WI-35

Report to

GREDE FOUNDRIES, INC.

Reedsburg, Wisconsin

for

EMISSION TESTING
CUPOLA BAGHOUSE STACK

March 12, 1998

new

by

ENVIRONMENTAL TECHNOLOGY & ENGINEERING CORPORATION
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ETE

SUMMARY

On March 12, 1998 Environmental Technology & Engineering Corp. personnel performed stack emissions testing at the Grede Foundries, Inc. Reedsburg, Wisconsin facility. The tests were performed to document the particulate emissions from a baghouse recently installed to control the cupola emissions. Additional testing was performed to verify compliance with a Wisconsin Department of Natural Resources (WDNR) limit for this source. Lastly, informational tests were performed to document the benzene emissions. All measured emissions and the guarantees and limits are shown in the following tables:

TEST NO.	TOTAL PARTICULATE	FRONT HALF PARTICULATE	BENZENE
1	0.0012 lb/1000 lb	0.0001 gr/acf	<0.052 lb/hr
2	0.0014	0.0003	<0.043
3	0.0011	0.0002	<0.051
AVERAGE	0.0012 lb/1000 lb	0.0002 gr/acf	<0.049 lb/hr
DNR LIMIT	0.25		
GUARANTEE		0.001	NA
% OF LIMIT	0.5 %	20 %	NA

The measured emissions meet the WDNR particulate limit and the baghouse manufacturer's guarantee. Benzene emissions were undetectable.

1.0 GENERAL

On March 12, 1998, Environmental Technology & Engineering Corp. (ETE) personnel performed stack emissions testing at the Grede Foundries Reedsburg, Wisconsin facility. The tests were performed to document the particulate emissions from a baghouse recently installed to control the cupola emissions. Additional testing was performed to verify compliance with a Wisconsin Department of Natural Resources (WDNR) limit for this source. Lastly, informational tests were performed to document the benzene emissions.

Tom McManamy of Grede Foundries was responsible for assuring proper operating conditions throughout the testing. All testing was coordinated with Grede personnel to assure that it was performed during high melt rate periods. Mike Sloat of the WDNR was notified of the tests and witnessed a portion of the testing. The field tests, corresponding laboratory analysis, and report preparation were performed by ETE personnel; Bill Dick was the test team leader.

The following sections of this report document the activities and results of the test program. The report presents all of the relevant data collected. Discussions on the interpretation of the data are provided where appropriate. The report, therefore, includes much necessary detail. The results, however, have been presented in the SUMMARY section at the beginning of this report for those readers not wishing to be burdened by the details.

2.0 RESULTS

All samples were collected and analyzed in accordance with EPA test methods. A sketch with the sampling location is included in APPENDIX C of this report. The methods were as follows:

Parameter	Reference Method
Front Half Particulate	EPA Method 5
Total Particulate	EPA Method 5 and Method 202
Benzene	EPA Method 18

Detailed results of total particulate testing are included as Tables 2-1 through 2-3. Detailed results of front half particulate testing are included as Tables 2-4 through 2-6. Benzene results are summarized in Table 2-7.

GREDE FOUNDRIES | CUPOLA BAGHOUSE | 12-Mar-98 | TABLE 2-1

TEST NO.	1	
BAROMETRIC PRESSURE	29.70	IN HG
TIP DIAMETER	0.305	IN
STACK DIAMETER	72	IN
STACK AREA	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME	78.32	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.002	
PARTICULATE COLLECTED	0.0033	GRAMS
WATER COLLECTED	18	ML
STATIC PRESSURE	-0.7	IN H2O

ORSAT RESULTS

CO2	O2	CO	N2
6.00%	15.00%	0.00%	79.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	265	0.82	5.10	42	59.27
2	275	0.98	6.10	43	65.24
3	270	1.00	6.20	45	65.68
4	270	1.05	6.60	45	67.30
5	272	1.05	6.60	46	67.39
6	270	1.10	6.90	47	68.88
7	272	1.05	6.60	48	67.39
8	272	1.00	6.20	50	65.77
9	270	0.92	5.75	50	62.99
10	268	0.82	5.10	51	59.39
11	265	0.82	5.10	51	59.27
12	262	0.80	5.00	52	58.42
13	270	0.80	5.00	55	58.74
14	275	0.96	6.00	56	64.57
15	272	1.00	6.20	57	65.77
16	275	1.05	6.60	59	67.53
17	275	1.05	6.60	60	67.53
18	277	1.10	6.90	60	69.21
19	275	1.00	6.20	61	65.90
20	277	0.90	5.60	62	62.60
21	267	0.65	4.00	63	52.84
22	270	0.82	5.10	64	59.47
23	272	0.82	5.10	65	59.55
24	270	0.76	4.80	66	57.25
AVERAGE	271		5.81	54	63.25

DRY STANDARD VOLUME	79.02	SCF
PERCENT WATER VAPOR	1.06	% VOL
FLOW RATE	107297	ACFM
	75974	DSCFM
	129095	M3/HR
PARTICULATE CONCENTRATION	0.0006	GR/DSCF
PARTICULATE EMISSION RATE	0.41	LB/HR
LB PART PER 1000 LB GAS	0.0012	
ISOKINETIC PERCENT	96.6	

Total Test 1

GREDE FOUNDRIES | CUPOLA BAGHOUSE | 12-Mar-98 | TABLE 2-2

TEST NO.	2	
BAROMETRIC PRESSURE	29.70	IN HG
TIP DIAMETER	0.305	IN
STACK DIAMETER	72	IN
STACK AREA	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME	76.19	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.002	
PARTICULATE COLLECTED	0.0040	GRAMS
WATER COLLECTED	23	ML
STATIC PRESSURE	-0.7	IN H2O

ORSAT RESULTS

CO2	**O2**	**CO**	**N2**
6.20%	15.00%	0.00%	78.80%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	270	0.78	4.90	69	58.01
2	272	0.86	5.40	70	61.00
3	275	0.90	5.60	70	62.53
4	277	0.90	5.60	70	62.61
5	275	1.00	6.20	71	65.91
6	275	1.00	6.20	72	65.91
7	277	1.05	6.60	73	67.63
8	275	1.05	6.60	74	67.54
9	277	1.00	6.20	75	66.00
10	275	1.00	6.20	76	65.91
11	272	0.90	5.60	78	62.40
12	275	0.82	5.10	79	59.68
13	275	0.82	5.10	79	59.68
14	277	0.82	5.10	80	59.76
15	277	0.88	5.50	81	61.91
16	277	0.90	5.60	81	62.61
17	278	1.00	6.20	82	66.04
18	277	1.00	6.20	82	66.00
19	275	1.00	6.20	83	65.91
20	265	1.00	6.20	83	65.46
21	262	0.90	5.60	83	61.97
22	265	0.86	5.40	84	60.70
23	265	0.90	5.60	84	62.10
24	265	0.80	5.00	85	58.55
AVERAGE	273		5.75	78	63.16

