E-06	2.82E-02	8.19E-0
Other TCDF	3.73E-04	**2.82E+00**	8.22E-07	#DIV/0!	3.14E-04	**2.43E+00**	6.92E-07	#DIV/0!	3.07E-04	**2.33E+00**	6.77E-0
1,2,3,7,8-PeCDF	5.17E-07	3.91E-03	1.14E-09	#DIV/0!	6.53E-07	5.05E-03	1.44E-09	#DIV/0!	6.80E-07	5.16E-03	1.50E-0
2,3,4,7,8-PeCDF	4.84E-07	3.66E-03	1.07E-09	#DIV/0!	3.90E-07	3.01E-03	8.59E-10	#DIV/0!	9.47E-07	7.19E-03	2.09E-0
Other PeCDF	9.10E-06	6.88E-02	2.01E-08	#DIV/0!	8.67E-06	6.71E-02	1.91E-08	#DIV/0!	1.47E-05	1.12E-01	3.25E-0
1,2,3,4,7,8-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	1.67E-07	1.30E-03	3.69E-10	#DIV/0!	4.76E-07	3.62E-03	1.05E-0
1,2,3,6,7,8-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	3.74E-07	2.84E-03	8.25E-
2,3,4,6,7,8-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	2.97E-07	2.26E-03	6.55E-
1,2,3,7,8,9-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+
Other HxCDF	2.17E-07	1.64E-03	4.78E-10	#DIV/0!	3.17E-07	2.45E-03	6.99E-10	#DIV/0!	2.07E-06	1.57E-02	4.57E-0
1,2,3,4,6,7,8-HpCDF	1.50E-07	1.13E-03	3.31E-10	#DIV/0!	1.56E-07	1.21E-03	3.45E-10	#DIV/0!	1.97E-06	1.50E-02	4.35E-0
1,2,3,4,7,8,9-HpCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+
Other HpCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+
1,2,3,4,6,7,8,9-OCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	2.97E-07	2.26E-03	6.55E-
Total CDF	3.89E-04	2.94E+00	8.57E-07	#DIV/0!	3.29E-04	2.54E+00	7.25E-07	#DIV/0!	3.33E-04	2.53E+00	7.34E-0
Total CDD/CDF	**3.94E-04**	**2.98E+00**	**8.68E-07**	**#DIV/0!**	**3.33E-04**	**2.65E+00**	**7.34E-07**	**#DIV/0!**	**3.56E-04**	**2.71E+00**	**7.86E-0**

Table 3-12. coal Only Dioxin/Furan Toxic Equivalency Factors

Three Run Average				1989 Toxic Equivalency	Toxic Equivalent Three Run Average			
Concentration		Emission Rate			Concentration		Emission Rate	
g/hr	ng/dscm	lb/hr	lb/ton[a]	Factor	g/hr	ng/dscm	lb/hr	lb/ton
1.19E-07	9.04E-04	2.61E-10	NA	1.000	1.19E-07	9.04E-04	2.61E-10	NA
6.91E-06	7.73E-02	1.52E-08	NA	---	NA	NA	NA	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.500	0.00E+00	0.00E+00	0.00E+00	NA
1.64E-06	1.24E-02	3.61E-09	NA	---	NA	NA	NA	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
5.06E-08	3.85E-04	1.12E-10	NA	0.100	5.06E-09	3.85E-05	1.12E-11	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
7.91E-07	6.01E-03	1.74E-09	NA	---	NA	NA	NA	NA
2.96E-07	2.25E-03	6.53E-10	NA	0.010	2.96E-09	2.25E-05	6.53E-12	NA
3.95E-07	3.00E-03	8.71E-10	NA	---	NA	NA	NA	NA
7.33E-07	5.58E-03	1.62E-09	NA	0.001	7.33E-10	5.58E-06	1.62E-12	NA
1.09E-05	1.08E-01	2.41E-08	NA	---	1.27E-07	9.71E-04	2.81E-10	NA
4.63E-06	3.53E-02	1.02E-08	NA	0.100	4.63E-07	3.53E-03	1.02E-09	NA
3.31E-04	2.53E+00	7.30E-07	NA	---	NA	NA	NA	NA
6.17E-07	4.71E-03	1.36E-09	NA	0.050	3.08E-08	2.35E-04	6.80E-11	NA
6.07E-07	4.62E-03	1.34E-09	NA	0.500	3.03E-07	2.31E-03	6.69E-10	NA
1.08E-05	8.26E-02	2.39E-08	NA	---	NA	NA	NA	NA
2.15E-07	1.64E-03	4.73E-10	NA	0.100	2.15E-08	1.64E-04	4.73E-11	NA
1.25E-07	9.47E-04	2.75E-10	NA	0.100	1.25E-08	9.47E-05	2.75E-11	NA
9.91E-08	7.52E-04	2.18E-10	NA	0.100	9.91E-09	7.52E-05	2.18E-11	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
8.69E-07	6.61E-03	1.92E-09	NA	---	NA	NA	NA	NA
7.60E-07	5.78E-03	1.68E-09	NA	0.010	7.60E-09	5.78E-05	1.68E-11	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.010	0.00E+00	0.00E+00	0.00E+00	NA
0.00E+00	0.00E+00	0.00E+00	NA	---	NA	NA	NA	NA
9.91E-08	7.52E-04	2.18E-10	NA	0.001	9.91E-11	7.52E-07	2.18E-13	NA
3.50E-04	2.67E+00	7.72E-07	NA	---	8.49E-07	6.47E-03	1.87E-09	NA
3.61E-04	2.78E+00	7.96E-07	NA	---	9.77E-07	7.44E-03	2.15E-09	NA

