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Report Sect. 4
Reference 24

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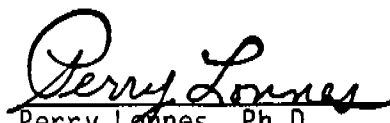
RESULTS OF THE JUNE 12, 13, 14 AND 15, 1984,
DUST COLLECTION EFFICIENCY TESTS
ON THE D-2 AND E-2 FURNACE TOP GAS
MECHANICAL COLLECTORS AT THE
ERIE MINING COMPANY PELLET PLANT
NEAR HOYT LAKES, MINNESOTA

Submitted to:

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Approved by:


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Report Number 4-1800
June 22, 1984

TABLE OF CONTENTS

	ABBREVIATIONS	iii
1	INTRODUCTION	1
2	SUMMARY AND DISCUSSION	3
3	RESULTS	8
	3.1 Results of Orsat and Moisture Analysis	9
	3.2 Results of Particulate Loading Determinations	18
	3.3 Results of Opacity Observations	27

APPENDICES:

- A - Velocity Profiles for Runs 1
- B - Location of Test Ports and Traverse Points
- C - Methods 2-5 Field Data Sheets
- D - Method 9 Field Data
- E - Laboratory Data Sheets
- F - Furnace Operating Charts
- G - Procedures
- H - Calculation Equations
- I - Sampling Train Calibration Data

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	diameter
FT/SEC	feet per second
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
G	gram
HP	horsepower
HRS	hours
IN.	inches
IN. HG.	inches of mercury
IN. WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10 ⁶ BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/DSCM	milligrams per dry standard cubic meter
microns (μm)	micrometer
MIN.	minutes
ohm-cm	ohm-centimeter
PPH	pounds per hour
PPM	parts per million
PSI	pounds per square inch
SQ. FT.	square feet
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure.

INTRODUCTION

On June 12, 13, 14 and 15, 1984, Interpoll Inc. personnel conducted a series of four (4) dust collection efficiency tests on the D-2 and E-2 Pellet Induration Furnace top gas mechanical collectors at the Erie Mining Company (EMCO) Pellet Plant located near Hoyt Lakes, Minnesota. On-site testing was performed by a five-man team under the direction of D. Stock. Coordination between testing activities and plant operation was provided by Bob Buchik of EMCO. The tests were witnessed by M. Osborn and R. Swenson of the Minnesota Pollution Control Agency.

Testing was performed simultaneously at the inlet to the mechanical collector serving the descending shaft induration furnace and in the stack. During the tests, the induration furnace throughput was approximately 56 to 57 wet LONG TONS/HR. The induration furnaces are fired with natural gas.

→ FESD RATE?

Evaluations were performed in accordance with EPA Methods 2-5, CFR Title 40, Part 60, Appendix A (revised July 1, 1983). Previous gas linear velocity information was used at both the dust collector inlet and stack test sites to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. Interpoll sampling trains which meet or exceed specifications in the above-cited reference were used to extract representative particulate samples. Heated stainless steel-lined probes were used at both test sites. A stainless steel filter thimble was used in place of the normal EPA Method 5 glass fiber filter at the inlet test location. This filter allows quantitative recovery of the particulate sample in the event subsequent chemical or physical analyses of the samples are required.

An integrated flue gas sample was extracted simultaneously with each particulate sample using a specially designed gas sampling

system. Integrated flue gas samples were collected in 44-liter Tedlar bags. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis.

Testing at the inlet to the collector was performed in a 1'-4" x 14'-10" rectangular vertically oriented duct just downstream of a cross sectional convergence on the small dimension and just upstream of a 90 degree direction change on the small dimension side of the duct. A row of nine test ports on the 14'-10" side of the duct was used for entry to perform three 36-point traverse samplings. Each traverse point was sampled two minutes to give a total sampling time of 72 minutes per run. Testing in the stack was conducted from two test ports oriented at 90 degrees located approximately 26 feet downstream of a minor change in duct cross-section and six feet upstream of the stack outlet. A 20-point traverse was used at the stack location. Each traverse point was sampled three minutes to give a total sampling time of 60 minutes per run. During each of the particulate runs, a currently-certified opacity observer performed a one-hour visible emission test.