DRY STANDARD VOLUME	76.86	SCF
PERCENT WATER VAPOR	1.39	% VOL
FLOW RATE	107145	ACFM
	75412	DSCFM
	128141	M3/HR
PARTICULATE CONCENTRATION	0.0008	GR/DSCF
PARTICULATE EMISSION RATE	0.51	LB/HR
LB PART PER 1000 LB GAS	0.0014	
ISOKINETIC PERCENT	94.7	

Total Test 2

GREDE FOUNDRIES | CUPOLA BAGHOUSE | 12-Mar-98 | TABLE 2-3

TEST NO.	3	
BAROMETRIC PRESSURE	29.70	IN HG
TIP DIAMETER	0.305	IN
STACK DIAMETER	72	IN
STACK AREA	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME	75.22	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.002	
PARTICULATE COLLECTED	0.0031	GRAMS
WATER COLLECTED	14	ML
STATIC PRESSURE	-0.7	IN H2O

ORSAT RESULTS

CO2	O2	CO	N2
6.00%	15.00%	0.00%	79.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	275	0.80	5.00	83	58.92
2	275	0.82	5.10	83	59.65
3	272	0.90	5.60	84	62.37
4	275	0.90	5.60	85	62.49
5	272	0.90	5.60	86	62.37
6	272	0.84	5.20	87	60.25
7	275	1.00	6.20	87	65.87
8	265	0.80	5.00	88	58.52
9	270	0.84	5.20	89	60.17
10	272	0.94	5.90	90	63.74
11	272	1.00	6.20	90	65.74
12	270	0.80	5.00	91	58.72
13	270	0.76	4.80	91	57.23
14	272	0.80	5.00	92	58.80
15	272	0.90	5.60	92	62.37
16	270	0.90	5.60	92	62.28
17	272	0.90	5.60	92	62.37
18	275	1.00	6.20	92	65.87
19	277	1.05	6.60	92	67.59
20	280	1.05	6.60	92	67.73
21	280	1.00	6.20	92	66.10
22	280	1.00	6.20	92	66.10
23	278	0.90	5.60	92	62.62
24	275	0.82	5.10	92	59.65
AVERAGE	274		5.61	89	62.40

DRY STANDARD VOLUME	75.86	SCF
PERCENT WATER VAPOR	0.86	% VOL
FLOW RATE	105854	ACFM
	74847	DSCFM
	127180	M3/HR
PARTICULATE CONCENTRATION	0.0006	GR/DSCF
PARTICULATE EMISSION RATE	0.39	LB/HR
LB PART PER 1000 LB GAS	0.0011	
ISOKINETIC PERCENT	94.1	

Total Test 3

GREDE FOUNDRIES | CUPOLA BAGHOUSE | 12-Mar-98 | TABLE 2-4

TEST NO.	1	
BAROMETRIC PRESSURE	29.70	IN HG
TIP DIAMETER	0.305	IN
STACK DIAMETER	72	IN
STACK AREA	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME	78.32	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.002	
FH PARTICULATE COLLECTED	0.0010	GRAMS
WATER COLLECTED	18	ML
STATIC PRESSURE	-0.7	IN H2O

ORSAT RESULTS

CO2	O2	CO	N2
6.00%	15.00%	0.00%	79.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	265	0.82	5.10	42	59.27
2	275	0.98	6.10	43	65.24
3	270	1.00	6.20	45	65.68
4	270	1.05	6.60	45	67.30
5	272	1.05	6.60	46	67.39
6	270	1.10	6.90	47	68.88
7	272	1.05	6.60	48	67.39
8	272	1.00	6.20	50	65.77
9	270	0.92	5.75	50	62.99
10	268	0.82	5.10	51	59.39
11	265	0.82	5.10	51	59.27
12	262	0.80	5.00	52	58.42
13	270	0.80	5.00	55	58.74
14	275	0.96	6.00	56	64.57
15	272	1.00	6.20	57	65.77
16	275	1.05	6.60	59	67.53
17	275	1.05	6.60	60	67.53
18	277	1.10	6.90	60	69.21
19	275	1.00	6.20	61	65.90
20	277	0.90	5.60	62	62.60
21	267	0.65	4.00	63	52.84
22	270	0.82	5.10	64	59.47
23	272	0.82	5.10	65	59.55
24	270	0.76	4.80	66	57.25
AVERAGE	271		5.81	54	63.25

DRY STANDARD VOLUME	79.02	SCF
PERCENT WATER VAPOR	1.06	% VOL
FLOW RATE	107297	ACFM
	75974	DSCFM
	129095	M3/HR
PARTICULATE CONCENTRATION	0.0002	GR/DSCF
	0.0001	GR/ACF
PARTICULATE EMISSION RATE	0.13	LB/HR
LB PART PER 1000 LB GAS	0.0004	
ISOKINETIC PERCENT	96.6	

Front Half Test 1

GREDE FOUNDRIES | CUPOLA BAGHOUSE | 12-Mar-98 | TABLE 2-5

TEST NO.	2	
BAROMETRIC PRESSURE	29.70	IN HG
TIP DIAMETER	0.305	IN
STACK DIAMETER	72	IN
STACK AREA	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME	76.19	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.002	
FH PARTICULATE COLLECTED	0.0020	GRAMS
WATER COLLECTED	23	ML
STATIC PRESSURE	-0.7	IN H2O

ORSAT RESULTS

CO2	O2	CO	N2
6.20%	15.00%	0.00%	78.80%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	270	0.78	4.90	69	58.01
2	272	0.86	5.40	70	61.00
3	275	0.90	5.60	70	62.53
4	277	0.90	5.60	70	62.61
5	275	1.00	6.20	71	65.91
6	275	1.00	6.20	72	65.91
7	277	1.05	6.60	73	67.63
8	275	1.05	6.60	74	67.54
9	277	1.00	6.20	75	66.00
10	275	1.00	6.20	76	65.91
11	272	0.90	5.60	78	62.40
12	275	0.82	5.10	79	59.68
13	275	0.82	5.10	79	59.68
14	277	0.82	5.10	80	59.76
15	277	0.88	5.50	81	61.91
16	277	0.90	5.60	81	62.61
17	278	1.00	6.20	82	66.04
18	277	1.00	6.20	82	66.00
19	275	1.00	6.20	83	65.91
20	265	1.00	6.20	83	65.46
21	262	0.90	5.60	83	61.97
22	265	0.86	5.40	84	60.70
23	265	0.90	5.60	84	62.10
24	265	0.80	5.00	85	58.55
AVERAGE	273		5.75	78	63.16