Table 3-13. Carpet Co-Fire Dioxin/Furan Run-by-Run Emission Rates and Concentrations

	Hi-M23-1				Hi-M23-2				Hi-M23-3			
	Concentration		Emission Rate		Concentration		Emission Rate		Concentration		Emission Rate	
Pollutant	g/hr	ng/dscm	lb/hr	lb/ton	g/hr	ng/dscm	lb/hr	lb/ton	g/hr	ng/dscm	lb/hr	lb/ton
Dioxins												
2,3,7,8-TCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
Other TCDD	4.22E-07	3.77E-03	9.31E-10	#DIV/0!	9.87E-07	6.56E-03	2.18E-09	#DIV/0!	9.29E-07	7.54E-03	2.05E-09	#DIV/0!
1,2,3,7,8-PeCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
Other PeCDD	5.32E-07	4.74E-03	1.17E-09	#DIV/0!	5.79E-07	5.87E-03	1.28E-09	#DIV/0!	4.58E-07	3.72E-03	1.01E-09	#DIV/0!
1,2,3,4,7,8-HxCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
1,2,3,6,7,8-HxCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
1,2,3,7,8,9-HxCDD	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
Other HxCDD	6.86E-07	6.11E-03	1.51E-09	#DIV/0!	4.53E-07	4.60E-03	9.99E-10	#DIV/0!	2.19E-07	1.77E-03	4.82E-10	#DIV/0!
1,2,3,4,6,7,8-HpCDD	4.52E-07	4.03E-03	9.97E-10	#DIV/0!	2.95E-07	2.99E-03	6.50E-10	#DIV/0!	2.10E-07	1.70E-03	4.62E-10	#DIV/0!
Other HpCDD	4.26E-07	3.80E-03	9.40E-10	#DIV/0!	2.91E-07	2.95E-03	6.42E-10	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
1,2,3,4,6,7,8,9-OCDD	8.07E-07	7.19E-03	1.78E-09	#DIV/0!	7.55E-07	7.66E-03	1.66E-09	#DIV/0!	6.44E-07	5.22E-03	1.42E-09	#DIV/0!
Total CDD	3.33E-06	2.96E-02	7.33E-09	#DIV/0!	3.36E-06	3.06E-02	7.41E-09	#DIV/0!	2.46E-06	2.00E-02	5.42E-09	#DIV/0!
Furans												
2,3,7,8-TCDF	8.21E-07	7.32E-03	1.81E-09	#DIV/0!	8.63E-07	8.76E-03	1.90E-09	#DIV/0!	9.74E-07	7.91E-03	2.15E-09	#DIV/0!
Other TCDF	6.97E-05	**6.21E-01**	1.54E-07	#DIV/0!	6.52E-05	**6.62E-01**	1.44E-07	#DIV/0!	7.54E-05	**6.12E-01**	1.66E-07	#DIV/0!
1,2,3,7,8-PeCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	4.56E-07	3.70E-03	1.00E-09	#DIV/0!
2,3,4,7,8-PeCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	1.74E-07	1.77E-03	3.84E-10	#DIV/0!	2.17E-07	1.76E-03	4.79E-10	#DIV/0!
Other PeCDF	1.93E-06	1.72E-02	4.26E-09	#DIV/0!	2.39E-06	2.42E-02	5.27E-09	#DIV/0!	2.41E-06	1.95E-02	5.31E-09	#DIV/0!
1,2,3,4,7,8-HxCDF	1.02E-07	9.06E-04	2.24E-10	#DIV/0!	2.02E-07	2.05E-03	4.46E-10	#DIV/0!	2.58E-07	2.09E-03	5.69E-10	#DIV/0!
1,2,3,6,7,8-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	1.15E-07	1.17E-03	2.54E-10	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
2,3,4,6,7,8-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
1,2,3,7,8,9-HxCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
Other HxCDF	2.71E-07	2.42E-03	5.97E-10	#DIV/0!	3.54E-07	3.59E-03	7.80E-10	#DIV/0!	3.66E-07	2.97E-03	8.06E-10	#DIV/0!
1,2,3,4,6,7,8-HpCDF	2.37E-07	2.11E-03	5.23E-10	#DIV/0!	2.74E-07	2.78E-03	6.03E-10	#DIV/0!	2.90E-07	2.36E-03	6.40E-10	#DIV/0!
1,2,3,4,7,8,9-HpCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
Other HpCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
1,2,3,4,6,7,8,9-OCDF	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!	0.00E+00	0.00E+00	0.00E+00	#DIV/0!
Total CDF	7.31E-05	6.51E-01	1.61E-07	#DIV/0!	6.96E-05	7.06E-01	1.53E-07	#DIV/0!	8.04E-05	6.52E-01	1.77E-07	#DIV/0!
Total CDD/CDF	**7.64E-05**	**6.81E-01**	**1.68E-07**	**#DIV/0!**	**7.29E-05**	**7.37E-01**	**1.61E-07**	**#DIV/0!**	**8.28E-05**	**6.72E-01**	**1.83E-07**	**#DIV/0!**