The important results of the test are summarized in Section 2. Detailed results are presented in Section 3. Results of preliminary measurements, field data and all other supporting information are presented in the appendices.

SUMMARY AND DISCUSSION

The important results of the mechanical collector particulate removal tests are summarized in Tables 1, 2, 3 and 4. The average E-2 Furnace top gas dust collector removal efficiency was 90.19% and 89.74% on June 12 and 15, respectively, with an overall two-day average of 89.97%. The average D-2 Furnace top gas dust collector removal efficiency was 92.96% and 92.42% on June 13 and 14, respectively, with an overall two-day average of 92.69%. The four-day average for both furnaces was 91.33%.

No difficulties were encountered in the field or in the laboratory evaluation of the particulate and gas analyzers. On the basis of this fact and a complete review of the entire test results, it is our opinion that the particulate removal efficiency rates and particulate removal efficiencies are accurate and closely reflect the actual values which existed at the time the tests were conducted.

Table 1. Summary of the Results of the June 12, 1984 Performance Test on the E-2 Furnace Top Gas Dust Collector at the Erie Mining Company in Hoyt Lakes, Minnesota

ITEM	RUN 1		RUN 2		RUN 3	
	INLET	STACK	INLET	STACK	INLET	STACK
Flow of Gas (MFC)			4150-1308	1154-1259	1330-1451	1334-1440
Electrical Power (kW)	54	56				
Electrical Efficiency (%)	38.7	20.0				
Gas Temperature (°F)	59600	76700	59600	76700	59600	76700
Actual Gas Flow (SCFM)	49000	49000	49000	49000	49000	42500
Actual Gas Flow (M³/min)	219	219	231	231	231	227
Weighting Factor	12.34	12.34	14.32	14.32	14.32	14.18
Gas Temperature (°F)	1.27	1.27	1.41	1.41	1.41	1.23
Actual Gas Flow (SCFM)	17.68	17.68	17.42	17.42	17.42	17.79
Actual Gas Flow (M³/min)	81.05	81.05	81.17	81.17	81.17	80.98
Weighting Factor	102.6	102.6	99.6	99.6	99.6	100.9
Gas Temperature (°F)	.09	.09	1.12	1.12	1.12	.10
Actual Gas Flow (SCFM)	.14	.14	1.82	1.82	1.82	.16
Actual Gas Flow (M³/min)	60.5	60.5	570	570	570	58.8
Weighting Factor	89.64	89.64	89.64	89.64	89.64	89.68
Actual Gas Flow (M³/min)						

63 1/4

Actual Gas Flow (M³/min)

Table 2. Summary of the Results of the June 13, 1964 Performance Test on the D-2 Furnace Top Gas Dust Collector at the Erie Mining Company in Hoyt Lakes, Minnesota

ITEM	RUN 1		RUN 2		RUN 3	
	INLET	STACK	INLET	STACK	INLET	STACK
Flow of Gas (SCFM)	1040-1184	1040-1184	1044-1148	1220-1338	1224-1328	
Actual Gas Flow (SCFM)	57	57	57	57	57	57
Standard Gas Flow (SCFM)	17.9	17.1	17.9	17.1	17.9	17.1
Gas temperature (°F)	88300	70200	88300	70200	88300	70200
Moisture content (lb/lb dry gas)	34300	41900	34300	41900	34300	41900
Gas temperature (°F)	243	257	243	257	243	257
Moisture content (lb/lb dry gas)	14.05	14.01	14.05	14.01	14.05	14.01
Gas flow (SCFM)	1.22	1.22	1.22	1.22	1.22	1.22
Moisture content (lb/lb dry gas)	17.51	17.51	17.51	17.51	17.51	17.51
Gas flow (SCFM)	81.23	81.23	81.23	81.23	81.23	81.23
Moisture content (lb/lb dry gas)	99.1	99.1	99.1	99.1	99.1	99.1
Gas flow (SCFM)	1.88	1.88	1.88	1.88	1.88	1.88
Moisture content (lb/lb dry gas)	3.19	3.19	3.19	3.19	3.19	3.19
Gas flow (SCFM)	50.4	50.4	50.4	50.4	50.4	50.4
Moisture content (lb/lb dry gas)	92.30	92.30	92.30	92.30	92.30	92.30
Particulate removal rate (lb/hr)	62.8	62.8	62.8	62.8	62.8	62.8
Removal efficiency (%)	93.76	93.76	93.76	93.76	93.76	93.76

