United States
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Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

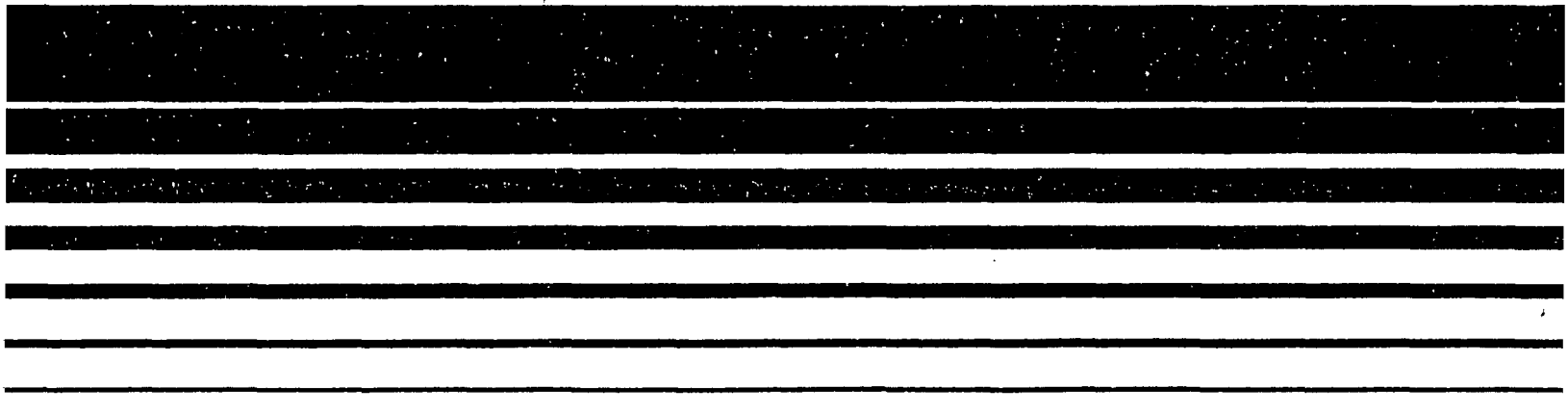
EMB Report 80-WFB-8
November 1980

Air

EPA

Nonfossil Fueled Boilers

Emission Test Report
Owens-Illinois
Forest Products Division
Big Island, Virginia



NONFOSSIL FUELED BOILERS

Emission Test Report
Owens-Illinois
Forest Products Division
Big Island, Virginia

22-26 September 1980

by

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EMISSION MEASUREMENT BRANCH
RESEARCH TRIANGLE PARK, NC 27711

CONTENTS

FIGURES

TABLES

SECTION 1

INTRODUCTION

The Big Island Paper Mill of Owens-Illinois, Inc., Forest Products Division, in Big Island, Virginia was emission tested by Monsanto Research Corporation (MRC) for the U.S. Environmental Protection Agency (EPA) under Contract No. 68-02-2818, Work Assignment No. 31. The purpose of testing the Big Island Mill was to gather data that could possibly be used to support the setting of standards of performance for the nonfossil fuel boiler industry; in this case, the production of process steam from firing wood bark in conjunction with coal. Particulate matter emissions were determined by simultaneous sampling of four points: inlets and outlets of control devices at two parallel boilers. The two boiler units sampled consisted of one firing 100% wood waste and another firing 100% coal. Each boiler is equipped with a multicyclone, the outlets of which feed a common exhaust duct. This exhaust duct is split into two equal streams, each equipped with a five-stage electrostatic precipitator (ESP).

The field test work was monitored by Dan Bivins, Field Testing Section, Emission Measurement Branch, EPA. The sampling performed by MRC was directed by Jesse R. McKendree as team leader. The Big Island Mill was sampled by MRC during the week of September 22-26, 1980. The sample collection methods employed were EPA Methods 1 through 5, and 9, and particulate sizing by Andersen cascade impactor.

Quality assurance/quality control in the sampling area covered such activities as instrument calibration, using standard or approved sampling methods, chain-of-custody procedures, and protocols for the recording and calculation of data. QA/QC in the analysis area involved using only validated analysis methods, periodic operator QC checking and training, sample QC by the use of splits, reference standards, and spikes, and interlaboratory audits.

SECTION 2

SUMMARY OF RESULTS

During this emission test, a total of three particulate matter emission runs were conducted simultaneously at four locations with two smoke readers taking opacity readings at each of the two electrostatic precipitator outlet stacks. The cyclone inlet and ESP outlet of boiler #4 are designated as the Trackside locations (because of their physical proximity to the railroad tracks at the plant), and the cyclone inlet and ESP outlet of boiler #5 are designated as the Riverside locations. The stack sampling procedure consisted of extracting four samples simultaneously for each test run, one from each multiclone inlet duct and one from each ESP outlet stack.

Boiler #4 (Trackside) was 100% coal-fired and boiler #5 (Riverside) was 100% wood-fired. Sootblowing is performed on both boilers at the beginning of each plant shift, at 7:00 a.m., 3:00 p.m., and 11:00 p.m. During this emission test, no sootblows were made during any of the three runs.

The normal operating mode of the two boilers sampled is to operate the Trackside (coal-fired) boiler at a constant loading, and to vary the Riverside (wood-fired) boiler loading with demand. This operating mode was continued during all three sampling runs. The output loading of the Riverside boiler varied from 140,000 to 210,000 lb steam/hr, while the Trackside boiler load varied from 55,000 to 75,000 lb steam/hr.

Emissions of particulate matter and stack gas parameters are summarized in Tables 1 and 2. All test runs were conducted within isokinetic variation limits. Post-test calibration of the console meters used at the ESP outlet locations indicated that gas volume measurement was out of calibration (change greater than 5%). The pre-test calibration gave the lower value of total sample volume; hence, it was used in the emission calculations, as described in Section 5.3 of the Federal Reference Method 5.

Simultaneous opacity readings were taken with particulate testing by a certified observer for each ESP outlet stack during each emission test. Summarized results of opacity readings are given in Table 3. Plume readings remained at 0% opacity for all runs with occasional periods of 1-5% opacity. Complete opacity results are furnished in Appendix C.

Integrated gas analysis results are given in Table 4; small amounts of CO (less than 0.1%) were detected at both inlet and outlet locations. A gas chromatograph with thermal conductivity detector was used for the analysis rather than an Orsat analyzer. Complete analytical results are given in Appendix D, with GC calibration results presented in Appendix F.

Particulate sizing by Andersen cascade impactor was done at the inlet and outlet of the Riverside emission control unit (wood-fired) and the outlet only of the Trackside (coal-fired) since uncontrolled emissions from coal-fired boilers have been well characterized. Results are presented in Table 5; at the Riverside inlet only two particle sizing runs are presented. The first two runs were well over isokinetic variation limits due to pressure head reading outside the magnehelic gage range; the last two runs are presented. Complete particle sizing results are given in Appendix B.

Samples of fuel were collected during each emission test run for ultimate analysis. Table 6 presents a summary of analysis results of the bark and coal fuels.

Plant operating data for each of three emission tests is summarized in Table 7. Complete operating data taken during testing is contained in Appendix E. The coal and bark feed rates given in Table 7 were not directly measured since the plant measures only daily use rates; the rates given were based on historical usage data as determined by plant operating personnel.