Table 3-14. Carpet Co-Fire Dioxin/Furan Toxic Equivalency Factors

Three Run Average				1989 Toxic Equivalency Factor	Toxic Equivalent Three Run Average			
Concentration		Emission Rate			Concentration		Emission Rate	
g/hr	ng/dscm	lb/hr	lb/ton[a]		g/hr	ng/dscm	lb/hr	lb/ton[a]
0.00E+00	0.00E+00	0.00E+00	NA	1.000	0.00E+00	0.00E+00	0.00E+00	NA
7.79E-07	5.96E-03	1.72E-09	NA	---	NA	NA	NA	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.500	0.00E+00	0.00E+00	0.00E+00	NA
5.23E-07	4.78E-03	1.15E-09	NA	---	NA	NA	NA	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
4.52E-07	4.16E-03	9.97E-10	NA	---	NA	NA	NA	NA
3.19E-07	2.91E-03	7.03E-10	NA	0.010	3.19E-09	2.91E-05	7.03E-12	NA
2.39E-07	2.25E-03	5.27E-10	NA	---	NA	NA	NA	NA
7.35E-07	6.69E-03	1.62E-09	NA	0.001	7.35E-10	6.69E-06	1.62E-12	NA
3.05E-06	2.67E-02	6.72E-09	NA	---	3.92E-09	3.58E-05	8.65E-12	NA
8.86E-07	7.99E-03	1.95E-09	NA	0.100	8.86E-08	7.99E-04	1.95E-10	NA
7.01E-05	6.32E-01	1.55E-07	NA	---	NA	NA	NA	NA
1.52E-07	1.23E-03	3.35E-10	NA	0.050	7.60E-09	6.17E-05	1.67E-11	NA
1.31E-07	1.18E-03	2.88E-10	NA	0.500	6.53E-08	5.89E-04	1.44E-10	NA
2.24E-06	2.03E-02	4.94E-09	NA	---	NA	NA	NA	NA
1.87E-07	1.68E-03	4.13E-10	NA	0.100	1.87E-08	1.68E-04	4.13E-11	NA
3.84E-08	3.89E-04	8.46E-11	NA	0.100	3.84E-09	3.89E-05	8.46E-12	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.100	0.00E+00	0.00E+00	0.00E+00	NA
3.30E-07	2.99E-03	7.28E-10	NA	---	NA	NA	NA	NA
2.67E-07	2.42E-03	5.89E-10	NA	0.010	2.67E-09	2.42E-05	5.89E-12	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.010	0.00E+00	0.00E+00	0.00E+00	NA
0.00E+00	0.00E+00	0.00E+00	NA	---	NA	NA	NA	NA
0.00E+00	0.00E+00	0.00E+00	NA	0.001	0.00E+00	0.00E+00	0.00E+00	NA
7.43E-05	6.70E-01	1.64E-07	NA	---	1.87E-07	1.68E-03	4.12E-10	NA
7.74E-05	6.97E-01	1.71E-07	NA	---	1.91E-07	1.72E-03	4.20E-10	NA

