SOURCE TESTING STUDY
AT AN
IRON ORE BENEFICIATION FACILITY

EVELETH TACONITE COMPANY
EVELETH, MINNESOTA

REPORT NO. 76-IOB-3

TESTING CONDUCTED BY THE
EMISSION MEASUREMENT BRANCH
O A Q P S
E P A

November 17 to 21, 1975

REPORT PREPARED
BY
ROBERT M. MARTIN

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I. INTRODUCTION

The Emission Measurement Branch of the Environmental Protection Agency conducted a series of tests November 17-20, 1975, at the Eveleth Taconite Company in order to obtain emission data from an iron ore beneficiation plant. The purpose of the test was two-fold. First, to determine if particulate or SO_2 emissions are sufficiently significant to justify the development of a new source performance standard for this industry, and, second, to determine if asbestos emissions pose a hazardous pollutant problem.

The sources of interest were the grate discharge end and the main waste gas stream of the grate-kiln type pelletizing furnace--both of which were controlled by wet scrubbers.

The emissions of interest were particulate mass and asbestos in the grate discharge end emissions and particulate mass, asbestos, SO_2, and particle size in the waste gas stream. Visible emission readings were attempted but were abandoned due to adverse weather conditions. High volume sampling was also attempted using the Rader* automatic sampling device but was unsuccessful due to high moisture and low ambient temperatures.

This report presents the particulate and SO_2 results from the test. Recent preliminary electron microscope analyses of testings samples from Eveleth did not indicate the presence of asbestos. Theoretically, the tailing samples should have a higher percentage of asbestos than the ore or the iron concentrate (if asbestos is present at all) because of the

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beneficiation techniques utilized at iron ore plants e.g. magnetic and gravity separation. Thus, the Agency currently does not plan to analyze the Eveleth emissions from asbestos content.

II. SUMMARY AND DISCUSSION OF RESULTS

Particulate Results

Table I summarizes the results of particulate mass and SO_2 emissions from the two sources sampled.

(Venturi Scrubber (Points A & B))

The sampling was conducted according to Method 5 with the substitution of millipore filters rather than the usual glass fiber filters. The millipores were used so that subsequent asbestos analysis could be performed. Due to construction material of the millipore filters, sample box temperatures were maintained below 200^{o}F. Stainless steel probes were used on the inlets and glass-lined probes were used on the outlets.

On the inlet of the waste gas scrubber (Point A) modifications of the Method 5 train were required due to the unusual duct configuration. The filter was attached to the probe at a 75^{o} angle and enclosed in a protective box. The filter was then attached to the impingers by means of a flexible teflon tube (Figure 4). This created problems on the first run as the impinger box was accidently pulled over causing it to fall and break. Consequently this run was abondoned.

In the data on Point B, Run 1 is based on saturation at the stack temperature of 127^{o}F. The other two runs are based on actual moisture collected. The average outlet concentration of the Venturi Scrubber (Point B) is .0852 G/SCF versus 2.1675 on the inlet (Point A) indicating an efficiency 96.1 percent of the control device.

(Ducon Scrubber (Points C & D))

A preliminary traverse on the outlet to the Ducon Scrubber (Point D) indicated extreme cyclonic flow. Straightening vanes were installed and the cyclonic flow was eliminated.

No other problems occurred and the sampling on these points proceeded uneventfully.

The data on the Ducon Scrubber indicated an average outlet concentration of .00514 G/SCF and inlet concentration of 3.5561 G/SCF indicating an efficiency of 99.85 percent for the Ducon Scrubber.

Tables II thru IX shows data printouts for individual points. Figures 1 thru 7 illustrate the sampling points and details of the individual locations.

TABLE 1

SUMMARY OF PARTICULATE AND SO_2 DATA

RUN NO.	STACK TEMP °F	STACK FLOW SCFM	% I	LOADING FRONT G/SCF	LOADING TOTAL G/SCF	SO_2 PPM
1A	*---	-----	---	-----	-----	16.29
2A	207	282,249	120.1	2.7183	2.7195	10.04
3A	251	300,825	104.8	1.6166	1.6194	9.56
AVG	229	291,537	112.4	2.1675	2.1695	11.96
1B	127	273,044	103.0	0.05384	0.05584	< 0.23
2B	125	273,627	107.8	0.11010	0.11079	2.67
3B	137	278,880	109.8	0.09163	0.09198	15.29
AVG	130	275,184	106.9	0.08519	0.08620	6.06
1C	193	13,593	113.8	4.0868	4.0872	**
2C	190	13,552	107.3	3.3329	3.3230	---
3C	177	13,523	106.6	3.2587	3.2590	---
AVG	187	13,556	109.2	3.5561	3.5564	---
1D	78	13,254	99.4	0.00734	0.00751	---
2D	73	13,197	97.8	0.00479	0.00531	---
3D	68	13,149	100.4	0.00329	0.00355	---
AVG	73	13,200	99.2	0.00514	0.00546	---