DRY STANDARD VOLUME	76.86	SCF
PERCENT WATER VAPOR	1.39	% VOL
FLOW RATE	107145	ACFM
	75412	DSCFM
	128141	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
	0.0003	GR/ACF
PARTICULATE EMISSION RATE	0.25	LB/HR
LB PART PER 1000 LB GAS	0.0007	
ISOKINETIC PERCENT	94.7	

Front Half Test 2

GREDE FOUNDRIES | CUPOLA BAGHOUSE | 12-Mar-98 | TABLE 2-6

TEST NO.	3	
BAROMETRIC PRESSURE	29.70	IN HG
TIP DIAMETER	0.305	IN
STACK DIAMETER	72	IN
STACK AREA	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME	75.22	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.002	
FH PARTICULATE COLLECTED	0.0012	GRAMS
WATER COLLECTED	14	ML
STATIC PRESSURE	-0.7	IN H2O

ORSAT RESULTS

CO2	O2	CO	N2
6.00%	15.00%	0.00%	79.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	275	0.80	5.00	83	58.92
2	275	0.82	5.10	83	59.65
3	272	0.90	5.60	84	62.37
4	275	0.90	5.60	85	62.49
5	272	0.90	5.60	86	62.37
6	272	0.84	5.20	87	60.25
7	275	1.00	6.20	87	65.87
8	265	0.80	5.00	88	58.52
9	270	0.84	5.20	89	60.17
10	272	0.94	5.90	90	63.74
11	272	1.00	6.20	90	65.74
12	270	0.80	5.00	91	58.72
13	270	0.76	4.80	91	57.23
14	272	0.80	5.00	92	58.80
15	272	0.90	5.60	92	62.37
16	270	0.90	5.60	92	62.28
17	272	0.90	5.60	92	62.37
18	275	1.00	6.20	92	65.87
19	277	1.05	6.60	92	67.59
20	280	1.05	6.60	92	67.73
21	280	1.00	6.20	92	66.10
22	280	1.00	6.20	92	66.10
23	278	0.90	5.60	92	62.62
24	275	0.82	5.10	92	59.65
AVERAGE	274		5.61	89	62.40

DRY STANDARD VOLUME	75.86	SCF
PERCENT WATER VAPOR	0.86	% VOL
FLOW RATE	105854	ACFM
	74847	DSCFM
	127180	M3/HR
PARTICULATE CONCENTRATION	0.0002	GR/DSCF
	0.0002	GR/ACF
PARTICULATE EMISSION RATE	0.15	LB/HR
LB PART PER 1000 LB GAS	0.0004	
ISOKINETIC PERCENT	94.1	

Front Half Test 3

GAS CHROMATOGRAPH ANALYSIS SHEET
METHOD 18 DATA

TABLE 2-7

CLIENT		Grede Reedsburg	
PROCESS/STACK		Cupola Baghouse	
CALIBRATION FACTORS			
PARAMETER	STD ug	STD AREA	FACTOR
Benzene	4.4	32167	0.000137
RECOVERY FACTOR	1.00		

TEST 1	PUMP	SKC1	
	PUMP CAL	0.429	cc/count
	PUMP COUNTS	25951	counts
	SAMPLE VOLUME	11.13	std liters
	PEAK AREA	-15000	
	WT OF COMPOUND	-2.05	ug
	BENZENE CONCENTRATION	-0.18	mg/m3
	STACK FLOW RATE	129095	m3/hr
	BENZENE EMISSION RATE	-0.052	lb/hr
TEST 2	PUMP	SKC1	
	PUMP CAL	0.429	cc/count
	PUMP COUNTS	31682	counts
	SAMPLE VOLUME	13.59	std liters
	PEAK AREA	-15000	
	WT OF COMPOUND	-2.05	ug
	BENZENE CONCENTRATION	-0.15	mg/m3
	STACK FLOW RATE	128141	m3/hr
	BENZENE EMISSION RATE	-0.043	lb/hr
TEST 3	PUMP	SKC1	
	PUMP CAL	0.429	cc/count
	PUMP COUNTS	26183	counts
	SAMPLE VOLUME	11.23	std liters
	PEAK AREA	-15000	
	WT OF COMPOUND	-2.05	ug
	BENZENE CONCENTRATION	-0.18	mg/m3
	STACK FLOW RATE	127180	m3/hr
	BENZENE EMISSION RATE	-0.051	lb/hr
AVERAGE	BENZENE EMISSION RATE	-0.049	lb/hr

A summary of results relative to the limits is included as Table 2-8.

TABLE 2-8

TEST NO.	TOTAL PARTICULATE	FRONT HALF PARTICULATE	BENZENE
1	0.0012 lb/1000 lb	0.0001 gr/acf	<0.052 lb/hr
2	0.0014	0.0003	<0.043
3	0.0011	0.0002	<0.051
AVERAGE	0.0012 lb/1000 lb	0.0002 gr/acf	<0.049 lb/hr
DNR LIMIT	0.25		
GUARANTEE		0.001	NA
% OF LIMIT	0.5 %	20 %	NA

3.0 METHODS

3.1 Particulate

The equipment used to sample was the Western Precipitation Division of the Joy Manufacturing Company Emission Parameter Analyzer. Samples were collected in accordance with EPA Method 5 (front half particulate) and EPA Method 202 (condensible particulate).

The sampling train consisted of a probe tip, a heated probe, a heated glass cyclone and flask, and a heated filter holder with a tared filter. A series of four impingers followed in an ice bath. The first was a modified Greenburg-Smith impinger with 100 ml of distilled water; the second was a Greenburg-Smith impinger with 100 ml distilled water; the third was a modified Greenburg Smith impinger dry; and the fourth was also a modified Greenburg-Smith impinger containing a tared quantity of Silica Gel. The gas then passed through a vacuum pump, calibrated dry gas meter, and a calibrated orifice. A schematic drawing of the sampling train is included.

The temperatures of the stack gas stream, as well as strategic locations within the sampling devices, were monitored by RTDs and read directly from a gauge on the control unit.

The initial gas stream velocity was obtained from a preliminary traverse using an "S" type pitot tube. The initial moisture was estimated from previous tests of similar processes. This data, along with the stack temperature, was used to set a nomograph so that rapid calculations of isokinetic sampling conditions could be made.

The principle of the method was to collect the sample representative of the exhaust by adjusting the sample collection velocity to match the exhaust gas stream velocity at the point of collection. The velocity at the point of collection was measured with an "S" type pitot tube attached to the probe and the collection velocity was matched to the stack gas velocity by adjusting the flow as indicated by the calibrated orifice.

At the completion of the test, the impinger contents were measured and weighed for determination of the actual moisture content of the exhaust gas stream. The probe tip and probe were washed and brushed with acetone and placed in a tared beaker and evaporated at room temperature. The filter and beaker were then desiccated to the tared humidity conditions and weighed for the determination of front half particulate.