3.2.5 CEMS Emissions Results

CEMS measurements of carbon monoxide sulfur dioxide, and nitrogen oxides were made both prior to and during the extractive sampling runs. The results are reported in Table 3-15. Carbon monoxide emissions were determined by EPA Method 10, sulfur dioxide emissions were determined by EPA Method 6C, and nitrogen oxides emissions were determined by EPA Method 7E. Oxygen and carbon dioxide emissions, as determined by EPA Method 3A are also presented. Table 3-16 presents a preliminary look at CEMS and production data.

Table 3-15. Kiln #1 Stack CEMS Results

Date/Time	Fuel	Run	O_2, %	CO_2, %	SO_2, ppmv	CO, ppmv	NO_X, ppmv
11/1/2004/12:43-14:52	Various*	1	7.6	20.5	2129	328	387
11/2/2004/08:35-11:52	Various	1	4.7	27.1	202	128	891
11/2/2004/12:02-15:03	Various	2	4.3	27.7	300	130	603
11/2/2004/15:12-16:34	Various	3	4.6	27.7	130	124	852
11/3/2004/08:11-11:12	Various	1	4.2	27.0	1366	193	1284
11/3/2004/11:20-14:25	Various	2	5.7	25.0	46	100	1004
11/3/2004/14:34-16:13	Various	3	4.8	25.6	104	121	774
11/4/2004/08:00-10:05	Various	1	5.3	25.5	434	450	751
11/4/2004/10:14-11:50	Various	2	5.1	26.4	39	110	1007
11/4/2004/11:59-14:58	Various	3	4.7	26.5	149	117	756
11/5/2004/07:46-12:48	Carpet Co-Fire	1	5.0	26.2	398	129	866
11/5/2004/13:06-13:33	Carpet Co-Fire	2	4.9	26.0	306	129	436
11/5/2004/15:34-20:05	Carpet Co-Fire	3	4.9	26.5	321	121	585
11/8/2004/08:16-	Carpet	1	5.3	25.7	23	95	990

Date/Time	Fuel	Run	O_2, %	CO_2, %	SO_2, ppmv	CO, ppmv	NO_X, ppmv
11:10	Co-Fire						
11/8/2004/11:26-15:03	Carpet Co-Fire	2	5.0	26.2	72	111	732
11/8/2004/15:16-18:07	Carpet Co-Fire	3	5.0	26.1	32	117	929
11/8/2004/18:24-18:41	Carpet Co-Fire	4	5.5	26.1	2	89	973
11/9/2004/06:49-11;18	Coal Only	1	4.9	26.5	2	90	889
11/9/2004/11:38-13:53	Coal Only	2	5.9	24.5	24	81	1470
11/10/2004/07:13-11:19	Coal Only	1	5.0	25.1	34	112	1173
11/10/2004/11:37-13:50	Coal Only	2	5.3	26.3	-3	115	800
11/10/2004/15:22-16:53	Coal Only	3	4.6	26.3	44	130	809
11/11/2004/07:50-09:55	Coal Only	1	4.9	26.7	6	101	900
11/11/2004/10:16-12:18	Coal Only	2	4.9	26.9	2	103	502
11/11/2004/12:38-14:17	Coal Only	3	4.2	25.3	115	121	766
11/11/2004/14:58-17:00	Coal Only	4	4.9	26.9	15	110	906
11/12/2004/09:46-10:19	Carpet Co-Fire	1	5.0	26.5	136	116	967
11/12/2004/13:00-15:03	Carpet Co-Fire	2	5.1	26.3	121	120	830
11/12/2004/15:19-17:20	Carpet Co-Fire	3	5.0	26.6	138	127	733
11/12/2004/17:35-18:37	Carpet Co-Fire	4	5.3	26.2	1	106	819