TABLE 1. PARTICULATE EMISSION DATA AND STACK GAS PARAMETERS, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 24-25, 1980 (ENGLISH UNITS)

Run number	Date	Time, min	Temperature, °F	Flow, dscfm	H_2O, percent	Isokinetic, percent	Emissions			
							Actual			Corrected to 12 percent CO_2
							gr/dscf	lb/hr	lb/mm Btu[a]	gr/dscf
Riverside inlet boiler #5										
1	9/24/80	98	324	80,824	12.19	96.3	2.2344	1,547.7	6.7695	2.5536
2	9/24/80	98	333	79,848	15.63	101.0	1.2146	831.1	4.3159	1.6948
3	9/25/80	98	328	75,399	13.04	95.0	1.2282	793.7	3.4320	1.4887
Average		98	328	78,690	13.62		1.5590	1,057.5	4.8391	2.1476
Trackside inlet boiler #4										
1	9/24/80	90	401	36,315	4.84	103.9	1.3823	430.2	6.0281	2.7193
2	9/24/80	90	413	35,679	5.31	100.9	1.7583	537.7	8.0329	3.7017
3	9/25/80	90	406	35,584	5.48	101.3	1.2250	373.6	4.7011	2.0137
Average		90	407	35,859	5.21		1.4552	447.2	6.2540	2.8116
Riverside outlet										
1	9/24/80	96	260	85,051	11.77	104.7	0.0366	26.7	0.1672	0.0699
2	9/24/80	96	339	84,481	12.70	106.5	0.0147	10.7	0.0486	0.0213
3	9/25/80	96	330	84,205	11.43	99.8	0.0208	15.0	0.0624	0.0430
Average		96	310	84,579	11.97		0.0240	17.5	0.0927	0.0447
Trackside outlet										
1	9/24/80	96	267	72,079	12.07	107.7	0.0244	15.1	0.0826	0.0327
2	9/24/80	96	347	75,509	9.27	103.9	0.0111	7.2	0.0355	0.0203
3	9/25/80	96	339	71,226	12.21	107.9	0.0056	3.4	0.0199	0.0091
Average		96	318	72,938	11.18		0.0137	8.6	0.0460	0.0207

[a]Calculated using F-factor method with F = 9,640 dscf/mm Btu for wood bark.

TABLE 2. PARTICULATE EMISSION DATA AND STACK GAS PARAMETERS, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 24-25, 1980 (METRIC UNITS)

Run number	Date	Time, min	Temperature, °C	Flow, dncmpm	H_2O, percent	Isokinetic, percent	Emissions			
							Actual			Corrected to 12 percent CO_2
							gr/dncm	kg/hr	kg/GJ[a]	gr/dncm
Riverside inlet boiler #5										
1	9/24/80	98	162	2,289	12.19	96.3	5.1143	702.0	2.911	5.8449
2	9/24/80	98	167	2,261	15.63	101.0	2.7800	377.0	1.856	3.8791
3	9/25/80	98	164	2,135	13.04	95.0	2.8113	360.0	1.476	3.4076
Average		98	164	2,228	13.62		3.5685	479.7	2.081	4.3772
Trackside inlet boiler #4										
1	9/24/80	90	205	1,028	4.84	103.9	3.1640	195.1	2.592	6.2243
2	9/24/80	90	211	1,010	5.31	100.9	4.0247	243.9	3.454	8.4731
3	9/25/80	90	208	1,008	5.48	101.3	2.8040	169.5	2.021	4.6093
Average		90	208	1,015	5.21		3.3309	202.8	2.689	6.4356
Riverside outlet										
1	9/24/80	96	127	2,409	11.77	104.7	0.0838	12.1	0.0719	0.1596
2	9/24/80	96	170	2,393	12.70	106.5	0.0338	4.8	0.0209	0.0488
3	9/25/80	96	165	2,385	11.43	99.8	0.0475	6.8	0.0268	0.0983
Average		96	154	2,396	11.97		0.0550	7.9	0.0399	0.1022
Trackside outlet										
1	9/24/80	96	130	2,041	12.07	107.7	0.0559	6.8	0.0355	0.0762
2	9/24/80	96	175	2,138	9.27	103.9	0.0253	3.2	0.0153	0.0349
3	9/25/80	96	171	2,017	12.21	107.9	0.0129	1.6	0.0086	0.0770
Average		96	159	2,065	11.18		0.0314	3.9	0.0198	0.0627

[a]Calculated using F-factor method with F = 263.3 dncm/GJ for wood bark.

TABLE 3. SUMMARY OF VISIBLE EMISSIONS, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 24-25, 1980

Owens-Illinois, Run R-1

Date: 9-24-80
Type of Discharge: Stack
Height of Point of Discharge: 190 ft
Wind Direction: North
Color of Plume: Black
Observer Name: J. Hoeflein
Distance from Observer to Discharge Point: 500 yds
Direction of Observer from Discharge Point: South
Height of Observation Point: Ground level

Type of Plant: Paper Mill
Location of Discharge: Riverside stack
Description of Sky: Overcast
Wind Velocity: 5-10 mph
Detached Plume: No
Duration of Observation: 145 min

Summary of avarage opacity

Set number	Time Start	Time End	Opacity Sum	Opacity Average
Test began				
1	12:06	12:11	0.0	0.0
2	12:12	12:17	0.0	0.0
3	12:18	12:73	0.0	0.0
4	12:24	12:29	0.0	0.0
5	12:35	12:40	10.0	0.4
6	12:41	12:46	0.0	0.0
7	12:47	12:52	0.0	0.0
8	12:53	12:58	0.0	0.0
9	12:59	13:04	0.0	0.0
10	13:05	13:40	0.0	0.0
11	13:11	13:16	0.0	0.0
12	13:17	13:22	0.0	0.0
13	13:13	13:28	0.0	0.0
14	13:29	13:34	35.0	1.6
15	13:35	13:40	0.0	0.0
16	13:41	13:46	0.0	0.0
17	13:47	13:52	0.0	0.0
18	13:53	13:58	0.0	0.0
19	13:59	14:04	0.0	0.0
20	14:05	14:10	0.0	0.0
21	14:11	14:16	0.0	0.0
22	14:17	14:22	0.0	0.0
Test ended				
Average, all sets				0.08%

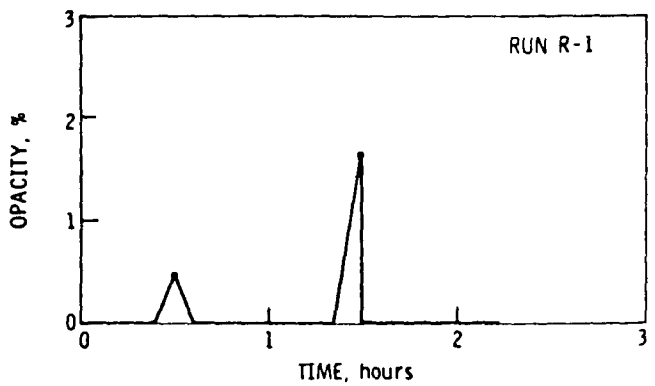

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TABLE 3 (continued)

Owens-Illinois, Run R-2

Date:	9 24 80	Type of Plant:	Paper Mill
Type of Discharge:	Stack	Location of Discharge:	Riverside stack
Height of Point of Discharge:	190 ft	Description of Sky:	Overcast
Wind Direction:	NE	Wind Velocity:	5-12 mph
Color of Plume:	Reddish	Detached Plume:	No
Observer Name:	J. Hoeflein	Duration of Observation:	90 min
Distance from Observer to Discharge Point:	150 yds		
Direction of Observer from Discharge Point:	S-W		
Height of Observation Point:	Ground level		

Summary of avarage opacity

Set number	Time Start	Time End	Opacity Sum	Opacity Average
1	17:01	17:06	40.0	1.7
2	17:07	17:12	25.0	1.0
3	17:13	17:18	0.0	0.0
4	17:19	17:24	0.0	0.0
5	17:25	17:30	0.0	0.0
Test began				
6	17:31	17:36	0.0	0.0
7	17:37	17:42	0.0	0.0
8	17:43	17:48	0.0	0.0
9	17:49	17:54	0.0	0.0
10	17:55	18:00	0.0	0.0
11	18:01	18:06	0.0	0.0
12	18:07	18:12	0.0	0.0
13	18:13	18:18	0.0	0.0
14	18:19	18:24	0.0	0.0
15	18:25	18:30	0.0	0.0
Reading stopped				
Average, all sets				0.18%