The impinger contents were then further analyzed for condensible matter in accordance with Method 202. These condensible particulates were added to the front half particulate to determine the total particulate.

A computer was used to calculate the stack velocities, emission concentrations, emission rates and volumetric flow rates using the field and laboratory data.

3.2 Benzene

Sampling for benzene was performed in accordance with EPA Method 18 - "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography." Samples were drawn from the exhaust gas stream onto solid sorbent tubes (charcoal) using an SKC pump with a stroke counter to measure the sample volume. A minimum of two tubes were placed in series. At the completion of the tests the tubes were desorbed and analyzed by a gas chromatograph equipped with a flame ionization detector. Standard concentrations of benzene were prepared by injecting a known quantity into a tube and then desorbing and analyzing the tube in the same manner as the samples.

The concentrations of the exhaust gas stream were then determined by comparing the response of the standards to the response to the exhaust stack samples. Sample retention times and peak areas were used to quantify the compound emissions. The compound concentrations were then used in conjunction with the exhaust gas flow rates to determine organic compound emission rates in units of pounds per hour (lb/hr).

4.0 CALIBRATIONS

The probe tips, pitot tubes, dry gas meters, and orifices were calibrated prior to the test according to procedures published by the EPA. The values obtained were:

Parameter	Value
Probe Tip Diameter	0.305"
Pitot Coefficient	0.84
Dry Gas Meter Coefficient	1.002
Orifice Coefficient	1.780
Date	January 26, 1998

Environmental
Technology &
Engineering Corp.

PARTICULATE FIELD DATA

Cp = 0.85 } 1-26-98

PLANT Glede Foundries
DATE 3-17-98
LOCATION Reydosuel
OPERATOR WJD
STACK NO. Cupola RH
RUN NO. 1
SAMPLE BOX NO. 4
METER BOX NO. 1

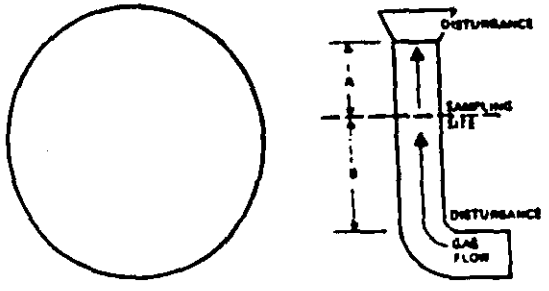
AMBIENT TEMPERATURE 10
BAROMETRIC PRESSURE 29.70
ASSUMED MOISTURE, % 8
PROBE LENGTH, in.
NOZZLE DIAMETER, in. 5/16
STACK DIAMETER, in. 72
PROBE HEATER SETTING 250
HEATER BOX SETTING 250

METER ΔH, 1.780
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2 6.0
O2 15.0
CO
N2 79.0

LEAK CHECK
@ Pre <.01 @ 2
@ Pitot 4"
@ Post <.01 @ 2
@ Pitot 4"

2½/pt



CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD ($\sqrt{P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (Vm), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. H_g gauge	0.929 Stc #1 VELOCITY fps
1	0905		265	.82	5.10		679.00		52	250	35	3	969743
2	07+	-0.7	275	.98	6.10		82 3		53				995694
3	10		270	1.00	6.20		85.6		45				25951
4	13+		270	1.05	6.60		89.0		45				
5	15	-0.8	272	1.05	6.60		92.5		46	252	130	3	
6	17+		270	1.10	6.90		96.1		47				
7	20		272	1.05	6.60		99.7		48				
8	22+	-0.7	272	1.00	6.20		03.2		50	252	40	3	
9	25		270	.92	5.70		06.5		50				
10	27+		268	.82	5.10		09.9		51				
11	30		265	.82	5.10		13.0		51				
12	32+		262	.80	5.00		15.9		52				
1	35/36		270	.80	5.00		19.0		55	255	42	3	
2	38+	-0.7	275	.96	6.00		22.1		56				
3	41		272	1.00	6.20		25.4		57				
4	43+		275	1.05	6.60		28.6		59				
5	46	-0.8	275	1.05	6.60		32.1		60	250	41	3	
6	48+		277	1.10	6.90		35.6		60				
7	51		275	1.00	6.20		39.0		61				
8	53+		277	.90	5.60		42.3		62				
9	56		267	.65	4.00		45.5	78.32	63				
10	58+	-0.6	270	.82	5.10		48.3		64	250	99	3	
11	01		272	.82	5.10		51.3		65				
12	03+		270	.76	4.80		54.3		66				
	06						757.32						

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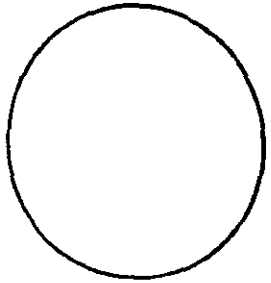
PARTICULATE FIELD DATA



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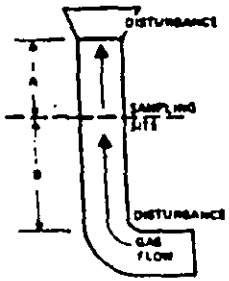

PLANT GREDE
DATE 3-12-98
LOCATION BLEDSBURG
OPERATOR WJD
STACK NO. CUPOLA
RUN NO. 2
SAMPLE BOX NO. 5
METER BOX NO. 1

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
PROBE LENGTH, in.
NOZZLE DIAMETER, in. 5/16
STACK DIAMETER, in. 72
PROBE HEATER SETTING 250
HEATER BOX SETTING 250

METER ΔH,
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2 6.2
O2 15.0
CO
N2 78.8

LEAK CHECK
on Pre 0.01 21
on Pitot 9"
on Post 0.01
on Pitot 9"

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD ($\sqrt{P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (Vm), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. H_g gauge	SECT 1 VELOCITY fps
1	1020		270	.78	4.90		760.00		69	250	35	5	495694
2	22+	-0.7	272	.86	5.50		63.1		74				527376
3	0[illegible]		275	.90	5.60		66.1		70				31682
4	27+		277	.90	5.60		69.3		70				
5	30	-0.7	275	1.00	6.20		72.5		71				
6	32+		275	1.00	6.20		75.8		72	252	39	7	
7	35		277	1.05	6.60		79.0		73				
8	37+		275	1.05	6.60		82.5		74				
9	40	-0.7	277	1.00	6.20		86.0		75				
10	42+		275	1.00	6.20		89.3		76	252	40	8	
11	45		272	.90	5.60		92.6		78				
12	47		275	.82	5.10		95.7		79				
1	50/51		275	.82	5.10		98.7		79				
2	53+	-0.7	277	.82	5.10		01.7		80				
3	56		277	.88	5.50		04.6		81	255	42	8	
4	58+		277	.90	5.60		07.7		81				
5	01	-0.7	278	1.00	6.20		10.7		82				
6	03+		277	1.00	6.20		13.7		83				
7	06		275	1.00	6.20		17.4		83				
8	08/10		265	1.00	6.20		20.6		83				
9	21+	-0.7	262	.90	5.60		24.0	76.19	83	252	40	8	
10	13		265	.86	5.40		27.1		84				
11	16		265	.90	5.60		30.2		84				
12	18		265	.80	5.00		33.2		85				
	1132+						836.19						