*** - a number of fuel combinations were used as shakedown runs of the carpet feed system were being performed**

Table 3-16. Preliminary Lehigh CEMS and Production Analyzer Data

Carpet Feed Rate = 2.2 TPH	Carpet Burned (tons)	Opacity (%)	NOx (ppm)	NOx (lbs/hr)	Dry O2 (%)	Wet O2 (%)	Moisture (%)	Baghouse Inlet Temp. (Deg. F)	Stack Flow (KACFM)	Stack Flow (KDSCFH)	Stack Temp. (Deg. F)	Stack Press. (in. HG)	Kiln Amps (amps)
Carpet Run # 1 - 11/5/04	32	1.1	792.4	517.0	4.7	4.0	14.9	408.2	171.1	5417.9	392.8	29.9	23.0
Carpet Run # 2 - 11/8/04	27	2.1	927.3	599.0	4.9	4.1	15.6	406.7	172.8	5393.1	396.2	29.9	23.1
Carpet Run # 3 - 11/12/04	33	1.9	981.5	654.1	4.7	4.1	12.0	412.6	166.7	5514.6	384.5	29.9	21.3
Carpet Run Averages		**1.7**	**900.4**	**590.0**	**4.8**	**4.1**	**14.2**	**409.2**	**170.2**	**5441.9**	**391.2**	**29.9**	**22.5**
Baseline Run # 1 - 11/9/04	0	2.1	1115.5	681.6	5.3	4.3	18.4	406.1	167.9	5119.8	387.7	29.9	24.0
Baseline Run # 2 - 11/10/04	0	2.6	1089.8	629.0	6.2	5.4	18.3	405.3	156.9	4847.3	384.7	31.2	22.7
Baseline Run # 1 - 11/11/04	0	1.4	846.8	572.9	4.5	4.0	8.1	403.2	163.5	5612.9	387.5	29.9	21.4
Baseline Run Averages	0	**2.0**	**1017.4**	**627.8**	**5.3**	**4.6**	**14.9**	**404.9**	**162.8**	**5193.3**	**386.6**	**30.3**	**22.7**

Chain Gas Temp. (Deg. F)	Coal Feed (TPH)	Raw Feed (TPH)	Clinker Production (TPH)	Combustion (%)	Kiln NOx (ppm)	Kiln O2 (%)	Pyrometer (Deg. F)	Kiln Speed (RPH)	Tire Feed lbs/Rev.
1533.0	9.5	111.5	71.9	0.1	1019.3	1.8	2393.7	93.2	0
1496.8	9.8	113.5	73.3	0.1	1070.1	1.7	2464.2	95.2	0
1484.6	9.5	112.5	72.6	0.1	1099.6	1.8	2563.5	95.9	0
1504.8	**9.6**	**112.5**	**72.6**	**0.1**	**1063.0**	**1.8**	**2473.8**	**94.8**	**0**
1482.7	11.0	117.0	75.5	0.1	1338.6	1.8	2569.7	98.5	0
1486.8	10.3	107.4	69.3	0.1	1257.3	1.9	2567.8	89.7	0
1480.1	10.6	114.7	74.0	0.1	984.8	1.6	2449.6	95.9	0
1483.2	**10.6**	**113.0**	**72.9**	**0.1**	**1193.6**	**1.8**	**2529.0**	**94.7**	**0**

3.3 Field Test Changes and Problems

3.3.1 Variation from Test Methods and/or Planned Activities

As mentioned earlier, process upsets and delays lead to several on-the-fly changes to the original test plan as detailed in the QAPP. The major change was to drop the low carpet co-fire condition. The single carpet co-fire rate decided upon was the maximum sustainable rate of 2.2 long tons per hour. Also, CARB Method 501/EPA Method 202 were substituted for Modified EPA Method 201A called for in the QAPP. This allowed the collection of condensable particulate matter in addition to PM_{10} and saved considerable project resources.