*Sample Lost

**No SO_2 requested

TABLE II

Point A - Dryer - Inlet - Venturi Scrubber

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	1	2	AVERAGE
DATE OF RUN		11-18-75	11-19-75	
STACK AREA	FT2	102.000	102.000	
NET TIME OF RUN	MIN	96.0	96.0	
BAROMETRIC PRESSURE	IN.HG	28.32	28.42	
AVG ORIFICE PRES DROP	IN.H2O	.670	.600	
VOL DRY GAS-METER COND	DCF	44.77	41.65	
AVG GAS METER TEMP	DEG.F	101.9	101.9	
VOL DRY GAS-STD COND	DSCF	40.74	37.89	
TOTAL H2O COLLECTED	ML	185.0	102.0	
VOL H2O VAPOR-STD COND	SCF	8.77	4.83	
PERCENT MOISTURE BY VOL		17.7	11.3	
MOLE FRACTION DRY GAS		.823	.837	
PERCENT CO2 BY VOL, DRY		1.4	1.4	
PERCENT O2 BY VOL, DRY		19.6	19.6	
PERCENT CO BY VOL, DRY		.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	
MOLECULAR WT-DRY STK GAS		29.01	29.01	
MOLECULAR WT-STK GAS		27.06	27.76	
AVG STACK TEMPERATURE	DEG.F	207.0	251.0	
NET SAMPLING POINTS		1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	27.92	27.70	
AVG STACK GAS VELOCITY	FPS	75.604	80.332	77.968
STK FLOWRATE, DRY,STD CN	DSCFM	282249.	300825.	291537.
ACTUAL STACK FLOWRATE	ACFM	462694.	491631.	477163.
PERCENT ISOKINETIC		120.1	104.8	112.4
PARTICULATE WT-PARTIAL	MG	7190.70	3977.60	5584.15
PARTICULATE WT-TOTAL	MG	7193.60	3984.50	5589.05
PERC IMPINGER CATCH		.0	.2	.1
PART. LOAD-PTL,STD CN	GR/DSCF	2.71838	1.61662	2.16750
PART. LOAD-TTL,STD CN	GR/DSCF	2.71947	1.61943	2.16945
PART. LOAD-PTL,STD CN @ 12% CO2		23.30037	13.85678	18.57357
PART. LOAD-TTL,STD CN @ 12% CO2		23.30976	13.88031	18.59529
PART. LOAD-PTL,STK CN	GR/ACF	1.65730	.98664	1.32197
PART. LOAD-TTL,STK CN	GR/ACF	1.65797	.99035	1.32416
PARTIC EMIS-PARTIAL	LB/HR	6576.56	4168.49	5372.53
PARTIC EMIS-TOTAL	LB/HR	6579.21	4175.72	5377.47
PART EMIS/WT PRD FD PTL	LB/TON	************	************	************
PART EMIS/WT PRD FD TTL	LB/TON	************	************	************
PERCENT EXCESS AIR		1560.5	1560.5	1560.5

PLANT: EVELETH TACONITE
LOCATION: EVELETH,MINN.
OPERATOR: EMB

TABLE III

Point A - Dryer - Inlet - Venturi Scrubber

PARTICULATE SUMMARY IN METRIC UNITS

DESCRIPTION	UNITS	1	2	AVERAGE
DATE OF RUN		11-18-75	11-19-75	
STACK AREA	M2	9.476	9.476	
NET TIME OF RUN	MIN	96.0	96.0	
BAROMETRIC PRESSURE	MM.HG	732.03	732.03	
AVG ORIFICE PRES DROP	MM.H2O	17.018	15.240	
VOL DRY GAS-METER COND	DCM	1.27	1.18	
AVG GAS METER TEMP	DEG.C	38.3	38.8	
VOL DRY GAS-STD COND	DNM3	1.15	1.07	
TOTAL H2O COLLECTED	ML	185.0	102.0	
VOL H2O VAPOR-STD COND	NM3	.25	.14	
PERCENT MOISTURE BY VOL		17.7	11.3	
MOLE FRACTION DRY GAS		.823	.837	
PERCENT CO2 BY VOL, DRY		1.4	1.4	
PERCENT O2 BY VOL, DRY		19.6	19.6	
PERCENT CO BY VOL, DRY		.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	
MOLECULAR WT-DRY STK GAS		29.01	29.01	
MOLECULAR WT-STK GAS		27.06	27.76	
AVG STACK TEMPERATURE	DEG.C	97.2	121.7	
NET SAMPLING POINTS		1	1	
STACK PRESSURE, ABSOLUTE	MM.HG	709.17	703.58	
AVG STACK GAS VELOCITY	M/S	23.044	24.485	23.765
STK FLOWRATE, DRY,STD CN	DNM3/M	7992.	8518.	8255.
ACTUAL STACK FLOWRATE	AM3/M	13102.	13922.	13512.
PERCENT ISOKINETIC		120.1	104.8	112.4
PARTICULATE WT-PARTIAL	MG	7190.70	3977.60	5584.15
PARTICULATE WT-TOTAL	MG	7193.60	3984.50	5589.05
PERC IMPINGER CATCH		.0	.2	.1
PART. LOAD-PTL,STD CN	MG/NM3	6220.67	3699.45	4960.06
PART. LOAD-TTL,STD CN	MG/NM3	6223.18	3705.86	4964.52
PART. LOAD-PTL,STD CN @ 12% CO2		53320.05	31709.54	42514.79
PART. LOAD-TTL,STD CN @ 12% CO2		53341.55	31764.55	42553.05
PART. LOAD-PTL,STK CN	MG/AM3	3792.54	2262.38	3027.46
PART. LOAD-TTL,STK CN	MG/AM3	3794.07	2266.31	3030.19
PARTIC EMIS-PARTIAL	KG/HR	2983.13	1890.83	2436.98
PARTIC EMIS-TOTAL	KG/HR	2984.33	1894.11	2439.22
PART EMIS/WT PRD FD PTL	KG/MTON	*********	*********	*********
PART EMIS/WT PRD FD TTL	KG/MTON	*********	*********	*********
PERCENT EXCESS AIR		1560.5	1560.5	1560.5

TABLE IV

Point B - Outlet - Dryer - Venturi Scrubber

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		11-18-75	11-18-75	11-19-75	
STACK AREA	FT2	78.533	78.538	78.538	
NET TIME OF RUN	MIN	96.0	96.0	96.0	
BAROMETRIC PRESSURE	IN.HG	28.81	28.81	28.60	
AVG ORIFICE PRES DROP	IN.H2O	.796	1.120	.880	
VOL DRY GAS-METER COND	DCF	47.05	49.19	50.63	
AVG GAS METER TEMP	DEG.F	79.1	79.6	71.0	
VOL DRY GAS-STD COND	DSCF	44.62	46.65	48.40	
TOTAL H2O COLLECTED	ML	.0	146.0	175.0	
VOL H2O VAPOR-STD COND	SCF	.00	6.92	8.29	
PERCENT MOISTURE BY VOL		13.8	12.9	14.6	
MOLE FRACTION DRY GAS		.862	.871	.854	
PERCENT CO2 BY VOL, DRY		1.9	1.7	1.8	
PERCENT O2 BY VOL, DRY		19.1	19.3	19.2	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	
MOLECULAR WT-DRY STK GAS		29.07	29.04	29.06	
MOLECULAR WT-STK GAS		27.54	27.62	27.44	
AVG STACK TEMPERATURE	DEG.F	127.0	125.0	137.0	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	28.87	28.87	28.66	
AVG STACK GAS VELOCITY	FPS	77.174	76.295	81.538	78.336
STK FLOWRATE, DRY,STD CN	DSCFM	273044.	273627.	278880.	275184.
ACTUAL STACK FLOWRATE	ACFM	363663.	359520.	384229.	369137.
PERCENT ISOKINETIC		103.0	107.8	109.8	106.9
PARTICULATE WT-PARTIAL	MG	156.00	333.50	283.00	259.17
PARTICULATE WT-TOTAL	MG	161.80	335.60	289.10	262.17
PERC IMPINGER CATCH		3.6	.6	.4	1.5
PART. LOAD-PTL.STD CN	GR/DSCF	.05384	.11010	.09163	.08519
PART. LOAD-TTL.STD CN	GR/DSCF	.05584	.11079	.09198	.08620
PART. LOAD-PTL.STD CN @ 12% CO2		.34005	.77715	.61086	.57602
PART. LOAD-TTL.STD CN @ 12% CO2		.35269	.78204	.61319	.58264
PART. LOAD-PTL.STK CN	GR/ACF	.04040	.08375	.06647	.06354
PART. LOAD-TTL.STK CN	GR/ACF	.04190	.08427	.06672	.06430
PARTIC EMIS-PARTIAL	LB/HR	126.01	258.22	219.03	201.09
PARTIC EMIS-TOTAL	LB/HR	130.69	259.84	219.87	203.47
PART EMIS/WT PRD FD PTL	LB/TON	**********	**********	**********	**********
PART EMIS/WT PRD FD TTL	LB/TON	**********	**********	**********	**********
PERCENT EXCESS AIR		1087.7	1240.4	1159.4	1162.5