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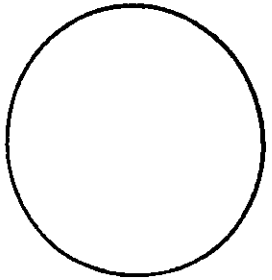
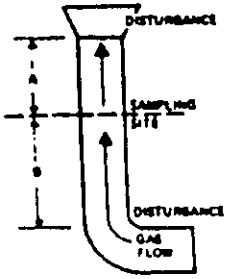
PARTICULATE FIELD DATA



CROSS SECTION



PLANT GREDE
DATE 3.10.99
LOCATION REACTOR BLDG
OPERATOR WJD
STACK NO. CURA
RUN NO. 3
SAMPLE BOX NO. 6
METER BOX NO. 1

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 8
PROBE LENGTH, in.
NOZZLE DIAMETER, in. 5/16
STACK DIAMETER, in. 72
PROBE HEATER SETTING 250
HEATER BOX SETTING

METER ΔH@
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2 6.0
O2 15.0
CO
N2 79.0

LEAK CHECK
@ Pre <.01 @ 22
@ Pitot @
@ Post <.01 @ 22
@ Pitot @

TRAVERSE POINT NUMBER	SAMPLING TIME (A), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s) ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLEY ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), F	SAMPLE BOX TEMPERATURE F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	VELOCITY fps
1	11:45		275	.80	5.00		838.00		83	250	35	4	587376
2	91+	-0.7	271	.82	5.10		41.0		83				553559
3	50		272	.90	5.60		44.0		84				26193
4	57+		275	.90	5.60		47.1		85				
5	55	-0.7	272	.90	5.60		50.2		86	250	39	5	
6	57+		272	.84	5.20		53.3		87				
7	00		271	1.00	6.20		56.3		87				
8	02+/05		265	.80	5.00		59.7		88				
9	07+		270	.84	5.20		62.8		89	250	40	5	
10	10	-0.7	272	.94	5.90		65.9		90				
11	12+		272	1.00	6.20		69.0		90				
12	15		270	.80	5.00		72.3		91				
1	17+/20		270	.76	4.80		75.3		91				
2	22+	-0.7	272	.80	5.00		78.0		92	252	41	6	
3	25		272	.90	5.60		81.1		92				
4	27+		270	.90	5.60		84.3		92				
5	30	-0.7	272	.90	5.60		87.4		92	251	44	5	
6	32+		275	1.00	6.20		90.4		92				
7	35		277	1.05	6.60		93.7		92				
8	37+		280	1.05	6.60		97.1		92				
9	40		280	1.00	6.20		900.5		92				
10	42+	-0.1	280	1.00	6.20		03.8	75.22	92	250	50	7	
11	45		278	.90	5.60		07.1		92				
12	47+		275	.82	5.10		10.1		92				
	1250						913.22						

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME Grede - Reedsburg DATE OF TEST 3-17-98

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 1 STACK Cupola

SAMPLE BOX 4 FILTER NUMBER 2173

BEAKERS: FH Acetone 1 BH MetCl 1 BH Water E

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
1	102	100	2
2	106	100	6
3	105	100	5
Sil Gel	607	602	5
		WATER TOTAL -	18

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter		0.5678	0.5678	-
FH Wash	.0002	106.3429	106.3417	0.0010
			FILTERABLE TOTAL -	0.0010
Extract	.0003	68.5780	68.5765	0.0012
Water	.0002	115.4494	115.4481	0.0011
			CONDENSIBLE TOTAL -	0.0023
			TOTAL PARTICULATE -	0.0033

Comments:

R 1 = 0.43

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME Gerdau Reedsburg DATE OF TEST 3-12-98

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 3 STACK Cupola

SAMPLE BOX 6 FILTER NUMBER 2175

BEAKERS: FH Acetone 3 BH MetCl 3 BH Water G

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
1	100	100	0
2	102	100	2
3	102	100	2
Sil Gel	699	689	10
		WATER TOTAL -	14

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter		0.5697	0.5695	0.0002
FH Wash	.0002	94.1769	94.1755	0.0012
			FILTERABLE TOTAL - a	0.0012
Extract	.0003	69.6517	68.6504	0.0010
Water	.0007	111.6427	111.6409	0.0009
			CONDENSIBLE TOTAL - b	0.0019
			TOTAL PARTICULATE -	0.0031

Comments: $\frac{a}{b}$ x grains/lb x lb/hr

R3 0.63

GAS CHROMATOGRAPH ANALYSIS SHEET
METHOD 18 DATA

CLIENT			Grede Reedsburg	
PROCESS/STACK			Cupola Baghouse	
CALIBRATION FACTORS				
	PARAMETER	STD ug	STO AREA	FACTOR
	Benzene	4.4	32167	0.000137
RECOVERY FACTOR		1.00		

TEST			
1	PUMP	SKC1	
	PUMP CAL	0.429	cc/count
	PUMP COUNTS	25951	counts
	SAMPLE VOLUME	11.13	std liters
	PEAK AREA	-15000	
	WT OF COMPOUND	-2.05	ug
	BENZENE CONCENTRATION	-0.18	mg/m3
	STACK FLOW RATE	129095	m3/hr
	BENZENE EMISSION RATE	-0.052	lb/hr
TEST			
2	PUMP	SKC1	
	PUMP CAL	0.429	cc/count
	PUMP COUNTS	31682	counts
	SAMPLE VOLUME	13.59	std liters
	PEAK AREA	-15000	
	WT OF COMPOUND	-2.05	ug
	BENZENE CONCENTRATION	-0.15	mg/m3
	STACK FLOW RATE	128141	m3/hr
	BENZENE EMISSION RATE	-0.043	lb/hr
TEST			
3	PUMP	SKC1	
	PUMP CAL	0.429	cc/count
	PUMP COUNTS	26183	counts
	SAMPLE VOLUME	11.23	std liters
	PEAK AREA	-15000	
	WT OF COMPOUND	-2.05	ug
	BENZENE CONCENTRATION	-0.18	mg/m3
	STACK FLOW RATE	127180	m3/hr
	BENZENE EMISSION RATE	-0.051	lb/hr
AVERAGE	BENZENE EMISSION RATE	-0.049	lb/hr