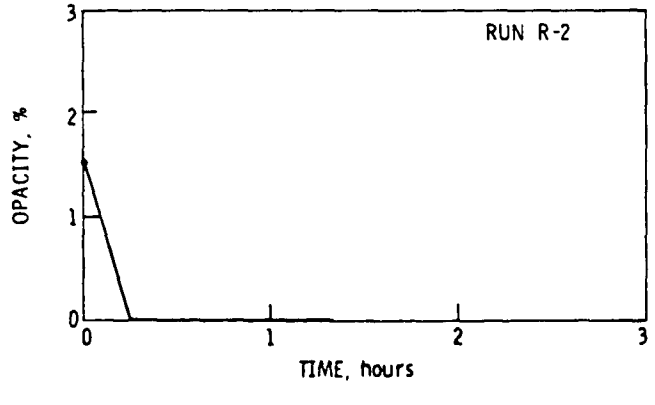

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TABLE 3 (continued)

Owens-Illinois, Run R-3

Date: 9/25/80
Type of Discharge: Stack
Height of Point of Discharge: 190 ft
Wind Direction: SW
Color of Plume: Black
Observer Name: J. Hoeflein
Distance from Observer to Discharge Point: 500 yds
Direction of Observer from Discharge Point: South
Height of Observation Point: Ground level

Type of Plant: Paper Mill
Location of Discharge: Riverside stack
Description of Sky: Overcast
Wind Velocity: 5-10 mph
Detached Plume: No
Duration of Observation: 175 min

Summary of avarage opacity

Set number	Time Start	Time End	Opacity Sum	Opacity Average
1	11:30	11:35	0.0	0.0
2	11:36	11:41	0.0	0.0
3	11:42	11:47	0.0	0.0
4	11:48	11:53	0.0	0.0
5	11:54	11:59	0.0	0.0
Test began				
6	12:06	12:11	0.0	0.0
7	12:12	12:17	0.0	0.0
8	12:18	12:23	0.0	0.0
9	12:24	12:29	0.0	0.0
10	12:30	12:35	0.0	0.0
11	12:36	12:41	0.0	0.0
12	12:42	12:47	25.0	1.0
13	12:48	12:53	0.0	0.0
14	12:54	12:59	0.0	0.0
15	13:00	13:05	0.0	0.0
16	13:06	13:11	0.0	0.0
17	13:12	13:17	0.0	0.0
18	13:18	13:23	0.0	0.0
19	13:24	13:29	0.0	0.0
20	13:30	13:35	0.0	0.0
21	13:36	13:41	0.0	0.0
22	13:42	13:47	0.0	0.0
23	13:48	13:53	0.0	0.0
24	13:54	13:59	0.0	0.0
25	14:00	14:05	0.0	0.0
26	14:06	14:11	0.0	0.0
27	14:12	14:17	0.0	0.0
28	14:18	14:23	0.0	0.0
29	14:24	14:29	0.0	0.0
Test ended				
Average, all sets				0.03%

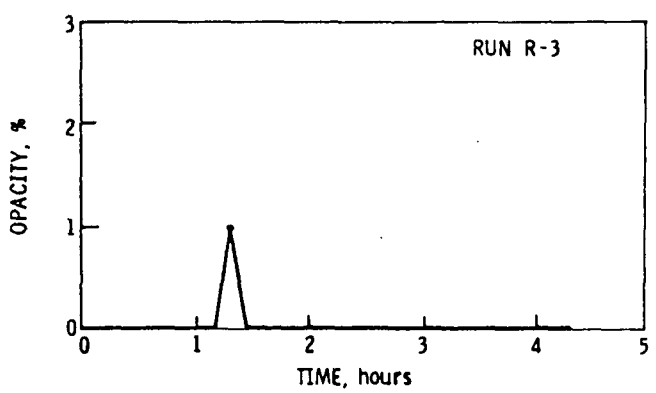

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TABLE 3 (continued)

Owens-Illinois, Run T-1

Date: 9/24/80
Type of Discharge: Stack
Height of Point of Discharge: 190 ft
Wind Direction: N
Color of Plume: Black
Observer Name: C. Clark
Distance from Observer to Discharge Point: 500 yds
Direction of Observer from Discharge Point: South
Height of Observation Point: Ground level

Type of Plant: Paper Mill
Location of Discharge: Trackside stack
Description of Sky: Scattered clouds
Wind Velocity: 0-5 mph
Detached Plume: No
Duration of Observation: 120 min

Summary of avarage opacity

Set number	Time Start	Time End	Opacity Sum	Opacity Average
Test began				
1	12:05	12:10	0.0	0.0
2	12:11	12:16	0.0	0.0
3	12:17	12:22	0.0	0.0
4	12:23	12:28	0.0	0.0
5	12:29	12:34	0.0	0.0
6	12:35	12:40	0.0	0.0
7	12:41	12:46	0.0	0.0
8	12:47	12:52	35.0	1.5
9	12:53	12:58	0.0	0.0
10	12:59	13:04	5.0	0.2
11	13:05	13:10	0.0	0.0
12	13:11	13:16	0.0	0.0
13	13:17	13:22	0.0	0.0
14	13:23	13:28	0.0	0.0
15	13:29	13:34	0.0	0.0
16	13:35	13:40	0.0	0.0
17	13:41	13:46	0.0	0.0
18	13:47	13:52	0.0	0.0
19	13:53	13:58	0.0	0.0
20	13:59	14:04	0.0	0.0
Test ended				
Average, all sets				0.09%

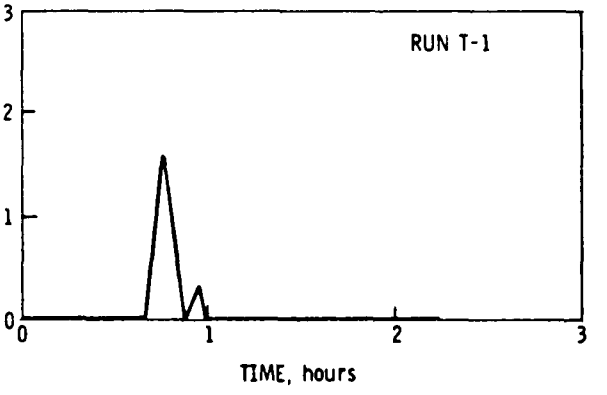

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TABLE 3 (continued)

Owens-Illinois, Run T-2

Date: 9/24/80
Type of Discharge: Stack
Height of Point of Discharge: 190 ft
Wind Direction: NE
Color of Plume: Reddish
Observer Name: C. Clark
Distance from Observer to Discharge Point: 150 yds
Direction of Observer from Discharge Point: South-West
Height of Observation Point: Ground level

Type of Plant: Paper Mill
Location of Discharge: Trackside stack
Description of Sky: Overcast
Wind Velocity: 5-10 mph
Detached Plume: No
Duration of Observation: 90 min

Summary of avarage opacity

Set number	Time Start	Time End	Opacity Sum	Opacity Average
Test began				
1	17:01	17:06	110.0	4.6
2	17:07	17:12	5.0	0.2
3	17:13	17:18	0.0	0.0
4	17:19	17:24	0.0	0.0
5	17:25	17:30	0.0	0.0
6	17:31	17:36	0.0	0.0
7	17:37	17:42	0.0	0.0
8	17:43	17:48	0.0	0.0
9	17:49	17:54	0.0	0.0
10	17:55	18:00	0.0	0.0
11	18:01	18:06	0.0	0.0
12	18:07	18:12	0.0	0.0
13	18:13	18:18	0.0	0.0
14	18:19	18:24	0.0	0.0
15	18:25	18:30	0.0	0.0
Reading stopped				
Average, all sets				0.3%