PLANT: EVELETH TACONITE
LOCATION: EVELETH,MINN.

TABLE V

Point B - Outlet - Dryer - Venturi Scrubber

PARTICULATE SUMMARY IN METRIC UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		11-18-75	11-18-75	11-19-75	
STACK AREA	M2	7.297	7.297	7.297	
NET TIME OF RUN	MIN	96.0	96.0	96.0	
BAROMETRIC PRESSURE	MM.HG	731.77	731.77	726.44	
AVG ORIFICE PRES DROP	MM.H2O	20.218	28.448	22.352	
VOL DRY GAS-METER COND	DM3	1.33	1.39	1.43	
AVG GAS METER TEMP	DEG.C	26.2	26.4	21.7	
VOL DRY GAS-STD COND	DNM3	1.26	1.32	1.37	
TOTAL H2O COLLECTED	ML	.0	146.0	175.0	
VOL H2O VAPOR-STD COND	NM3	.00	.20	.23	
PERCENT MOISTURE BY VOL		13.8	12.9	14.6	
MOLE FRACTION DRY GAS		.862	.871	.854	
PERCENT CO2 BY VOL, DRY		1.9	1.7	1.8	
PERCENT O2 BY VOL, DRY		19.1	19.3	19.2	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	
MOLECULAR WT-DRY STK GAS		29.07	29.04	29.06	
MOLECULAR WT-STK GAS		27.54	27.62	27.44	
AVG STACK TEMPERATURE	DEG.C	52.8	51.7	58.3	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	MM.HG	733.30	733.30	727.96	
AVG STACK GAS VELOCITY	M/S	23.523	23.255	24.853	23.877
STK FLOWRATE, DRY,STD CN	DNM3/M	7732.	7748.	7897.	7792.
ACTUAL STACK FLOWRATE	AM3/M	10298.	10181.	10880.	10453.
PERCENT ISOKINETIC		103.0	107.8	109.8	106.9
PARTICULATE WT-PARTIAL	MG	156.00	333.50	288.00	259.17
PARTICULATE WT-TOTAL	MG	161.80	335.60	289.10	262.17
PERC IMPINGER CATCH		3.6	.6	.4	1.5
PART. LOAD-PTL,STD CN	MG/NM3	123.21	251.94	209.68	194.94
PART. LOAD-TTL,STD CN	MG/NM3	127.79	253.53	210.48	197.27
PART. LOAD-PTL,STD CN @ 12% CO2		778.16	1778.40	1397.83	1318.15
PART. LOAD-TTL,STD CN @ 12% CO2		807.09	1789.60	1403.22	1333.30
PART. LOAD-PTL,STK CN	MG/AM3	92.45	191.64	152.10	145.40
PART. LOAD-TTL,STK CN	MG/AM3	95.89	192.85	152.69	147.14
PARTIC EMIS-PARTIAL	KG/HR	57.16	117.13	99.35	91.21
PARTIC EMIS-TOTAL	KG/HR	59.28	117.86	99.73	92.29
PART EMIS/WT PRD FD PTL	KG/MTON	************	************	************	************
PART EMIS/WT PRD FD TTL	KG/MTON	************	************	************	************
PERCENT EXCESS AIR		1087.7	1240.4	1159.4	1162.5

11:20:54

TABLE VI

Point C - Inlet - Kiln - Ducon Scrubber

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		11-20-75	11-20-75	11-20-75	
STACK AREA	FT2	3.500	3.500	3.500	
NET TIME OF RUN	MIN	64.0	64.0	64.0	
BAROMETRIC PRESSURE	IN.HG	28.59	28.59	28.59	
AVG ORIFICE PRES DROP	IN.H2O	1.040	1.100	1.020	
VOL DRY GAS-METER COND	DCF	39.31	37.27	37.28	
AVG GAS METER TEMP	DEG.F	85.5	90.5	95.0	
VOL DRY GAS-STD COND	DSCF	36.58	34.38	34.10	
TOTAL H2O COLLECTED	ML	14.7	24.0	12.4	
VOL H2O VAPOR-STD COND	SCF	.70	1.14	.59	
PERCENT MOISTURE BY VOL		1.9	3.2	1.7	
MOLE FRACTION DRY GAS		.981	.968	.983	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	
MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	
MOLECULAR WT-STK GAS		28.64	28.49	28.66	
AVG STACK TEMPERATURE	DEG.F	193.0	190.0	177.0	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	28.32	28.32	28.32	
AVG STACK GAS VELOCITY	FPS	85.878	86.403	83.198	85.160
STK FLOWRATE, DRY,STD CN	DSCFM	13593.	13552.	13523.	13556.
ACTUAL STACK FLOWRATE	ACFM	18034.	18145.	17471.	17884.
PERCENT ISOKINETIC		113.8	107.3	106.6	109.2
PARTICULATE WT-PARTIAL	MG	9708.30	7417.40	7215.70	8113.97
PARTICULATE WT-TOTAL	MG	9709.70	7417.70	7216.30	8114.57
PERC IMPINGER CATCH		.0	.0	.0	.0
PART. LOAD-PTL,STD CN	GR/DSCF	4.08682	3.32285	3.25871	3.55613
PART. LOAD-TTL,STD CN	GR/DSCF	4.08720	3.32298	3.25893	3.55639
PART. LOAD-PTL,STD CN @ 12% CO2		*********	*********	*********	*********
PART. LOAD-TTL,STD CN @ 12% CO2		*********	*********	*********	*********
PART. LOAD-PTL,STK CN	GR/ACF	3.07854	2.48042	2.52087	2.69328
PART. LOAD-TTL,STK CN	GR/ACF	3.07833	2.48052	2.52108	2.69348
PARTIC EMIS-PARTIAL	LB/HR	476.16	385.99	377.73	413.29
PARTIC EMIS-TOTAL	LB/HR	476.20	386.00	377.76	413.32
PART EMIS/WT PRD FD PTL	LB/TON	*********	*********	*********	*********
PART EMIS/WT PRD FD TTL	LB/TON	*********	*********	*********	*********
PERCENT EXCESS AIR		*********	*********	*********	*********