APPENDIX B

Sample Calculations

SAMPLE CALCULATIONS

1. DRY MOLECULAR WEIGHT (Md) lb/lb-mole

   Md = .44*% CO2 + .32*%O2 + .282*%N2 + .28*%CO

2. WATER VAPOR PERCENT (%H2O)

   Vw std = 0.04707*(Vf - Vi)

   where: Vw std = standard cubic feet of water vapor
   Vf = Final volume of impingers, ml
   Vi = Initial volume of impingers, ml

   %H2O = Vw std * 100/(Vm std + Vw std)

   where Vm std = standard cubic feet of gas sampled

3. WET MOLECULAR WEIGHT (Ms) lb/lb-mole

   Ms = Md*(1 - %H2O/100) + 18*%H2O/100

4. STACK PRESSURE (Ps) in. Hg

   Ps = Pb + Pg/13.6

   where: Pb = barometric pressure (uncorrected), in. Hg
   Pg = stack gauge pressure, in. H2O
   13.6 = specific gravity of mercury (Hg)

5. AVERAGE STACK VELOCITY (Vs) feet per second

   Vs = Kp*Cp* (DELP) Tsavg/(Ps*Ms)

   where: Kp = 85.49 unit conversion
   Cp = 0.85, pitot tube calibration factor
   DELP = square root of velocity head, in. H2O
   Tsavg = average stack temperature, deg R (460+F)
   Ps = stack pressure
   Ms = wet molecular weight

6. STACK GAS FLOW RATE (Qs) std cubic feet per minute

   Qs = 60*(1 - %H2O/100)*Vs*A*(528*Ps/Tsavg/29.92)

   where: A = stack area, ft2
   528 = std temperature, deg R
   29.92 = std pressure, in. Hg

7. DRY GAS VOLUME (Vm std) std cubic feet

Vm std = GAMA*(Vm-(AL-.02)t)*(Pb+DELH/13.6)/29.92

where: GAMA = dry gas meter calibration factor
Vm = volume of dry gas metered, cubic feet
AL = post test leak rate, cubic feet per minute
t = total time of test, minutes
DELH = average orifice pressure drop, in.H2O

8. PARTICULATE CONCENTRATION (Cs) grains/dry std cubic foot

Cs = Mn * 15.43/Vm std

where: Mn = particulate captured, grams
15.43 = grains per gram

9. EMISSION RATE (ER) pounds per hour

PMRA = Mn*A*60/(t*An*453.6) AREA METHOD lb/hr

PMRC = Cs*Qs*60/(15.43*453.6) CONC. METHOD lb/hr

ER = (PMRA + PMRC)/2

where: An = area of sampling nozzle, square feet

10. EMISSION CONCENTRATION (EC) lb/1000 lb exhaust gas

EC = ER * 386700 * (1-%H2O/100)/(Qs*60*Ms)

where: 386700 = cubic feet per lb mole * 1000

11. ISOKINETIC SAMPLING PERCENTAGE (I) %

I = PMRA/PMRC

SAMPLE CALCULATION

BAROMETRIC PRESSURE, in Hg (Pb) = 29.200
STACK PRESSURE, in Hg (Pb + Pg/13.6) = 29.178
TIP DIAMETER, in (An = PI*D^2/576) = .2450
STACK AREA, sq ft (A) = 10.560
SAMPLING TIME PER POINT, min = 2.50
NUMBER OF POINTS = 24
GAS METER VOLUME, acf (Vm) = 66.06
WATER COLLECTED, ml (Vf - Vi) = 86.00
PARTICULATE COLLECTED, grams (Mn) = 0.0755
CO2 = 0.60 O2 = 21.00 CO = 0.00 N2 = 78.40
WET MOLECULAR WEIGHT, lb/mole (Ms) = 28.45

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE DEL H inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	110	1.450	4.05	32	72.51
2	110	1.350	3.75	32	69.97
3	110	1.350	3.75	32	69.97
4	110	1.300	3.70	32	68.66
5	110	1.250	3.60	32	67.33
6	110	1.250	3.60	32	67.33
7	110	1.050	2.95	32	61.71
8	110	1.000	2.85	32	60.22
9	110	1.000	2.85	34	60.22
10	110	1.050	2.95	34	61.71
11	110	0.950	2.75	38	58.69
12	115	0.950	2.75	38	58.95
13	115	1.300	3.70	42	68.96
14	115	1.250	3.60	42	67.62
15	115	1.200	3.40	42	66.26
16	115	1.200	3.40	42	66.26
17	115	1.150	3.30	44	64.86
18	115	1.150	3.30	46	64.86
19	115	1.050	2.95	48	61.98
20	115	1.150	3.30	48	64.86
21	115	1.000	2.85	50	60.48
22	115	1.100	3.15	50	63.43
23	115	1.050	2.95	50	61.98
24	115	0.900	2.55	50	57.38
AVG VALUES	113		3.250	40	64.42

TOTAL GAS WITHDRAWN, scf = 69.39
DRY GAS WITHDRAWN, scf (Vmstd) = 65.35
WATER VAPOR WITHDRAWN, scf (Vwstd) = 4.05
PERCENT WATER VAPOR (%H2O) = 5.83
ACTUAL WET FLOW RATE, acfm = 40,819.39
STANDARD DRY FLOW RATE, scfm (Qs) = 34,558.69
PARTICULATE CONCENTRATION, grains/dscf (Cs) = 0.018
PARTICULATE EMISSION RATE, lb/hr (ER) = 5.325
PARTICULATE EMISSIONS, lb/1000 lb (EC) = 0.033
PERCENT OF ISOKINETIC SAMPLING (I) = 101.67