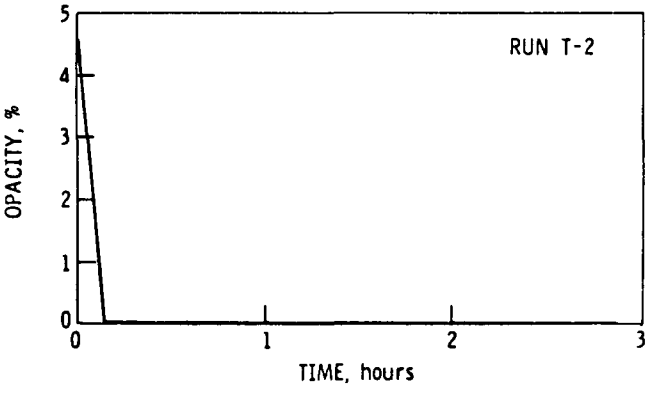

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TABLE 3 (continued)

Owens-Illinois, Run T-3

Date: 9/25/80
Type of Discharge: Stack
Height of Point of Discharge: 190 ft
Wind Direction: NW
Color of Plume: Black
Observer Name:
Distance from Observer to Discharge Point: 500 yds
Direction of Observer from Discharge Point: South
Height of Observation Point: Ground level

Type of Plant: Paper Mill
Location of Discharge: Trackside stack
Description of Sky: Overcast
Wind Velocity: 5-10 mph
Detached Plume: No
Duration of Observation: 175 min

Summary of avarage opacity

Set number	Time Start	Time End	Opacity Sum	Opacity Average
1	11:30	11:35	0.0	0.0
2	11:36	11:41	0.0	0.0
3	11:42	11:47	0.0	0.0
4	11:48	11:53	0.0	0.0
5	11:54	11:59	0.0	0.0
Test began				
6	12:06	12:11	0.0	0.0
7	12:12	12:17	0.0	0.0
8	12:18	12:23	0.0	0.0
9	12:24	12:29	0.0	0.0
10	12:30	12:35	0.0	0.0
11	12:36	12:41	0.0	0.0
12	12:42	12:47	0.0	0.0
13	12:48	12:53	0.0	0.0
14	12:54	12:59	0.0	0.0
15	13:00	13:05	0.0	0.0
16	13:06	13:11	0.0	0.0
17	13:12	13:17	0.0	0.0
18	13:18	13:23	0.0	0.0
19	13:24	13:29	0.0	0.0
20	13:30	13:35	0.0	0.0
21	13:36	13:41	0.0	0.0
22	13:42	13:47	0.0	0.0
23	13:48	13:53	0.0	0.0
24	13:54	13:59	0.0	0.0
25	14:00	14:05	0.0	0.0
26	14:06	14:11	0.0	0.0
27	14:12	14:17	0.0	0.0
28	14:18	14:23	0.0	0.0
29	14:24	14:29	0.0	0.0
Test ended				
Average, all sets				0.0%

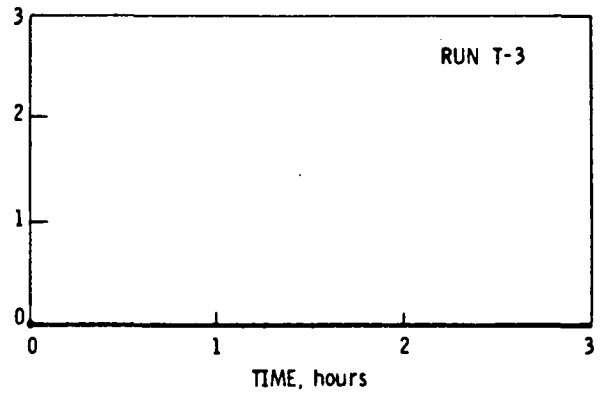


TABLE 4. SUMMARY OF INTEGRATED GAS ANALYSES, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 24-25, 1980

Run number	Date	CO_2, percent	O_2, percent	CO, percent	N_2, percent	MW, lb/lb mole
Riverside inlet boiler #5						
1	9/24/80	10.5	11.4	0.10	78.0	30.39
2	9/24/80	8.6	12.8	0.08	78.5	29.89
3	9/25/80	9.9	10.6	0.07	79.4	30.00
Average		9.7	11.6	0.08	78.6	30.09
Trackside inlet boiler #4						
1	9/24/80	6.1	14.3	0.04	79.5	29.55
2	9/24/80	5.7	14.6	0.0	79.7	29.48
3	9/25/80	7.3	13.4	0.0	79.4	29.69
Average		6.4	14.1	0.01	79.5	29.57
Riverside outlet						
1	9/24/80	6.3	14.6	0.04	79.1	29.54
2	9/24/80	8.3	12.2	0.04	79.4	29.82
3	9/25/80	5.8	11.3	0.03	82.9	29.62
Average		6.8	12.7	0.04	80.5	29.66
Trackside outler						
1	9/24/80	8.8	12.4	0.04	78.7	29.91
2	9/24/80	8.7	11.9	0.04	79.4	29.86
3	9/25/80	7.4	12.8	0.03	79.8	29.70
Average		8.3	12.4	0.04	79.3	29.82

TABLE 5. SUMMARY OF ANDERSEN PARTICLE SIZING RESULTS, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 24-25, 1980

Riverside ESP outlet

Run RO-1			Run RO-2			Run RO-3		
Flow rate (ACFM): 0.32			Flow rate (ACFM): 0.31			Flow rate (ACFM): 0.32		
Percent ISO: 106.0			Percent ISO: 90.0			Percent ISO: 96.4		
Percent in size range	Cumulative percent less than size range	Size range, microns	Percent in size range	Cumulative percent less than size range	Size range, microns	Percent in size range	Cumulative percent less than size range	Size range, microns
88.6	11.4	>19.0	12.0	88.0	>19.5	14.2	85.8	>19.0
2.4	9.1	11.8 - 19.0	6.3	82.8	12.1 - 19.5	1.8	84.0	11.8 - 19.0
1.9	7.2	8.1 - 11.8	1.9	79.9	8.2 - 12.1	1.8	82.1	8.1 - 11.8
1.9	5.3	5.3 - 8.1	2.5	77.4	5.6 - 8.2	5.1	77.1	5.3 - 8.1
1.2	4.2	3.55 - 5.3	0.0	77.4	3.6 - 5.6	3.7	73.4	3.55 - 5.3
1.0	3.1	1.75 - 3.55	2.5	74.8	1.8 - 3.6	21.6	51.9	1.75 - 3.55
0.5	2.6	1.1 - 1.75	10.7	64.2	1.1 - 1.8	26.6	25.3	1.1 - 1.75
0.9	1.8	0.76 - 1.1	40.9	23.3	0.78 - 1.10	8.3	17.0	0.76 - 1.1
1.8	0	0 - 0.76	23.3	0	0 - 0.78	17.0	0	0 - 0.76