Events which affected the sampling program were:

1.) On 11/5/04 the kiln went down at ~13:30 and was back on line at load at ~15:50; this period was between sampling runs.

2.) On 11/8/04 the data CEMS collection program froze and had to be re-started; a bias check was performed and data collection resumed with Run 4. Power was lost on the stack at ~17:30 causing a pause in sampling; it was restored at ~ 18:15 and testing resumed. The kiln went down at ~18:30 with 55 minutes left in the Carpet Co-Fire Runs 3 of M26A and M29; these runs were nevertheless analyzed and reported here.

3.) On 11/9/04 the kiln went down at ~13:45. At ~16:00 the kiln operator said the kiln would not be up for several more hours. Over two hours remained in Coal Only M23 Run 3; it was aborted and repeated on 11/10/04.

4.) On 11/10/04 the SO_2 monitor was changed from 1000 ppmv to 100 ppmv at the direction of Rob Small of PA DER.

5.) On 11/11/04 the SO_2 monitor was over ranged on the 100 ppmv range at ~12:53 during Run 3; it was changed to the 500 ppmv range and returned to service at ~13:36 without re-calibration. For the remainder of Run 3 the SO_2 results were multiplied by 5 to make them correct. The SO_2 monitor was re-calibrated for the 500 ppmv range for Run 4.

6.) The kiln went down at ~ 17:00 with no hope of being back on line sooner than several hours. This led to the cancellation of Coal Only CARB M501/EPA M202 Run 3.

4. Sampling and Analytical Procedures

4.1 Test Methods

The test methods used in this test program were: EPA Method 5 (front half) combined with EPA Method 26A (back half) for filterable particulate/HCl, Cl^-, HBr, Br^-; EPA Method 29 for RCRA/CAA metals (Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mn, Hg, Ni, Se, Ag); EPA Method 23 for dioxins/furans; CARB Method 501 (front half) combined with EPA Method 202 (back half) for PM_{10} particulate, particle size distribution, and condensable particulate matter (neither N2 purging for organics removal or NH_4OH addition for sulfate correctionwere used due to the fact that condensable organics were of interest and our experience with the sulfate correction procedure has shown overcorrection, i.e., negative values); EPA Method 3A for O_2/CO_2; EPA Method 6C for SO_2; EPA Method 7E for NO_X; and EPA Method 10 for CO. EPA Method 205 was used to verify the proper performance of the diluter used to blend CEMS calibration gases. All laboratory analytical procedures were those called for in the corresponding test method. See Appendix 5 for complete texts of the sampling and analytical methods.

4.2 Analytical Methods

All analytical methods employed in this testing program were those contained in or required by the test methods used. They are further detailed in the individual laboratory analytical reports which can be seen in Appendix 4.

5. Internal QA/QC Activities

QA/QC procedures followed were those in the individual sampling and analytical methods. See individual methods (Appendix 4) for further information.

5.1 QA/QC Problems

No known QA/QC problems occurred during this test program.

5.2 QA Audits

QA audit samples, as procured by PA DEP, were submitted for this test program. They consisted of audit samples for M26A submitted to Resolution Analytics and those for M29 submitted to First Analytical Laboratories. The audit samples were delivered to ARCADIS G&M and submitted to the contract labs along with the samples from the test program. The results are shown in Table 5-1. According to PA DEP personnel, the labs passed the audits.

Table 5-1. QA Audit Samples Results

Laboratory	EPA Audit Sample Number	Analyte	Concentration	Blank Filter
Resolution	M-1536	Cl	53.1 mg/L	-
Resolution	M-1890	Cl	14.7 mg/L	-
First Analytical	AM-01111	As	8.63 ug/mL	-
First Analytical	AM-01111	Cd	6.83 ug/mL	-
First Analytical	AM-01111	Cr	8.53 ug/mL	-
First Analytical	AM-01111	Pb	9.60 ug/mL	-
First Analytical	Fil-3732	As	20.1 ug	<0.5 ug
First Analytical	Fil-3732	Cd	33.8 ug	<0.02 ug
First Analytical	Fil-3732	Cr	29.3 ug	0.15 ug
First Analytical	Fil-3732	Pb	38.3 ug	<0.5 ug
First Analytical	HG-0846	Hg	97.6 ng/mL	-

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