Table 3. Summary of the Results of the June 14, 1984 Performance Test on the D-2 Furnace Top
Gas Dust Collector at the Edison Generating Company in Hoyt Lakes, Minnesota

ITEM	RUN 1		RUN 2		RUN 3	
	INLET	STACK	INLET	STACK	INLET	STACK
Time of test, minutes	100	100	100	100	100	100
Volume of gas, m ³	56	56	56	56	56	56
Average temperature, °F	22.0	22.4	22.0	22.4	22.0	22.4
Volume of water, gal	60200	60200	60200	60200	60200	60200
Actual (calculated)	375000	375000	375000	375000	375000	375000
Standard deviation	264	264	264	264	264	264
Gas temperature, °F	12.95	12.95	12.95	12.95	12.95	12.95
Moisture content, %	1.22	1.22	1.22	1.22	1.22	1.22
Gas composition, %	17.96	17.96	17.96	17.96	17.96	17.96
Standard deviation	80.82	80.82	80.82	80.82	80.82	80.82
Temperature, °F	99.3	99.3	99.3	99.3	99.3	99.3
Particulate concentration, mg/m ³	2.53	2.53	2.53	2.53	2.53	2.53
Standard deviation	4.28	4.28	4.28	4.28	4.28	4.28
Particulate concentration, mg/m ³	1311	1311	1311	1311	1311	1311
Removal efficiency (%)	91.91	91.91	91.91	91.91	91.91	91.91

56 "63 T/HK

Table 4. Summary of the Results of the June 15, 1984 Performance Test on the E-2 Furnace Top Gas Dust Collector at the Erie Mining Company in Hoyt Lakes, Minnesota

ITEM	RUN 1		RUN 2		RUN 3	
	INLET	STACK	INLET	STACK	INLET	STACK
Time of test (min)	0800-0918	0804-0908	0940-1055	0944-1047	1115-1230	1119-1222
Throughput (lb/hr)				56		56
Average gas velocity (ft/min)				22.0		21.3
Volumetric flow (ACFT)						
ACTUAL	60400	60400	60400	66800	61100	63800
STANDARD	57800	57800	57800	42200	36200	39600
Gas temperature (°F)				232	277	248
Moisture content (lb/lb dry gas)				12.95	12.82	12.57
Gas concentration (lb/hr)				1.40	1.75	1.40
Gas capture efficiency (%)				17.80	17.35	17.80
Removal efficiency (%)				80.80	80.90	80.80
Particulate mass rate (lb/hr)				99.3	98.8	99.0
Particulate concentration (lb/ACFT)				.18	1.43	.16
STANDARD (lb/ACFT)				.28	2.40	.26
Particulate mass rate (lb/hr)	979	80.4	963	102.1	746	89.4
Removal efficiency (%)	91.79			89.40		88.02

The results of all field and laboratory evaluations are presented in this section. Gas composition results (Orsat and moisture) are presented first followed by the computer printouts of the particulate and visible emission data. Preliminary measurements including traverse point description are given in Appendices A and B.