Trackside ESP outlet

Run TO-1			Run TO-2			Run TO-3		
Flow rate (ACFM): 0.26			Flow rate (ACFM): 0.30			Flow rate (ACFM): 0.29		
Percent ISO: 107.5			Percent ISO: 107.3			Percent ISO: 107.3		
Percent in size range	Cumulative percent less than size range	Size range, microns	Percent in size range	Cumulative percent less than size range	Size range, microns	Percent in size range	Cumulative percent less than size range	Size range, microns
25.7	74.3	>21.3	7.2	92.8	>19.5	54.1	45.9	>19.9
2.8	71.5	13.3 - 21.3	7.2	85.6	12.3 - 19.5	2.7	43.2	12.5 - 19.9
1.7	69.8	9.1 - 13.3	2.4	83.2	8.4 - 12.3	5.4	37.8	8.5 - 12.5
1.7	68.2	6.2 - 9.1	3.2	80.0	5.7 - 8.4	0.0	37.8	5.8 - 8.5
6.2	62.0	3.95 - 6.2	6.4	73.6	3.65 - 5.7	0.0	37.8	3.7 - 5.8
5.6	56.4	2.0 - 3.95	4.0	69.6	1.8 - 3.65	2.7	35.1	1.85 - 3.7
15.1	41.3	1.25 - 2.0	0.8	68.8	1.13 - 1.8	5.4	29.7	1.15 - 1.85
24.6	16.8	0.85 - 1.25	19.2	49.6	0.79 - 1.13	5.4	24.3	0.80 - 1.15
16.8	0	0 - 0.85	49.6	0	0 - 0.79	24.3	0	0 - 0.80

TABLE 5 (continued)

Riverside ESP inlet					
Run RI-3			Run RI-4		
Flow rate (ACFM): 0.18 Percent ISO: 80.9			Flow rate (ACFM): 0.20 Percent ISO: 85.9		
Percent in size range	Cumulative percent less than size range	Size range, microns	Percent in size range	Cumulative percent less than size range	Size range, microns
86.7	13.3	>23.0	69.8	30.2	>22.0
0.0	13.3	15.9-23.0	1.7	28.5	15.0-22.0
1.0	12.2	10.8-15.9	2.4	26.1	10.3-15.0
1.6	10.6	7.3-10.8	2.2	23.9	7.0-10.3
2.4	8.2	4.8-7.3	2.6	21.3	4.5-7.0
1.3	6.9	2.4-4.8	5.3	16.0	2.25-4.5
2.1	4.8	1.48-2.4	4.6	11.4	1.4-2.25
0.9	3.9	1.05-1.48	3.7	7.7	0.97-1.4
3.9	0	0-1.05	7.7	0	0-0.97

TABLE 6. SUMMARY OF FUEL ULTIMATE ANALYSES, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 23-25, 1980[a]

Sample number	Date	Carbon, percent	Hydrogen, percent	Nitrogen, percent	Sulfur, percent	Ash percent	Oxygen, percent	Fuel value, Btu/lb
Trackside coal bin boiler #4								
Run 1	9/24/80							
as received		76.86	5.01	1.37	0.56	6.18	10.02	13,786
dry basis		79.37	4.81	1.41	0.58	6.38	7.45	14,235
Run 2	9/24/80							
as received		74.35	4.90	1.21	0.90	7.48	11.16	13,461
dry basis		77.38	4.65	1.26	0.94	7.79	7.99	14,009
Run 3	9/25/80							
as received		74.99	5.07	1.35	0.57	6.82	11.19	13,492
dry basis		78.56	4.79	1.42	0.60	7.14	7.49	14,134
Riverside bark screw feeder boiler #5								
Run 1	9/24/80							
as received		26.00	7.95	0.10	0.01	2.76	63.18	4,542
dry basis		45.66	5.56	0.17	0.02	4.83	43.75	7,980
Run 2	9/24/80							
as received		25.66	8.06	0.12	0.02	2.57	63.56	4,482
dry basis		45.78	5.68	0.21	0.03	4.59	43.71	7,995
Run 3	9/25/80							
as received		28.05	7.88	0.16	0.02	2.33	61.56	4,949
dry basis		46.35	5.77	0.26	0.04	3.85	43.73	8,179

[a]Numbers represent an average of samples taken at the start, middle, and end of sampling runs.

TABLE 7. AVERAGE BOILER OPERATING PARAMETERS DURING TESTING, OWENS-ILLINOIS, BIG ISLAND, VIRGINIA, SEPTEMBER 24-25, 1980

Boiler	Test 1	Test 2	Test 3
Date	9/24/80	9/24/80	9/25/80
Boiler test time, min	1205-1630	1700-1930	1205-1530
Fuel oil feed rate, gal/hr	5.2	5.2	2.3
Boiler #4 (Trackside)			
Steam production, 10^3 lb/hr	67.0	68.0	67.0
Steam pressure, psig	-[b]	-[b]	-[b]
Steam temperature	-[b]	-[b]	-[b]
Coal feed rate, ton/hr[a]	5.7	5.7	5.4
Boiler #5 (riverside)			
Steam production, 10^3 lb/hr	174.0	176.0	176.0
Steam pressure, psig	583	597	597
Steam temperature, °F	708	712	708
Bark feed rate, ton/hr[a]	28.2	28.2	21.9

[a]Calculated by plant personnel based on 24-hour period; estimated to be within ±1 ton/hr.

[b]Data not taken.

SECTION 3

PROCESS DESCRIPTION

The Big Island Mill manufactures paper products, and operates three boilers for process steam, two of which are in operation at all times. The third boiler is on secondary status. Boiler #3 uses wood bark and sawdust as fuel, is normally on standby, and has a design capacity of 60,000 lb steam per hour. The operating boilers are Boiler #4 (Trackside boiler) which is a Combustion Engineering, Inc. pulverized coal dry bottom boiler with a design capacity of 140,000 lb steam per hour and Boiler #5 (Riverside boiler) which is a Foster Wheeler stoker-grate coal or refuse boiler with a design capacity of 200,000 lb steam per hour. The Riverside boiler was historically fired with 80% coal, 20% bark, but that ratio has been switched as the plant burns as much bark as possible now--up to 100% bark in the Riverside boiler.

Each boiler is exhausted to Zurn multicyclone units (type MTSA), installed in 1970 and 1971, then ducted to a common duct which leads to a pair of United McGill electrostatic precipitators, as shown in Figure 1. There is not complete mixing of exhaust gases from the Trackside and Riverside boilers since the common duct is very straight between the two exhaust path junction points. The twin ESP's contain ten fields, five on each side, and are designed to handle a flow of 300,000 acfm. Installed in 1978, the twin ESP's exhaust to a pair of stacks which terminate 190 ft above ground level.

The plant is located between railroad tracks and the James River; hence, the two precipitators are designated the Riverside unit and Trackside unit, respectively.

The plant operations are best termed as continuous. The schedule is based on 24 hours a day operation, seven days a week.