PLANT: EVELETH TACONITE
LOCATION: EVELETH,MINN.

TABLE VII

Point C - Inlet - Kiln - Ducon Scrubber

PARTICULATE SUMMARY IN METRIC UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		11-20-75	11-20-75	11-20-75	
STACK AREA	M2	.325	.325	.325	
NET TIME OF RUN	MIN	64.0	64.0	64.0	
BAROMETRIC PRESSURE	MM.HG	726.19	726.19	726.19	
AVG ORIFICE PRES DROP	MM.H2O	26.416	27.940	25.908	
VOL DRY GAS-METER COND	DM3	1.11	1.06	1.06	
AVG GAS METER TEMP	DEG.C	29.7	32.5	35.0	
VOL DRY GAS-STD COND	DNM3	1.04	.97	.97	
TOTAL H2O COLLECTED	ML	14.7	24.0	12.4	
VOL H2O VAPOR-STD COND	NM3	.02	.03	.02	
PERCENT MOISTURE BY VOL		1.9	3.2	1.7	
MOLE FRACTION DRY GAS		.981	.968	.983	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	
MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	
MOLECULAR WT-STK GAS		28.64	28.49	28.66	
AVG STACK TEMPERATURE	DEG.C	89.4	87.8	80.6	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	MM.HG	719.33	719.33	719.33	
AVG STACK GAS VELOCITY	M/S	26.176	26.336	25.359	25.957
STK FLOWRATE, DRY, STD CN	DNM3/M	385.	384.	383.	384.
ACTUAL STACK FLOWRATE	AM3/M	511.	514.	495.	506.
PERCENT ISOKINETIC		113.8	107.3	106.6	109.2
PARTICULATE WT-PARTIAL	MG	9708.80	7417.40	7215.70	8113.97
PARTICULATE WT-TOTAL	MG	9709.70	7417.70	7216.30	8114.57
PERC IMPINGER CATCH		.0	.0	.0	.0
PART. LOAD-PTL, STD CN	MG/NM3	9352.18	7603.94	7457.16	8137.76
PART. LOAD-TTL, STD CN	MG/NM3	9353.05	7604.24	7457.78	8138.36
PART. LOAD-PTL, STD CN @ 12% CO2		**********	**********	**********	**********
PART. LOAD-TTL, STD CN @ 12% CO2		**********	**********	**********	**********
PART. LOAD-PTL, STK CN	MG/AM3	7044.86	5676.13	5768.71	6163.24
PART. LOAD-TTL, STK CN	MG/AM3	7045.52	5676.36	5769.19	6163.69
PARTIC EMIS-PARTIAL	KG/HR	215.98	175.08	171.34	187.47
PARTIC EMIS-TOTAL	KG/HR	216.00	175.09	171.35	187.48
PART EMIS/WT PRD FD PTL	KG/MTON	**********	**********	**********	**********
PART EMIS/WT PRD FD TTL	KG/MTON	**********	**********	**********	**********
PERCENT EXCESS AIR		**********	**********	**********	**********

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TABLE VIII

Point D - Outlet - Kiln Ducon Scrubber

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		11-20-75	11-20-75	11-20-75	
STACK AREA	FT2	4.909	4.909	4.909	
NET TIME OF RUN	MIN	64.0	64.0	64.0	
BAROMETRIC PRESSURE	IN.HG	28.59	28.59	28.50	
AVG ORIFICE PRES DROP	IN.H2O	2.800	2.700	2.800	
VOL DRY GAS-METER COND	DCF	55.19	53.56	54.98	
AVG GAS METER TEMP	DEG.F	60.0	55.0	55.0	
VOL DRY GAS-STD COND	DSCF	54.13	53.02	54.27	
TOTAL H2O COLLECTED	ML	.0	.0	.0	
VOL H2O VAPOR-STD COND	SCF	.00	.00	.00	
PERCENT MOISTURE BY VOL		4.3	1.0	4.7	
MOLE FRACTION DRY GAS		.957	.990	.953	
PERCENT CO2 BY VOL, DRY		.3	.5	.0	
PERCENT O2 BY VOL, DRY		20.7	20.5	21.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	
MOLECULAR WT-DRY STK GAS		28.83	28.90	28.84	
MOLECULAR WT-STK GAS		28.41	28.80	28.33	
AVG STACK TEMPERATURE	DEG.F	78.0	73.0	68.0	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	28.19	28.10	28.10	
AVG STACK GAS VELOCITY	FPS	50.685	48.454	49.699	49.613
STK FLOWRATE, DRY,STD CN	DSCFM	13254.	13197.	13149.	13200.
ACTUAL STACK FLOWRATE	ACFM	14927.	14270.	14637.	14612.
PERCENT ISOKINETIC		99.4	97.8	100.4	99.2
PARTICULATE WT-PARTIAL	MG	25.80	16.50	11.60	17.97
PARTICULATE WT-TOTAL	MG	26.40	18.30	12.50	19.07
PERC IMPINGER CATCH		2.3	9.8	7.2	6.4
PART. LOAD-PTL,STD CN	GR/DSCF	.00734	.00479	.00329	.00514
PART. LOAD-TTL,STD CN	GR/DSCF	.00751	.00531	.00355	.00546
PART. LOAD-PTL,STD CN @ 12% CO2		.29363	.11501	**********	**********
PART. LOAD-TTL,STD CN @ 12% CO2		.30045	.12756	**********	**********
PART. LOAD-PTL,STK CN	GR/ACF	.00651	.00443	.00296	.00463
PART. LOAD-TTL,STK CN	GR/ACF	.00667	.00491	.00318	.00492
PARTIC EMIS-PARTIAL	LB/HR	.83	.54	.37	.58
PARTIC EMIS-TOTAL	LB/HR	.85	.60	.40	.62
PART EMIS/WT PRD FD PTL	LB/TON	**********	**********	**********	**********
PART EMIS/WT PRD FD TTL	LB/TON	**********	**********	**********	**********
PERCENT EXCESS AIR		13269.2	5758.4	**********	**********