The results have been calculated on a DEC PDP-11 Computer using standard Fortran programs. EPA-published equations have been used as the basis of the calculation techniques in these programs. It should be noted in interpreting these results that the particulate emission rates have been calculated by both the "concentration x flow" and the "ratio of areas" methods and the average reported. The average is the best estimate of the true value, since the bias introduced by anisokinetic sampling is approximately equal but of opposite sign in the two calculation techniques and thus cancels in the average.

3.2 Results of Particulate Loading Determinations

Test No. 1
 E-2 MC Inlet

Results of Particulate Loadings Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/12/84	06/12/84	06/12/84
Time run start/end (HRS)	0955/1113	1150/1308	1330/1451
Pitot tube coefficient	.853	.853	.853
Water in sample			
condensate (ml)	122.0	130.0	132.0
silica gel (grams)	29.0	37.0	30.0
Total particulate material collected (grams) *	7.7388	5.5506	5.3783
Meter correction coefficient	1.0067	1.0067	1.0067
Volume through gas meter			
at meter conditions...(CF)	49.51	50.41	50.19
standard conditions...(SCF)	45.29	45.97	45.63
Total sampling time (MIN)	72.0	72.0	72.0
Nozzle diameter (IN)	.251	.251	.251
Average stack gas temperature during determination (DEG-F)	209	217	231
Volumetric flow			
actual.....(CFM)	56800	58561	59607
standard.....(DSCFM)	36321	36572	36584
Isokinetic variation (%)	99.6	100.4	99.6
Particle concentration			
actual.....(GR/ACF)	1.6929	1.1683	1.1207
dry standard.....(GR/DSCF)	2.6365	1.8632	1.8186
Particle mass flow (LB/HR)	819.66	585.56	569.56
Water mass flow (KLB/HR)	16.0	17.6	17.2

* Dry catch only
 mAmCQ/2

Test No. 1
E-2 Top Gas Stack

Results of Particulate Loading Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/12/84	06/12/84	06/12/84
Time run start/end (HRS)	1003/1109	1154/1259	1334/1440
Pitot tube coefficient	.856	.856	.856
Water in sample			
condensate (ml)	58.0	106.0	116.0
silica gel (grams)	56.0	71.0	61.0
Total particulate material collected (grams) *	.6163	.5521	.5280
Meter correction coefficient	.9979	.9979	.9979
Volume through gas meter			
at meter conditions...(CF)	53.70	62.12	53.97
standard conditions...(SCF)	50.70	59.20	50.47
Total sampling time (MIN)	60.0	60.0	60.0
Nozzle diameter (IN)	.248	.248	.248
Average stack gas temperature during determination (DEG-F)	221	219	227
Volumetric flow			
actual.....(CFM)	68008	76714	68662
standard.....(DSCFM)	44719	49008	42464
Isokinetic variation (%)	96.3	102.6	100.9
Particle concentration			
actual.....(GR/ACF)	.1238	.0923	.1002
dry standard.....(GR/DSCF)	.1876	.1439	.1614
Particle mass flow (LB/HR)	70.59	61.26	59.06
Water mass flow (KLB/HR)	13.1	19.6	19.8

* Dry catch only
mAmCQ/2

Test No. 2 ✓
 D-2 MC Inlet

Results of Particulate Loadings Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/13/84	06/14/84	06/14/84
Time run start/end (HRS)	0900/1018	1040/1156	1220/1338
Pitot tube coefficient	.853	.853	.853
Water in sample			
condensate (ml)	118.0	124.0	122.0
silica gel (grams)	30.0	30.0	32.0
Total particulate material collected (grams) *	9.5070	6.1965	9.0903
Meter correction coefficient	1.0067	1.0067	1.0067
Volume through gas meter			
at meter conditions...(CF)	47.22	47.41	48.64
standard conditions...(SCF)	43.12	42.94	43.91
Total sampling time (MIN)	72.0	72.0	72.0
Nozzle diameter (IN)	.251	.251	.251
Average stack gas temperature during determination (DEG-F)	262	263	269
Volumetric flow			
actual.....(CFM)	58325	58336	60415
standard.....(DSCFM)	34582	34332	35378
Isokinetic variation (%)	99.6	99.9	99.1
Particle concentration			
actual.....(GR/ACF)	2.0254	1.3157	1.8781
dry standard.....(GR/DSCF)	3.4020	2.2265	3.1940
Particle mass flow (LB/HR)	1006.96	655.29	965.01
Water mass flow (KLB/HR)	15.7	16.3	16.3