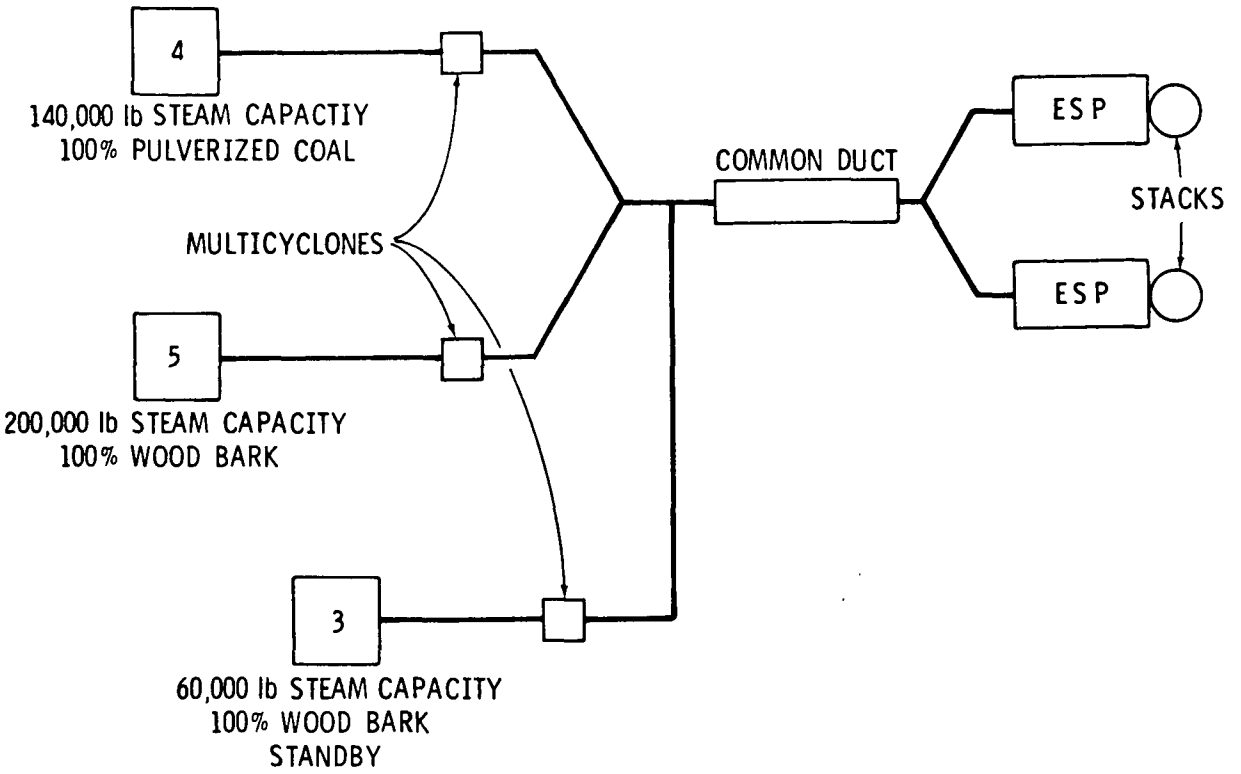


Figure 1. Schematic diagram of boilers at Owens-Illinois, Forest Product Division, Big Island, Virginia.

SECTION 4

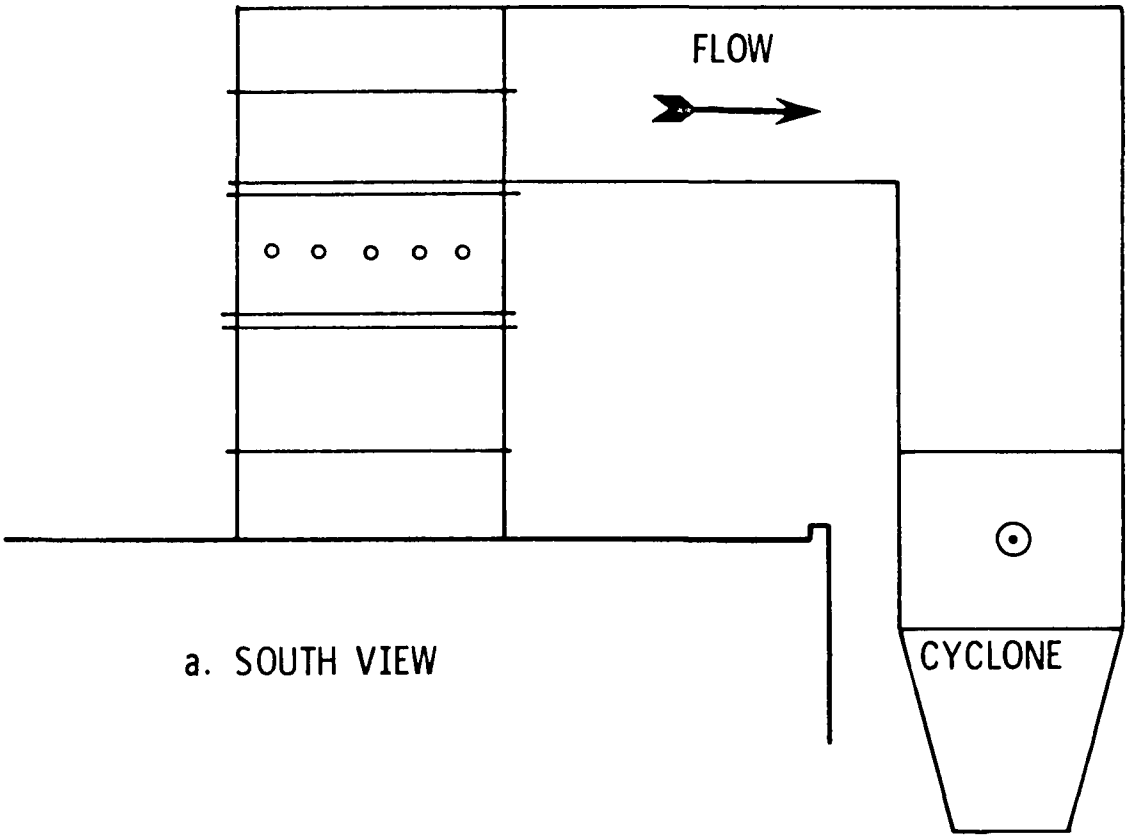
LOCATION OF SAMPLING POINTS

As a result of the pretest survey, the sampling program included the inlets to the multicyclone units of boilers #4 and #5 and the outlets of the ESP units at the stack platform. Simultaneous sampling for particulates using EPA Method 5 was performed at the four locations. The common duct leading to the ESP units branched and had existing sampling ports but was eliminated from consideration in this program due to the proximity of disturbances.

Sampling ports at the inlet of the cyclone on boiler #4 were utilized as is. The duct leading to the multicyclones was rectangular and measured 74 in. by 98 in. with five 4 in. capped ports installed 81 inches above floor level in the 98 in. face. The direction of flow when facing the port was upward. The nearest upstream disturbance was approximately one duct diameter away and the nearest downstream disturbance was also one duct diameter away. Figure 2 illustrates the duct configuration of the Trackside inlet sampling location.

Sampling ports for boiler #5 cyclone inlet were installed by a local contractor prior to the test. This location had seven 4 in. flanged ports unevenly spaced in a 116 in. by 122 in. rectangular duct. Figure 3 illustrates the duct configuration of the Riverside inlet sampling location. The nearest disturbances were two duct diameters upstream and one diameter downstream. The U-shaped ductwork resulted in a gas flow pattern which was not cyclonic but tended to stay close to the outside edge of the U-shape.

The twin ESP outlet locations were circular stacks, 84 in. diameter, each with two 4 in. ports at 90° from each other. The top of the stack was 2-1/2 diameters downstream and the nearest upstream disturbance was an expansion one diameter away. Figures 4 and 5 illustrate side and top views of the outlet locations, respectively.



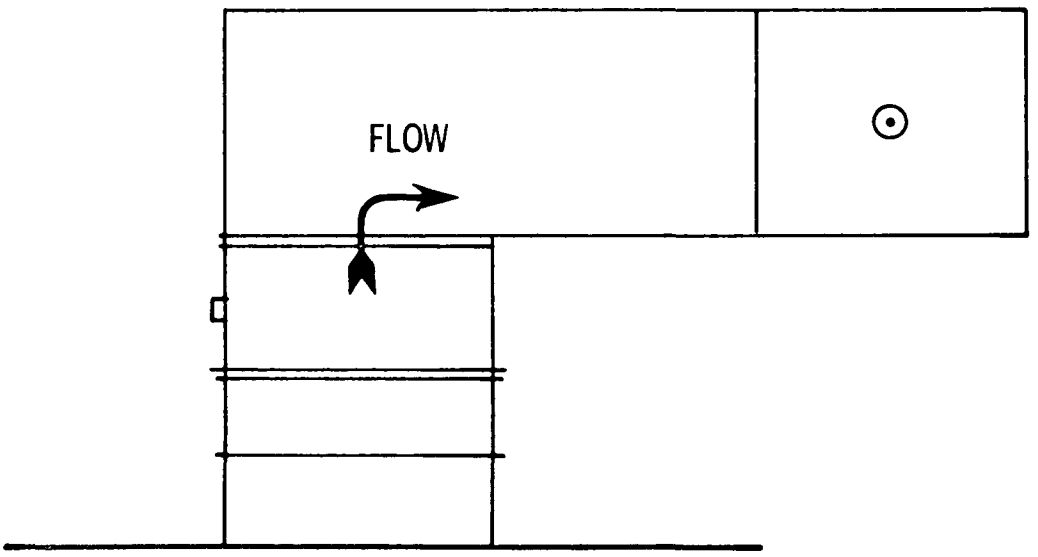


Figure 2. Inlet to boiler #4 multicyclones, Owens-Illinois, Big Island, Virginia.