PLANT: EVELETH TACONITE
LOCATION: EVELETH,MINN.

TABLE IX

Point D - Outlet - Kiln - Ducon Scrubber

PARTICULATE SUMMARY IN METRIC UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		11-20-75	11-20-75	11-20-75	
STACK AREA	M2	.456	.456	.456	
NET TIME OF RUN	MIN	64.0	64.0	64.0	
BAROMETRIC PRESSURE	MM.HG	726.19	726.19	723.90	
AVG ORIFICE PRES DROP	MM.H2O	71.120	68.580	71.120	
VOL DRY GAS-METER COND	DM3	1.56	1.52	1.56	
AVG GAS METER TEMP	DEG.C	15.6	12.8	12.8	
VOL DRY GAS-STD COND	DNM3	1.53	1.50	1.54	
TOTAL H2O COLLECTED	ML	.0	.0	.0	
VOL H2O VAPOR-STD COND	NM3	.00	.00	.00	
PERCENT MOISTURE BY VOL		4.3	1.0	4.7	
MOLE FRACTION DRY GAS		.957	.990	.953	
PERCENT CO2 BY VOL, DRY		.3	.5	.0	
PERCENT O2 BY VOL, DRY		20.7	20.5	21.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	
MOLECULAR WT-DRY STK GAS		28.88	28.90	28.84	
MOLECULAR WT-STK GAS		28.41	28.80	28.33	
AVG STACK TEMPERATURE	DEG.C	25.6	22.8	20.0	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	MM.HG	716.03	713.74	713.74	
AVG STACK GAS VELOCITY	M/S	15.449	14.769	15.148	15.122
STK FLOWRATE, DRY,STD CN	DNM3/M	375.	374.	372.	374.
ACTUAL STACK FLOWRATE	AM3/M	423.	404.	414.	414.
PERCENT ISOKINETIC		99.4	97.8	100.4	99.2
PARTICULATE WT-PARTIAL	MG	25.80	16.50	11.60	17.97
PARTICULATE WT-TOTAL	MG	26.40	18.30	12.50	19.07
PERC IMPINGER CATCH		2.3	9.8	7.2	6.4
PART. LOAD-PTL,STD CN	MG/NM3	16.80	10.97	7.53	11.77
PART. LOAD-TTL,STD CN	MG/NM3	17.19	12.16	8.12	12.49
PART. LOAD-PTL,STD CN @ 12% CO2		671.93	263.19	**********	**********
PART. LOAD-TTL,STD CN @ 12% CO2		687.55	291.90	**********	**********
PART. LOAD-PTL,STK CN	MG/AM3	14.91	10.14	6.76	10.60
PART. LOAD-TTL,STK CN	MG/AM3	15.25	11.24	7.29	11.26
PARTIC EMIS-PARTIAL	KG/HR	.38	.25	.17	.26
PARTIC EMIS-TOTAL	KG/HR	.39	.27	.18	.28
PART EMIS/WT PRD FD PTL	KG/MTON	**********	**********	**********	**********
PART EMIS/WT PRD FD TTL	KG/MTON	**********	**********	**********	**********
PERCENT EXCESS AIR		13269.2	5758.4	**********	**********

13:43:47

Visible Emissions

Visible emission measurements were attempted but it became obviously futile due to the massive steam plume and rapid deterioration of background conditions accompanying an impending storm.

Those readings which were attempted indicated no visible emissions but the environment surrounding the base of the stack and visible evaluation of the filters strongly suggest that, with the absence of the steam, visible emissions were likely.

That data obtained can be found in the Appendix.

High Volume Sampling

High Volume sampling was attempted using the Rader automatic instrument. This attempt was made on the exhaust stack of the dryer (Point B). The nipples on the ports had to be removed to enable insertion of the large radius probe. On the first attempt the filter became quite wet and while carrying it to the clean up area the weight of the water caused the filter to tear. The second test also resulted in a very wet filter. Through careful handling it was recovered intact, but there were numerous cracks and obvious areas of filter loss. Further attempts were discontinued.

Asbestos Sampling

Following the particulate mass analysis, the filters were sent to a contractor for asbestos analysis. As stated earlier, preliminary asbestos analyses of Eveleth tailings samples did not indicate the presence of asbestos. Thus, the Agency no longer plans to analyze the filter catch for asbestos contact.

SO_2 Sampling

Table I summarizes SO_2 data collected from Points A & B. Samples were collected during the particulate tests. The concentrations are quite low and are bordering on the lower limit of sensitivity for the method. SO_2 sampling was not conducted on Points C & D.

III. PROCESS DESCRIPTION AND OPERATION

Process Description

Eveleth Taconite Company is owned by Oglebay Norton and Ford Motor Company and is managed by Oglebay Norton. Eveleth is situated just south of Virginia, Minnesota, and is actually located in the bend of the Central Mesabi Iron Range formation. This is also south and west of the Duluth Gabbro influence. Eveleth started operations in 1965 and is now producing 2.2 million long tons of pellets per year. They are presently undergoing an expansion program to raise production capacity to about 6 million long tons per year of pellets.

The Thunderbird mine of Eveleth which is about 10 miles north of the Fairlane Plant, operates with 6-cubic-yard shovels. Presently they use jet piercers for drilling into the ore body.

The crushing circuit at the mine consists of primary crushing to 10 inches and secondary crushing to 4 inches. The primary crusher is a 54-inch gyratory and the two secondary crushers are 30" x 70" gyratories. The secondary crusher product is conveyed to coarse ore storage.