* Dry catch only
 mAmCQ/2

Test No. 2
 D-2 Top Gas Stack

Results of Particulate Loading Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/13/84	06/13/84	06/13/84
Time run start/end (HRS)	0904/1008	1044/1148	1224/1328
Pitot tube coefficient	.856	.856	.856
Water in sample			
condensate (ml)	78.0	118.0	129.0
silica gel (grams)	63.0	54.0	38.0
Total particulate material collected (grams) *	.5525	.4525	.6295
Meter correction coefficient	.9979	.9979	.9979
Volume through gas meter			
at meter conditions...(CF)	50.23	53.06	50.98
standard conditions...(SCF)	47.41	49.70	47.63
Total sampling time (MIN)	60.0	60.0	60.0
Nozzle diameter (IN)	.248	.248	.248
Average stack gas temperature during determination (DEG-F)	262	257	261
Volumetric flow			
actual.....(CFM)	67479	70168	66796
standard.....(DSCFM)	40788	41854	39562
Isokinetic variation (%)	98.7	100.8	102.2
Particle concentration			
actual.....(GR/ACF)	.1091	.0841	.1213
dry standard.....(GR/DSCF)	.1798	.1405	.2039
Particle mass flow (LB/HR)	62.49	50.64	69.97
Water mass flow (KLB/HR)	15.9	19.2	18.6

* Dry catch only
 mAmCQ/2

Test No. 3 ✓
 D-2 MC Inlet

Results of Particulate Loadings Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/14/84	06/14/84	06/14/84
Time run start/end (HRS)	0845/1001	1025/1141	1200/1316
Pitot tube coefficient	.853	.853	.853
Water in sample			
condensate (ml)	116.0	118.0	110.0
silica gel (grams)	30.0	28.0	24.0
Total particulate material collected (grams) *	8.7113	11.3064	12.2600
Meter correction coefficient	1.0067	1.0067	1.0067
Volume through gas meter			
at meter conditions...(CF)	48.21	48.67	48.00
standard conditions...(SCF)	44.99	45.01	44.22
Total sampling time (MIN)	72.0	72.0	72.0
Nozzle diameter (IN)	.251	.251	.251
Average stack gas temperature during determination (DEG-F)	267	264	287
Volumetric flow			
actual.....(CFM)	60439	60238	60825
standard.....(DSCFM)	36200	36224	35755
Isokinetic variation (%)	99.3	99.2	98.8
Particle concentration			
actual.....(GR/ACF)	1.7967	2.3404	2.5253
dry standard.....(GR/DSCF)	2.9876	3.8760	4.2783
Particle mass flow (LB/HR)	924.19	1199.65	1303.94
Water mass flow (KLB/HR)	15.5	15.5	14.3