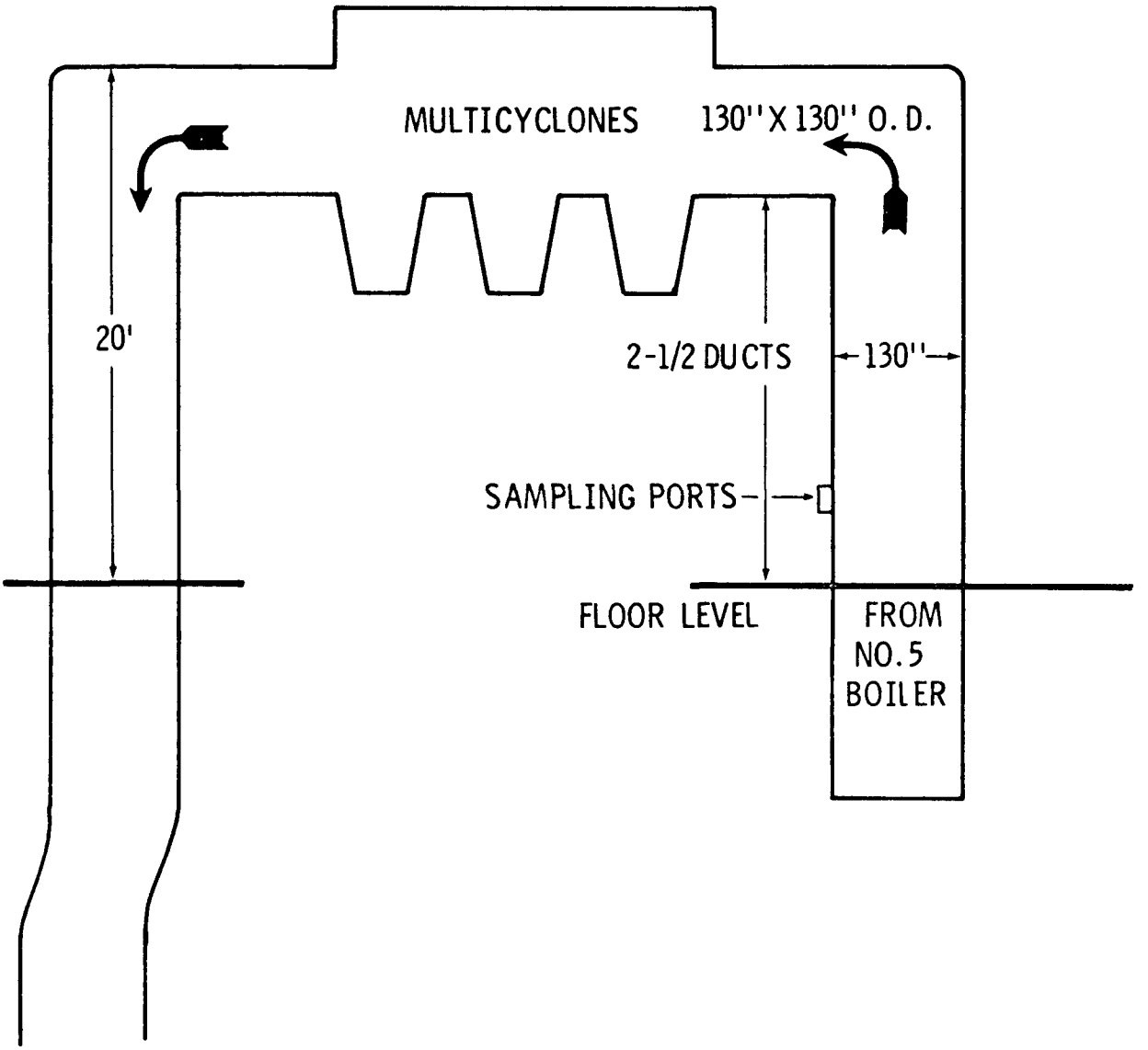


Figure 3. Inlet to boiler #5 multicyclones, East view, Owens-Illinois, Big Island, Virginia.

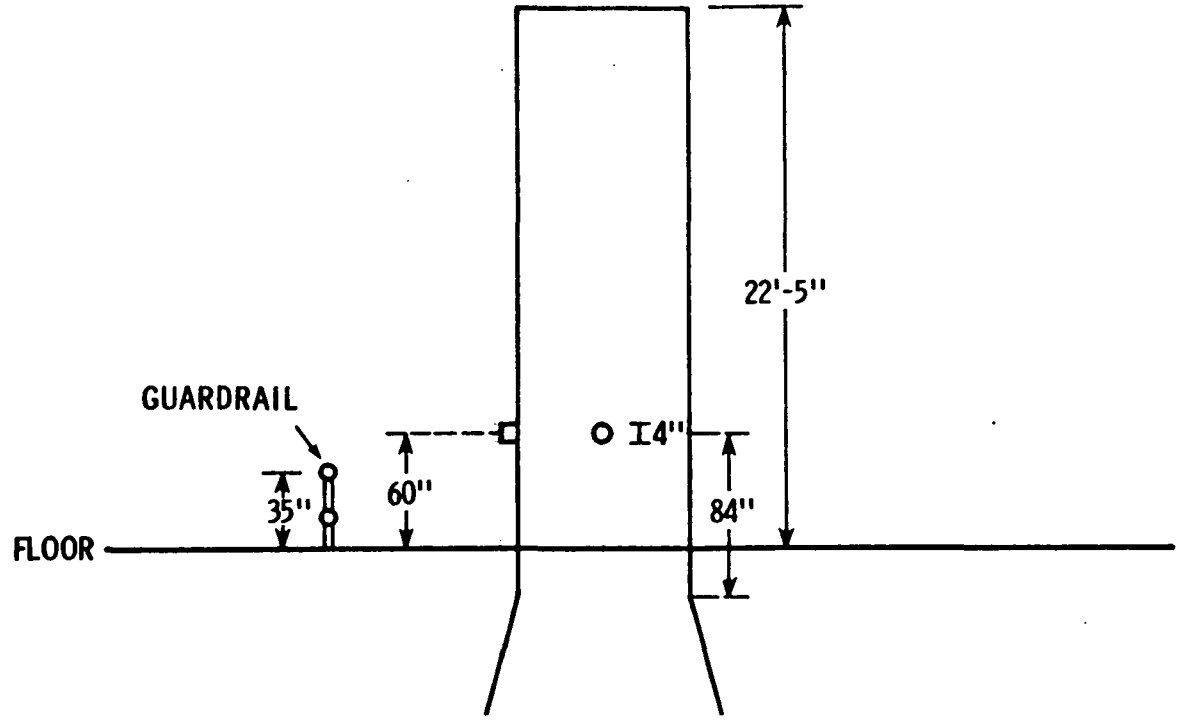


Figure 4. Side view of ESP outlet sampling location, Owens-Illinois, Big Island, Virginia.