The coarse ore storage is a conical building that is open on the bottom like a large tepee. The ore is dumped in from the top and drawn from the bottom with gravity chutes. Coarse ore storage is approximately 8,000 tons in the summer and about 4,500 tons in the winter. They use water sprays on the coarse ore storage area.

Eveleth hauls their coarse ore in 89 car trains from the mine to the Fairlane fine crusher building, each car holding 70 tons. The rail cars are bottom dump cars and the dump station holds 12 cars at a time. The 12 cars are dumped in approximately 12 minutes. Eveleth presently is handling 25,000 tpd of ore and the expansion is projected to increase this to

60,000 tpd. The present ore grade is averaging about 24 percent magnetic iron and 33 percent total iron.

Figure 1 depicts flow through the fine crusher building at Fairlane which contains the 3rd and 4th stages of crushing. The two stages of crushing reduce the ore to 1/2-inch for rod mill feed.

At the concentrator building, Figure 2, the rod mill reduces the ore to about 10 mesh in size. The rod mill discharge goes to the magnetic cobber which rejects about 35 to 40 percent of the weight. The concentrate from the magnetic cobbers then goes to ball mills where it is ground in closed circuit with cyclones. The overflow from the ball mill cyclones goes to hydroseparators. The concentrate coming out of the hydroseparators, which is the underflow, goes to fine screening. The overflow from the hydroseparator is tailings and flows to a tailings thickener. The coarse material rejected in the cobbers is conveyed up to a holding bin and dumped into a truck and transported to the tailings area for dike construction. The concentrate from the double-drum rougher magnetic separators is pumped to cyclones. The concentrate from the triple-drum finishers is then pumped to the pellet plant.

At the pellet plant, Figure 3, the concentrate is filtered and conveyed into concentrate holding bins. The concentrate is removed from the bins by table feeders onto a traveling belt to which bentonite is added. The concentrate plus bentonite is then fed to balling drums.

The five balling drums at Eveleth are 9 feet in diameter and 31 feet in length and will process about 80 tons per hour each. The balling drums discharge onto vibrating screens which reject the fine material and undersized pellets. The fine material and undersized pellets are recycled back to the balling drums as feed material. The oversized material passes on to a traveling grate. Eveleth does not use "gooney ball" breakers on their screen decks.

A grate-kiln system is used at Eveleth for induration of their iron ore pellets. The grate is 12 feet wide and 112 feet long. Drying temperatures are about 750°F with the preheat temperature around 1900 to 2000°F. From the traveling grate preheat section, the pellet passes into the rotary kiln. The rotary kiln is 18.5 feet in diameter and 120 feet long and operates at 2450°F. The pellets are discharged from the rotary kiln into an annular cooler. From the annular cooler the pellets are conveyed either directly to car-loading or to storage.

During operation, the main waste gases make several passes through the pellets. Initially, ambient air is forced by a fan through the first stage annular cooler where it passes through a 36-inch-deep bed of fired pellets and is heated to about 2000°F. The gases leaving the cooler (first stage only) pass into the kiln and along with natural gas firing heat the pellets to a temperature of about 2400°F. Gases leaving the kiln then flow to a plenum chamber above the traveling grate section of the furnace. Here, they are used for preheating the green pellets in a downdraft mode. These gases then pass through a multiplicity of dry cyclone collectors and are forced downdraft through the drying section of the grate. Waste gases passing thorugh the drying section then pass through the venturi scrubber and out the main stack.

Dust Control Devices

The control devices used at Eveleth include both the dry and wet-type collectors. The primary crusher and ore hauling facilities have Fly Ash

Arrestor dry mechanical collectors. The largest of these units, at the truck dumping station, is a 100-hp unit handling about 60,000 scfm of gases. The remaining units are 40-hp and 75-hp with about 45,000 scfm total gas flow. The new crusher facilities are designed to use Wheelabrator baghouses with 75,000 and 26,000 scfm gas flow. These will be the dry compressed pulse-air-cleaned units.

The fine crushing plant now contains six American Air Filter Rotoclones with a total gas flow of about 120,000 scfm. Two of these units are also used on the rod mill feeders. The fine ore surge storage area has a Fly Ash Arrestor dry collector handling about 4,000 cfm with a 7-1/2-hp motor. This, however, is being changed to a baghouse.

A unique feature at Eveleth is the use of a venturi scrubber on the waste gases from the grate-kiln indurating system. The waste gas flow has four venturi scrubbers with two water eliminators. The solids from the venturi go to the concentrate thickener and filter. The venturi operates with about a 9-inch water gauge pressure drop. Corrosion has been a problem on these units, primarily because of some sulfur oxide emissions which cause acidic conditions in the scrubber. Eveleth is presently feeding about 3 tons per day of liquid caustic to neutralize scrubber water in an attempt to decrease the corrosion in the venturi scrubber. This is done at a cost of about $100,000 per year. The venturi scrubber was put in operation in 1971 with mild steel construction and corrosion problems were experienced within two weeks of initial operation. The new pellet plant which is also designed with a venturi scrubber will use special alloys for construction in order to reduce or eliminate the corrosion problem. Eveleth is the only plant in the industry to use a venturi collector for the main waste gas emissions.

The grate feed, grate discharge (grate return area) and kiln discharge points each utilize Ducon UW-4 wet scrubbers for dust collection. The pellet loadout transfer point utilizes an American Air Filter Type W Rotoclone. The cooler exhaust is emitted directly to the atmosphere via a stack.

PROCESS OPERATION DURING TEST

A. Sites A and B - Main Waste Gas Stack

The first emission source tested at Eveleth was the main waste gas effluent from the grate-kiln system which was operating with a Ducon venturi scrubber collector. Sites A and B were the inlet gases and outlet gases for the scrubber; three separate samples were taken at each site.

During operation, the main waste gases make several passes through the pellets. Initially, ambient air is forced by a fan through the first stage annular cooler where it passes through a 36-inch-deep bed of fired pellets and is heated to about 2000 F. The gases leaving the cooler (first stage only) pass into the kiln and along with natural gas firing heat the pellets to a temperature of about 2400 F. Gases leaving the kiln then flow to a plenum chamber above the traveling grate section of the furnace. Here, they are used for preheating the green pellets in a downdraft mode. These gases then pass through a multiplicity of dry cyclone collectors and are forced downdraft through the drying section of the grate. Waste gases passing through the drying section then pass through the venturi scrubber and out the main stack.