* Dry catch only
 mAmCQ/2

Test No. 3
 D-2 Top Gas Stack

Results of Particulate Loadings Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/14/84	06/14/84	06/14/84
Time run start/end (HRS)	0849/0953	372./0.42	1204/1308
Pitot tube coefficient	.856	.856	.856
Water in sample			
condensate (ml)	92.0	110.0	95.0
silica gel (grams)	44.0	45.0	32.0
Total particulate material collected (grams) *	.6151	.8614	.8044
Meter correction coefficient	.9979	.9979	.9979
Volume through gas meter			
at meter conditions...(CF)	44.91	51.92	50.24
standard conditions...(SCF)	43.37	49.08	46.52
Total sampling time (MIN)	60.0	60.0	60.0
Nozzle diameter (IN)	.248	.248	.248
Average stack gas temperature during determination (DEG-F)	260	257	288
Volumetric flow			
actual.....(CFM)	61709	68795	68190
standard.....(DSCFM)	37485	41957	40535
Isokinetic variation (%)	98.2	99.3	97.4
Particle concentration			
actual.....(GR/ACF)	.1335	.1658	.1593
dry standard.....(GR/DSCF)	.2189	.2708	.2668
Particle mass flow (LB/HR)	69.74	97.11	91.57
Water mass flow (KLB/HR)	15.4	17.5	14.5

* Dry catch only
 mAmCQ/2

Test No. 4
E-2 MC Inlet

Results of Particulate Loadings Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/15/84	06/15/84	06/15/84
Time run start/end (HRS)	0800/0918	0940/1055	1115/1230
Pitot tube coefficient	.853	.853	.853
Water in sample			
condensate (ml)	122.0	125.0	114.0
silica gel (grams)	26.0	31.0	26.0
Total particulate material collected (grams) *	9.1983	9.0847	6.9764
Meter correction coefficient	1.0067	1.0067	1.0067
Volume through gas meter			
at meter conditions...(CF)	49.51	50.72	48.14
standard conditions...(SCF)	46.07	47.16	44.83
Total sampling time (MIN)	72.0	72.0	72.0
Nozzle diameter (IN)	.251	.251	.251
Average stack gas temperature during determination (DEG-F)	235	234	277
Volumetric flow			
actual.....(CFM)	59103	60380	61051
standard.....(DSCFM)	37088	37780	36246
Isokinetic variation (%)	99.2	99.7	98.8
Particle concentration			
actual.....(GR/ACF)	1.9412	1.8675	1.4313
dry standard.....(GR/DSCF)	3.0809	2.9724	2.4010
Particle mass flow (LB/HR)	976.14	961.71	741.91
Water mass flow (KLB/HR)	15.7	16.5	14.9

* Dry catch only
mAmCQ/2

Test No. 4
 E-2 Top Gas Stack

Results of Particulate Loadings Determinations -- Method 5

	Run 1	Run 2	Run 3
Date of run	06/15/84	06/15/84	06/15/84
Time run start/end (HRS)	0804/0906	0944/1047	1119/1222
Pitot tube coefficient	.856	.856	.856
Water in sample			
condensate (ml)	96.0	115.0	112.0
silica gel (grams)	55.0	41.0	29.0
Total particulate material collected (grams) *	.7084	.9027	.7889
Meter correction coefficient	.9979	.9979	.9979
Volume through gas meter			
at meter conditions...(CF)	50.86	51.68	48.45
standard conditions...(SCF)	49.19	49.36	46.17
Total sampling time (MIN)	60.0	60.0	60.0
Nozzle diameter (IN)	.248	.248	.248
Average stack gas temperature during determination (DEG-F)	236	232	248
Volumetric flow			
actual.....(CFM)	66938	66805	63789
standard.....(DSCFM)	42191	42195	39582
Isokinetic variation (%)	99.0	99.3	99.0
Particle concentration			
actual.....(GR/ACF)	.1406	.1790	.1643
dry standard.....(GR/DSCF)	.2222	.2822	.2636
Particle mass flow (LB/HR)	80.01	101.77	89.07
Water mass flow (KLB/HR)	17.1	17.6	15.9

* Dry catch only
 mAmCR/2

Date: 10/23/96

Location: Hoyt Lakes, MN

Ref. No.: 24

Basis for process rate :

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor			
						kg/Mg	lb/ton	rating	
E-2 vertical shaft Induration furnace top gas stack (natural gas fired)	Mechanical collector	fil. PM	1	70.59	57.1	0.62	1.2		
		fil. PM	2	61.26	57.1	0.54	1.1		
		fil. PM	3	59.06	57.1	0.52	1.0		
		AVERAGE					0.56	1.1	C
		CO2	1	3804.6	57.1	33	67		
		CO2	2	4271.5	57.1	37	75		
		CO2	3	3588.2	57.1	31	63		
		AVERAGE					34	68	C