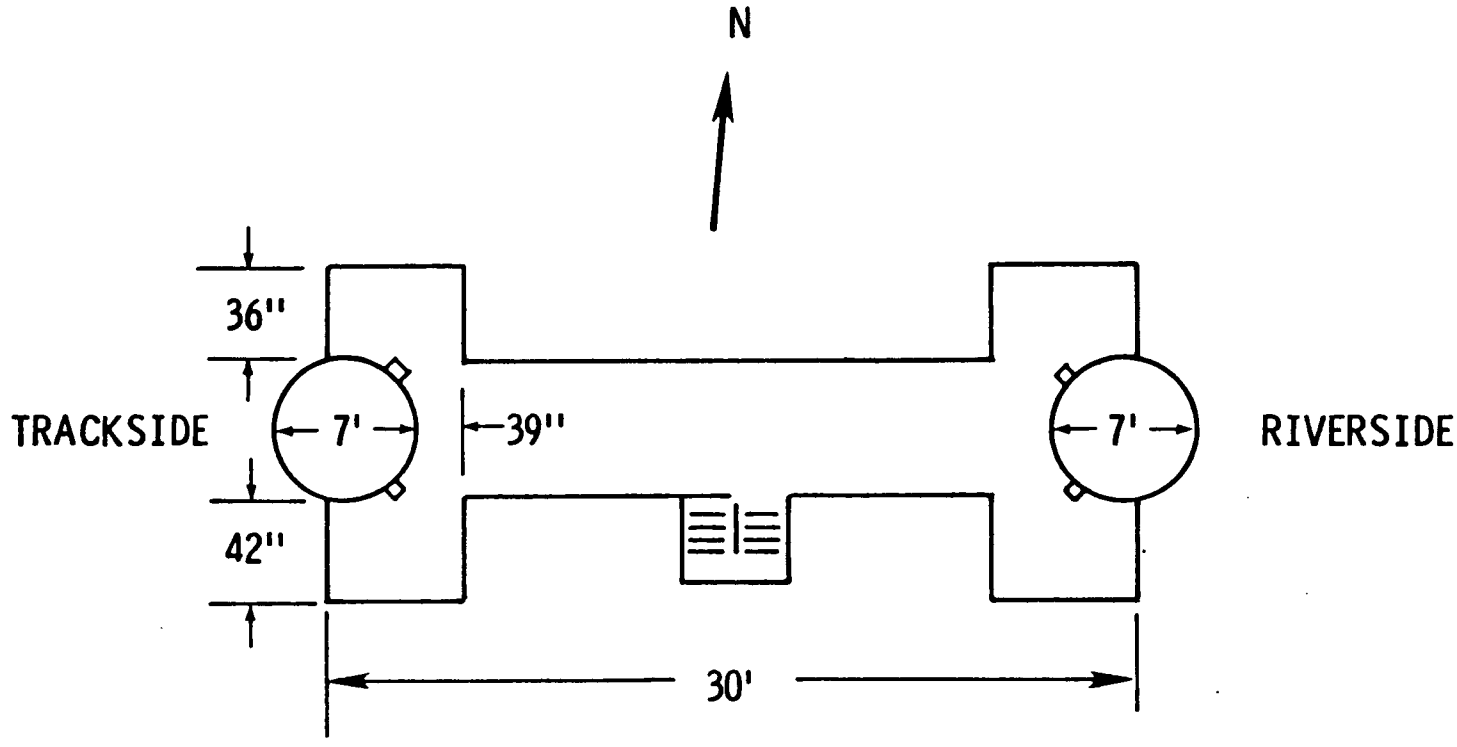


Figure 5. Top view of ESP outlet sampling location, Owens-Illinois, Big Island, Virginia.

SECTION 5

SAMPLING AND ANALYTICAL PROCEDURES

The Owens-Illinois Big Island Mill was sampled for particulate matter, particle size, opacity, integrated gas analysis, and fuel analysis.

The following describes the methods used.

Sampling Procedures

Particulate Matter--

Sampling for particulates was performed using the method outlined in the Federal Register, Method 5, "Determination of Particulate Emissions from Stationary Sources," modified so that the sample box temperature was 325°F instead of 250°F. A glass-lined probe was used at the Riverside inlet sampling location, and all other locations used stainless steel probes. A six-step cleanup is used on stainless steel probes and a three-step cleanup is used on glass-lined probes. Pre-filter cyclones were also used on all Method 5 trains at the inlet locations.

Particle Size--

Sampling for particle size was performed using an Andersen cascade impactor with seven stages and a back-up filter.

The sampling train used consisted of the following equipment listed in order of the flow: a 10-mm diameter probe tip; a curved (90°C) probe tip to Andersen head connector; standard Andersen heads; a stainless steel probe; a Smith-Greenburg impinger with water, then one charged with color indicating silica gel; and an EPA-5 console equipped with a dry gas meter, digital electronic thermometer and an inclined manometer. Also, an S-type pitot tube was connected to the probe so the stack pressure could be continually monitored. A 10-ft glass-lined probe with pre-separator was used at the Riverside inlet sampling location, and 5 ft stainless steel probes without preseparators were used at the outlet locations.

A total of 3 particle sizing runs were made simultaneously at the Riverside inlet location and both outlet locations. Each run was conducted for 5 minutes under isokinetic conditions at the Riverside inlet location and from 16 to 30 minutes at the stack outlets. At the completion of each run, the moisture collected was measured and the Andersen heads were opened and oven-dried for three hours. After drying, each stage was weighed, then the filter was removed and the stage assemblies were cleaned, desiccated and reweighed to provide partial tare weights. The tare weights of the filters were taken during the assembly of the heads (after desiccation for 24 hours).

All weight measurements were made with a Mettler analytical balance. The balance was calibrated daily and rezeroed before each weight determination. Calculations were performed using the methods and tables provided in the Andersen manual.

Opacity--
Visible emissions of each outlet stack were read during particulate sampling by a certified smoke reader who met the specification of Federal Register, Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources."

Integrated Gas Analysis--
Exhaust gas sampling was performed using the multi-point, integrated sampling method outlined in the Federal Register, Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight."

Fuel--
Fuel samples were grabbed in 1-liter nalgene bottles from the coal bins feeding boiler #4 and the bark screw feeder to boiler #5 just prior, during, and just after each test run.

Analytical Procedures

Particulate Matter--
Analytical procedures were performed using the methods described in EPA Method 5, previously mentioned in the sampling procedures section.

Integrated Gas Analysis--
Samples collected using a Tedlar bag were analyzed on site using direct injection into a gas chromatograph with a thermal conductivity detector (GC/TCE). The instrument was zeroed with prepurified nitrogen as a zero gas. Each gas analyzed (CO_2, O_2, and CO) had three calibration gas concentrations which spanned the probable concentrations in the exhaust gas. For O_2 calibration, NBS traceable cylinders containing 5% O_2, 9.99% O_2 and air (20.9% O_2) were used. For CO_2 calibration, NBS traceable cylinders containing 10.2% CO_2, 1.008% CO_2, and zero gas (N_2) were used. For CO calibration, cylinders containing 9,600 ppm CO, 5,000 ppm CO, and zero

gas (N_2) were used. The instrument was calibrated immediately before each sample run, and, in accordance with MRC's QA/QC manual, triplicate sample injections were made for each run.

Fuel--
Analysis of the coal and bark feed was performed using ASTM D 3178 for carbon and hydrogen, ASTM D 3176 for oxygen, ASTM D 3179 for nitrogen, ASTM D 3177 for sulfur, and ASTM D 3174 for ash. Fuel value was determined using ASTM D 2015.

Quality Assurance/Quality Control--
Results of quality control tests are furnished with the analytical data sheets provided in Appendix E, specifically calibration runs for integrated gas analyses and equipment calibration sheets.