APPENDIX C

Sampling Location Figures
Sampling Train Figures

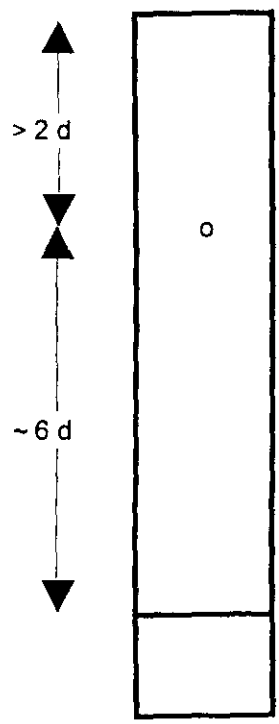
GREDE FOUNDRIES
REEDSBURG CUPOLA BAGHOUSE

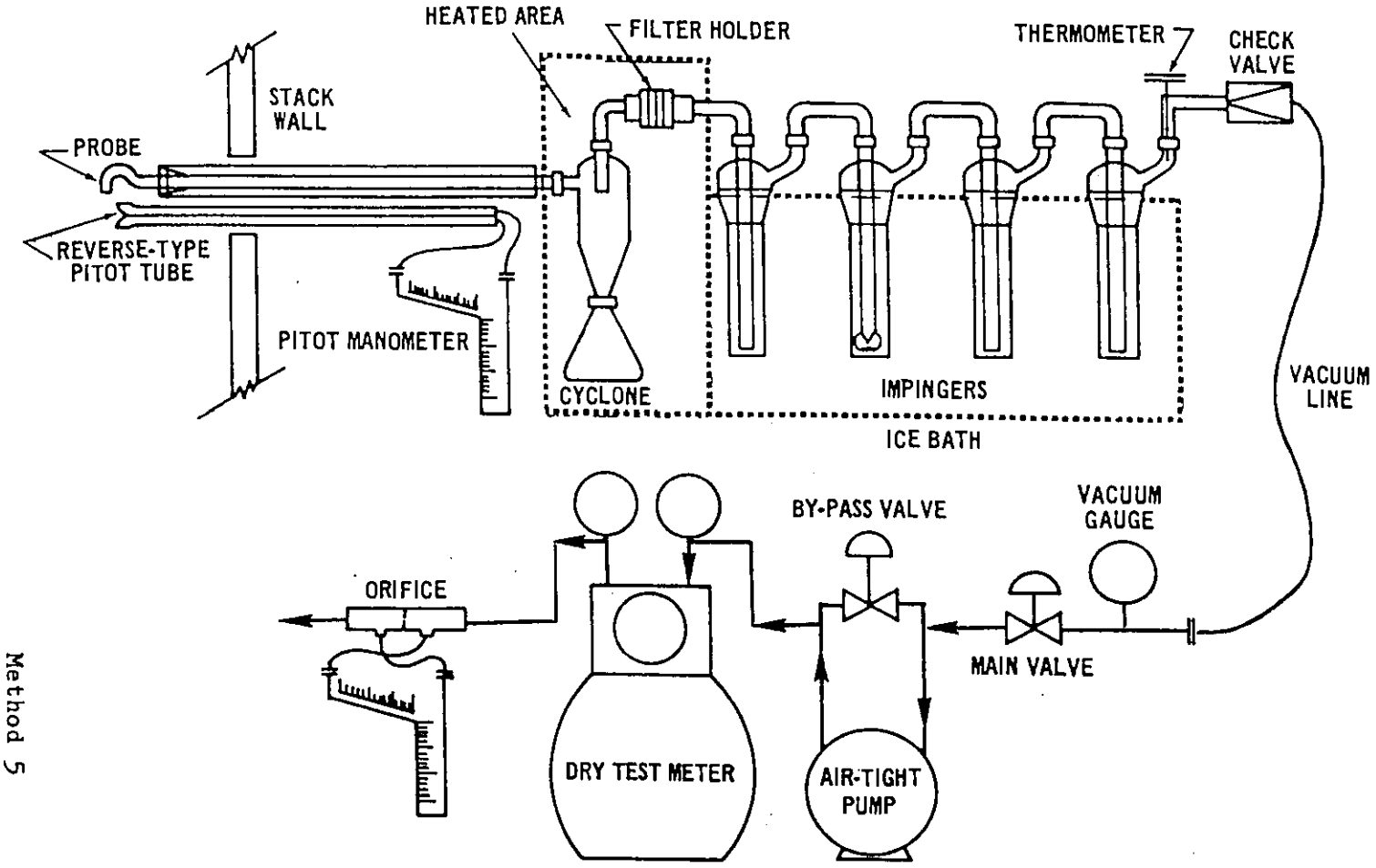
DIAMETER = 72"

SAMPLE POINT LOCATION

POINT	DISTANCE inches
1	1.5
2	4.8
3	8.5
4	12.7
5	18.0
6	25.6
7	46.4
8	54.0
9	59.3
10	63.5
11	67.2
12	70.5

SAMPLE PORT LOCATION





Particulate sampling train.

National Emission Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries - Background Information for Proposed Standards

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EPA-453/R-02-013
December 2002

National Emission Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries-- Background Information for Proposed Standards

Prepared by:
RTI International
Research Triangle Park, NC

Prepared for:
Kevin Cavender, Project Leader
Emission Standards Division

Contract No. 68-D01-73
Work Assignment No. 1-14

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Standards Division
Metals Group
Research Triangle Park, NC

APPENDIX D

SOURCE TEST PARTICULATE MATTER DATA FOR CUPOLA BAGHOUSES

D.1 SOURCE TEST PARTICULATE MATTER DATA FOR CUPOLA BAGHOUSES

This appendix presents the individual sampling run data for the source tests available to characterize the control performance for baghouses applied to cupolas (Chapter 4). Summary test data are given in Table D-1 along with information on melting rates and capacities and a description of the control systems and the processes they serve.

The data in Table D-1 represent a range of cupola sizes and types of baghouses. The design melting rates range from 3.5 to 80 tons per hour, and ventilation rates range from 30,000 to 195,000 actual cubic feet per minute. The cupolas include both recuperative and non-recuperative, and both above and below charge take off. The baghouses include both negative and positive pressure operating modes and employ both shaker and pulse jet cleaning systems. Some were installed about 30 years ago, and some are relatively new (rebuilt). The design air-to-cloth ratios cover a range of 1.68 to 5.1 feet per minute. No information is available on the ages of the bags in service when the tests were conducted.

The reported results were checked to ensure the weights of PM from the filter and the probe catch were above detection limits. When the reported catch was less than 3 mg, a detection limit value of 3 mg and the sample volume were used to estimate the detection limit in gr/dscf. Values calculated in this manner are reported as “less than” (<).

TABLE D-1. PM SOURCE TEST RESULTS FOR BAGHOUSES SERVING CUPOLAS

Foundry WI-35 (tested March 1998)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	<0.0006	<0.4	75,974	107,297	271	1.7		45 tph capacity, afterburner, recuperative, above charge takeoff	Installed 1998, negative pressure, pulse jet, horizontally-supported bags, 10.8 oz Nomex fabric, air:cloth = 2.4 ft/min, design for 280°F and 148,000 acfm
2	<0.0006	<0.4	75,412	107,145	273	1.7			
3	<0.0006	<0.4	74,847	105,854	274	1.7			
Avg	<0.0006	<0.4	75,411	106,765	273	1.7			
Foundry WI-35 (tested November 1998)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)		
1	<0.0007	<0.4	59,651	86,905	279	1.4	40		
2	<0.0008	<0.4	56,350	81,221	270	1.3	40		
3	<0.0008	<0.4	57,002	82,220	271	1.3	42.5		
Avg	<0.0008	<0.4	57,668	83,449	273	1.3	41		
Foundry WI-35 (tested May 2000)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)		
1	<0.0007	<0.4	61,074	88,945	271	1.4			
2	<0.0007	<0.4	60,856	88,346	269	1.4			
3	<0.0007	<0.4	61,132	88,483	267	1.4			
Avg	<0.0007	<0.4	61,021	88,591	269	1.4			