The first stack samples at Sites A and B were started at 10:40 a.m. on November 18. The plant was operating with four balling drums running at a capacity of about 360 tons per hour of green balls. Other pertinent operating data during this period is shown in Table 1. Near the end of this run, a problem developed in the support mechanism for the inlet sample train (Site A) and the glass filter disk was broken. The sample was recovered but is only about 80 percent completed.

The second samples at Sites A and B were started at 2:30 p.m. on November 18, again with the plant operating at about 360 tons per hour of green balls. Four balling drums were operating when the test began and the fifth drum came on line at 3:10 p.m. The production rate, however, did not change significantly during the entire sampling period. Data on this run are also shown in Table 1.

TABLE 1. PLANT OPERATING DATA DURING STACK SAMPLING PERIODS

	Sites A and B			Sites C and D		
	First Sample	Second Sample	Third Sample	First Sample	Second Sample	Third Sample
Production Rate of Green Balls, tons/hr	360	360	330	300	300	300
Pellet Bed Depth, inches	7	6.8	7	6.7	6.8	6.6
Grate Speed, inches/min.	195	175-190	160	175	120	155
Kiln Speed, rph	70	70	67	65	65	65
Temperatures, F						
First pass gases	840-880	830-900	800-900	900-920	880-900	870-900
No. 2 fan outlet	100	100	120	100	100	100
Drying zone	700	700	650	680	660	650
Preheat zone	770-800	800-830	880	800	800	770
Burning zone	2250-2330	2350	2350	2370	2350	2270
Feed Totalizer, No. 17 Belt, tons/hr	376[a]	376[a]	317[b]	288[c]	288[c]	288[c]
Undersize Return Totalizer, No. 20 Belt, tons/hr	14.6[a]	14.6[a]	13.7[b]	10.2[c]	10.2[c]	10.2[c]
Scrubber Water pH	8	8	10	8	8	8

(a) Average for 5-hour period on 11-18-75.
(b) Average for 6-hour period on 11-19-75.
(c) Average for 5-hour period on 11-20-75.

The third and final samples at Sites A and B were obtained on November 19. The Site A sample, inlet to scrubber, was taken between 11:20 a.m. and 1:20 p.m. and the Site B sample, outlet of scrubber or stack, was taken between 12:30 and 2:30 p.m. Production rate during both periods was about 330 tons per hour with four balling drums in operation.

B. Sites C and D - Grate Discharge Area

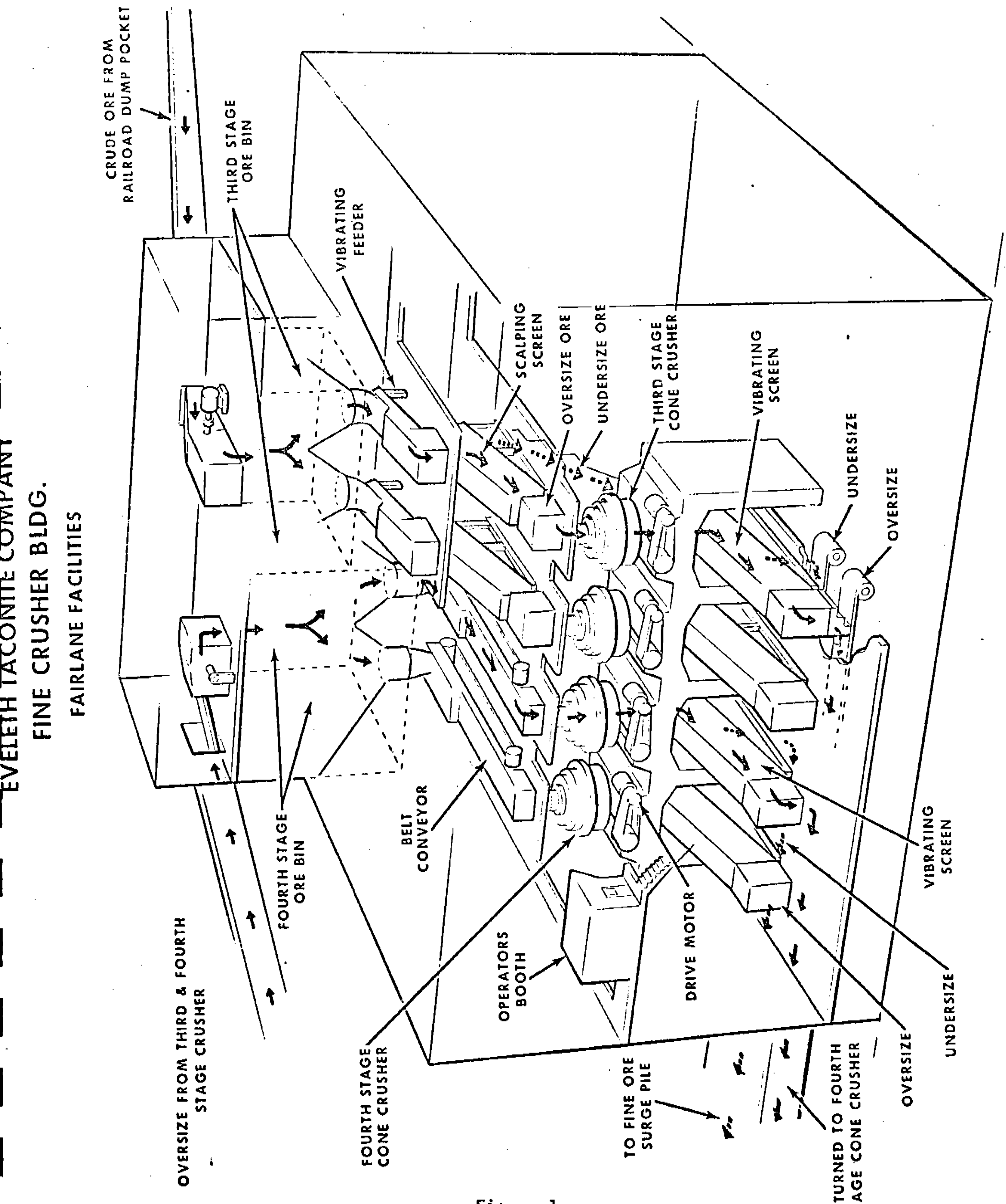
The second emission source at Eveleth was a Ducon collector operating on the plenum chamber between the grate machine and kiln. Dust emissions at this source therefore would be from dried pellets which have been preheated to about 800 F. Prior to conducting these tests a straightening vane was positioned in the stack for the Ducon outlet and this apparently eliminated much of the cyclonic flow patterns peculiar to the Ducon units. Total waste gas from this source is about 15,000 scfm.