E-2 vertical shaft Induration furnace top gas stack (natural gas fired)	None	fil. PM	1	819.66	57.1	7.2	14		
		fil. PM	2	585.56	57.1	5.1	10		
		fil. PM	3	569.56	57.1	5.0	10		
		AVERAGE					5.8	12	C
		CO2	1	4285.6	57.1	38	75		
		CO2	2	3165.4	57.1	28	55		
		CO2	3	3542.2	57.1	31	62		
		AVERAGE					32	64	C

E-2 vertical shaft Induration furnace top gas stack (natural gas fired)	Mechanical collector	fil. PM	1	80.01	57.1	0.70	1.4		
		fil. PM	2	101.77	57.1	0.89	1.8		
		fil. PM	3	89.07	57.1	0.78	1.6		
		AVERAGE					0.79	1.6	C
		CO2	1	4055.3	57.1	36	71		
		CO2	2	4055.3	57.1	36	71		
		CO2	3	3805.4	57.1	33	67		
		AVERAGE					35	70	C

E-2 vertical shaft Induration furnace top gas stack (natural gas fired)	None	fil. PM	1	976.14	57.1	8.6	17		
		fil. PM	2	961.71	57.1	8.4	17		
		fil. PM	3	741.91	57.1	6.5	13		
		AVERAGE					7.8	16	C
		CO2	1	4583.8	57.1	40	80		
		CO2	2	4670.3	57.1	41	82		
		CO2	3	4348.3	57.1	38	76		
		AVERAGE					40	79	C

D-2 vertical shaft Induration furnace top gas stack (natural gas fired)	Mechanical collector	filt. PM	1	62.49	58.1	0.54	1.1	
		filt. PM	2	50.64	58.1	0.44	0.87	
		filt. PM	3	69.97	58.1	0.60	1.2	
		AVERAGE				0.53	1.1	C
		CO2	1	3528.6	58.1	30	61	
		CO2	2	3508.7	58.1	30	60	
		CO2	3	3343.3	58.1	29	58	
		AVERAGE				30	60	C

D-2 vertical shaft Induration furnace top gas stack (natural gas fired)	None	filt. PM	1	1006.96	58.1	8.7	17	
		filt. PM	2	655.29	58.1	5.6	11	
		filt. PM	3	965.01	58.1	8.3	17	
		AVERAGE				7.5	15	C
		CO2	1	3443.7	58.1	30	59	
		CO2	2	2919.4	58.1	25	50	
		CO2	3	3061.6	58.1	26	53	
		AVERAGE				27	54	C

D-2 vertical shaft Induration furnace top gas stack (natural gas fired)	Mechanical collector	filt. PM	1	69.74	58.1	0.60	1.2	
		filt. PM	2	97.11	58.1	0.84	1.7	
		filt. PM	3	91.57	58.1	0.79	1.6	
		AVERAGE				0.74	1.5	C
		CO2	1	3217.5	58.1	28	55	
		CO2	2	3661.3	58.1	32	63	
		CO2	3	2807.7	58.1	24	48	
		AVERAGE				28	56	C

D-2 vertical shaft Induration furnace top gas stack (natural gas fired)	None	filt. PM	1	924.19	58.1	8.0	16	
		filt. PM	2	1199.65	58.1	10.3	21	
		filt. PM	3	1303.94	58.1	11	22	
		AVERAGE				9.8	20	C
		CO2	1	2832.6	58.1	24	49	
		CO2	2	3106.0	58.1	27	53	
		CO2	3	2997.9	58.1	26	52	
		AVERAGE				26	51	C

Test report presents feed rate; production rate estimated as 91 % of feed rate,
based on information presented in References 56 and 57 for same plant.