Foundry IN-01 (tested March 2000)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.00086	0.43	58,178	81,782	259		69.5	75 tph capacity, afterburner, below charge takeoff	New baghouse, pulse jet, horizontally-supported bags
2	0.00079	0.42	61,481	87,303	270		61.8		
3	0.00069	0.39	65,454	95,494	293		68.6		
Avg	0.00078	0.41	61,704	88,193	274		66.6		
Foundry MI-26 (tested December 1995)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0012	0.22	20,987				10	15 tph capacity, afterburner, above charge takeoff	Installed 1995, positive pressure, shaker, fiberglass fabric, air:cloth = 0.75 ft/min, design for 500°F and 25,700 acfm
2	0.0023	0.40	20,987						
3	0.0017	0.29	21,029						
Avg	0.0017	0.30	21,001						
Foundry NC-05 (tested February 2000)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0019	1.15	65,932	102,298	288	2.3	62.9	70 tph capacity, afterburner, above charge takeoff	New baghouse, negative pressure, pulse jet, air:cloth = 1.76 ft/min, design for 350°F and 79,000 acfm
2	0.0027	1.69	64,883	105,026	292	2.3	59.8		
3	0.0019	1.14	64,879	102,995	296	2.3	65.3		
Avg	0.0022	1.33	65,231	103,440	292	2.3	62.7		

Foundry NJ-3 (tested August 1991)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0048	12.7	306,488	390,656	213	3.5	87	2 cupolas with 64 tph capacity (only one operates at a time), afterburner, recuperative, below charge takeoff	Installed 1974, positive pressure, shaker, fiberglass fabric, air:cloth = 1.75 ft/min, design for 500°F and 195,000 acfm, controls melting
2	0.0055	11.2	238,254	305,489	217	2.7	67		
3	0.0026	3.5	159,297	211,491	241	1.9	88		
Avg	0.0043	8.9	234,680	304,017	224	2.7	81		
Foundry NJ-3 (tested September 1997)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)		
1	0.0012	3.06	219,000	263,000	175	2.4	80		
2	0.0023	1.89	220,100	282,000	216	1.9	90		
3	0.0014	2.99	240,200	316,000	235	2.8	75		
Avg	0.0016	2.6	226,433	287,000	209	2	82		
Foundry IN-34 (tested September 1997)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0026	0.71	32,100	45,000	231	1.2	53	80 tph capacity, afterburner, recuperative, below charge takeoff	Installed 1997, negative pressure, pulse jet, Nomex, air:cloth = 1.8 ft/min, design for 320°F and 70,000 acfm, controls melting and charging
2	<0.0003	<0.14	49,700	69,600	253	1.8	41		
3	0.0011	0.46	48,500	68,200	254	1.8	47		
Avg	<0.0013	<0.5	40,300	56,600	243	1.5	50		

Foundry VA-8 (tested January 1998)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0039	1.64	48,697	70,363	278	2.6	49	2 cupolas with 65 tph capacity (only one operates at a time), afterburner, recuperative, below charge takeoff	Installed 1997, negative pressure, pulse jet, Nomex, air:cloth = 3.74 ft/min, design for 375°F and 100,000 acfm, controls melting and charging
2	0.0028	1.14	47,588	69,934	281	2.6	51		
3	0.0026	1.08	48,934	72,472	283	2.7	53		
Avg	0.0031	1.29	48,407	70,923	281	2.6	51		
Foundry FL-6 (tested February 1998)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0028	0.52	21,976	35,420	246	0.9	17.7	22 tph capacity, afterburner, recuperative, above charge takeoff	Installed 1998, negative pressure, reverse air, fiberglass fabric, air:cloth = 1.68 ft/min, design for 460°F and 65,000 acfm, controls melting and charging
2	0.0031	0.67	25,178	42,114	266	0.7	19.8		
3	0.0051	1.11	25,288	41,495	272	0.7	25.1		
Avg	0.0037	0.77	24,147	39,676	261	0.8	20.9		
Foundry IA-19 (tested February 1998)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0026	0.92	41,861	58,271	245	4.2	13.5	20 tph capacity, afterburner, recuperative, below charge takeoff	Installed 1992, negative pressure, pulse jet, Nomex felt fabric, air:cloth = 5.1 ft/min, design for 450°F and 70,000 acfm, controls melting, charging, tapping
2	0.0015	0.58	46,281	63,363	233	4.6	13.5		
3	0.0022	0.90	46,811	64,433	238	4.7	13.5		
Avg	0.0021	0.80	44,984	62,022	239	4.5	13.5		

Foundry IN-35 (tested November 1997)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0044	1.71	45,055	66,407	213	4.1		22 tph capacity, afterburner, nonrecuperative, above charge takeoff	Installed 1997, positive pressure, pulse jet, Tuflex fabric, air:cloth = 4.65 ft/min, design for 400°F and 75,000 acfm, controls melting
2	0.0043	1.68	44,780	66,018	215	4.1			
3	0.0043	1.66	44,773	66,532	212	4.1			
Avg	0.0043	1.69	44,869	66,319	213	4.1			
Foundry SD-1 (tested March 1995)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0058	0.72	14,580	20,403	227	2.7	4.3	3.5 tph capacity, no afterburner, nonnonrecuperative, above charge takeoff	Installed 1994, negative pressure, pulse jet, 16 oz Nomex fabric, air:cloth = 3.96 ft/min, design for 400°F and 30,000 acfm, controls melting and charging
2	0.0035	0.48	16,008	21,992	216	2.9	4.3		
3	0.0047	0.62	15,336	21,567	231	2.9	6.4		
Avg	0.0046	0.61	15,308	21,321	225	2.8	5.0		
Foundry WI-49/50 (tested September 1995)									
Run	PM (gr/dscf)	PM (lb/hr)	Flow (dscfm)	Flow (acfm)	Temp (°F)	Air:cloth ratio (ft/min)	Melt rate (tph)	Cupola information	Baghouse information
1	0.0044	1.2	30,852	59,684	338	3.0	29.7	2 cupolas, 30 tph capacity, afterburner, recuperative, above charge takeoff	Installed 1994, negative pressure, pulse jet, woven fiberglas fabric, air:cloth = 2.4 to 3.7 ft/min, design for 450°F and 50,000 to 70,000 acfm, controls melting
2	0.0047	1.2	30,826	59,347	332	3.0	28.4		
3	0.0060	1.5	29,750	60,281	339	3.0	24.4		
Avg	0.0050	1.3	30,476	59,771	336	3.0	27.5		