Three separate samples were taken at Sites C and D on November 20, 1975. The samples were started at about 10:40 a.m., 1:00 p.m., and 3:00 p.m., respectively. During each period, the pellet plant was producing about 300 tons per hour of green balls with four of the balling drums in operation. Other pertinent operating data are shown in Table 1.

Generally, the production rate was somewhat lower on November 20 than earlier in the week, reportedly because of insufficient feed material coming from the concentrator. It is believed however that this would have only minor influence on the dust loadings for Sites C and D.

During each of the six stack sampling periods, a sample was obtained of the green ball feed to the grate furnace. These samples, identified below, will be retained at Battelle to be used for later analysis.

	Green Ball Sample Identification Code
Sites A and B:	
First Sample	S-75-000-342
Second Sample	S-75-000-343
Third Sample	S-75-000-344
Sites C and D:	
First Sample	S-75-000-345
Second Sample	S-75-000-346
Third Sample	S-75-000-347



EVELETH TACONITE COMPANY
FINE CRUSHER BLDG.
FAIRLANE FACILITIES
CRUDE ORE FROM RAILROAD DUMP POCKET
THIRD STAGE ORE BIN
VIBRATING FEEDER
SCALPING SCREEN
OVERSIZE ORE
UNDERSIZE ORE
THIRD STAGE CONE CRUSHER
VIBRATING SCREEN
UNDERSIZE
OVERSIZE
OVERSIZE FROM THIRD & FOURTH STAGE CRUSHER
FOURTH STAGE ORE BIN
BELT CONVEYOR
FOURTH STAGE CONE CRUSHER
OPERATORS BOOTH
DRIVE MOTOR
VIBRATING SCREEN
UNDERSIZE
OVERSIZE
UNDERSIZE
TO FINE ORE SURGE PILE
RETURNED TO FOURTH STAGE CONE CRUSHER
OVERSIZE

Figure 1

EVELETH TACONITE COMPANY
CONCENTRATOR
FAIRLANE FACILITIES

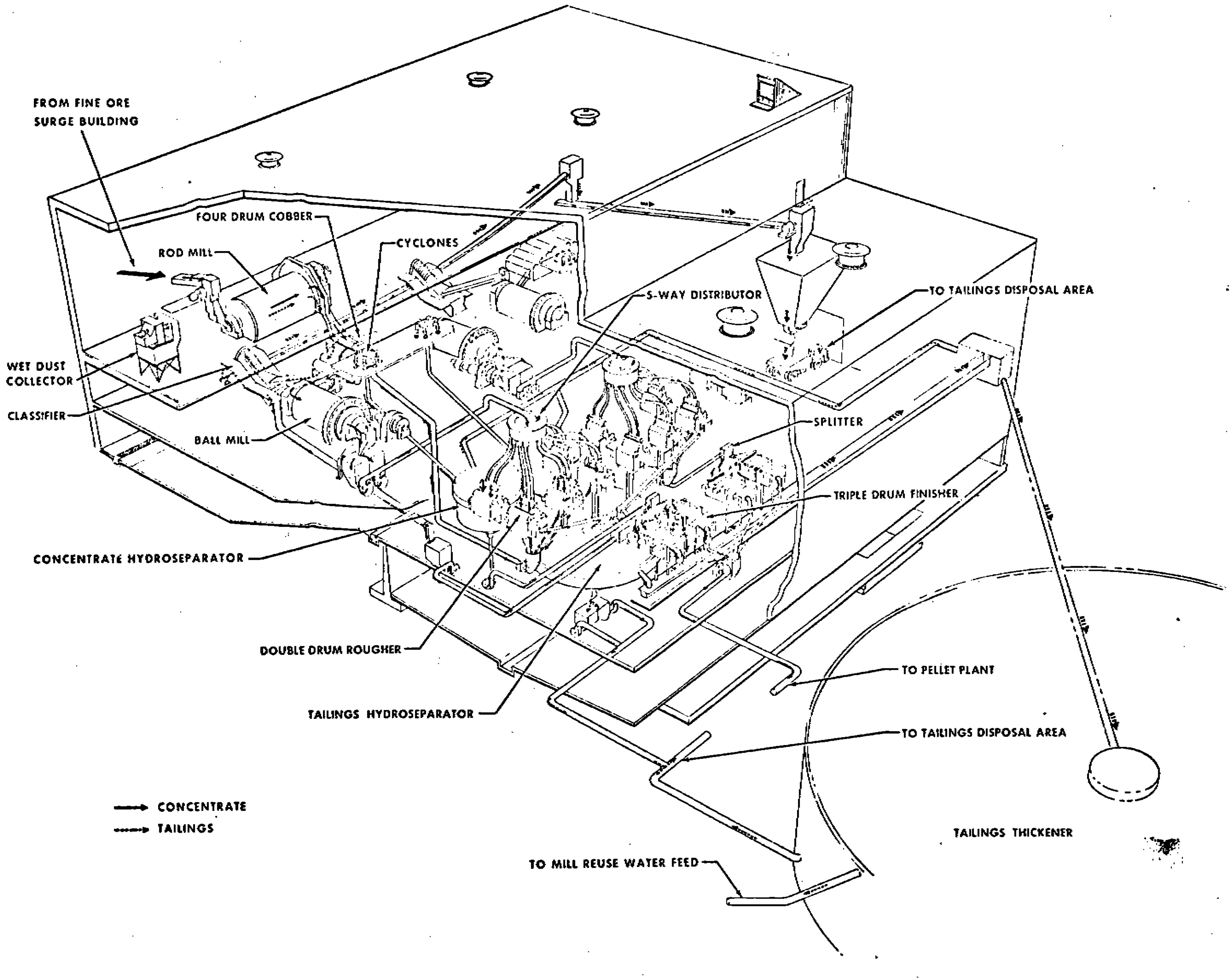


Figure 2

EVELETH TACONITE COMPANY
PELLET PLANT
FAIRLANE FACILITIES

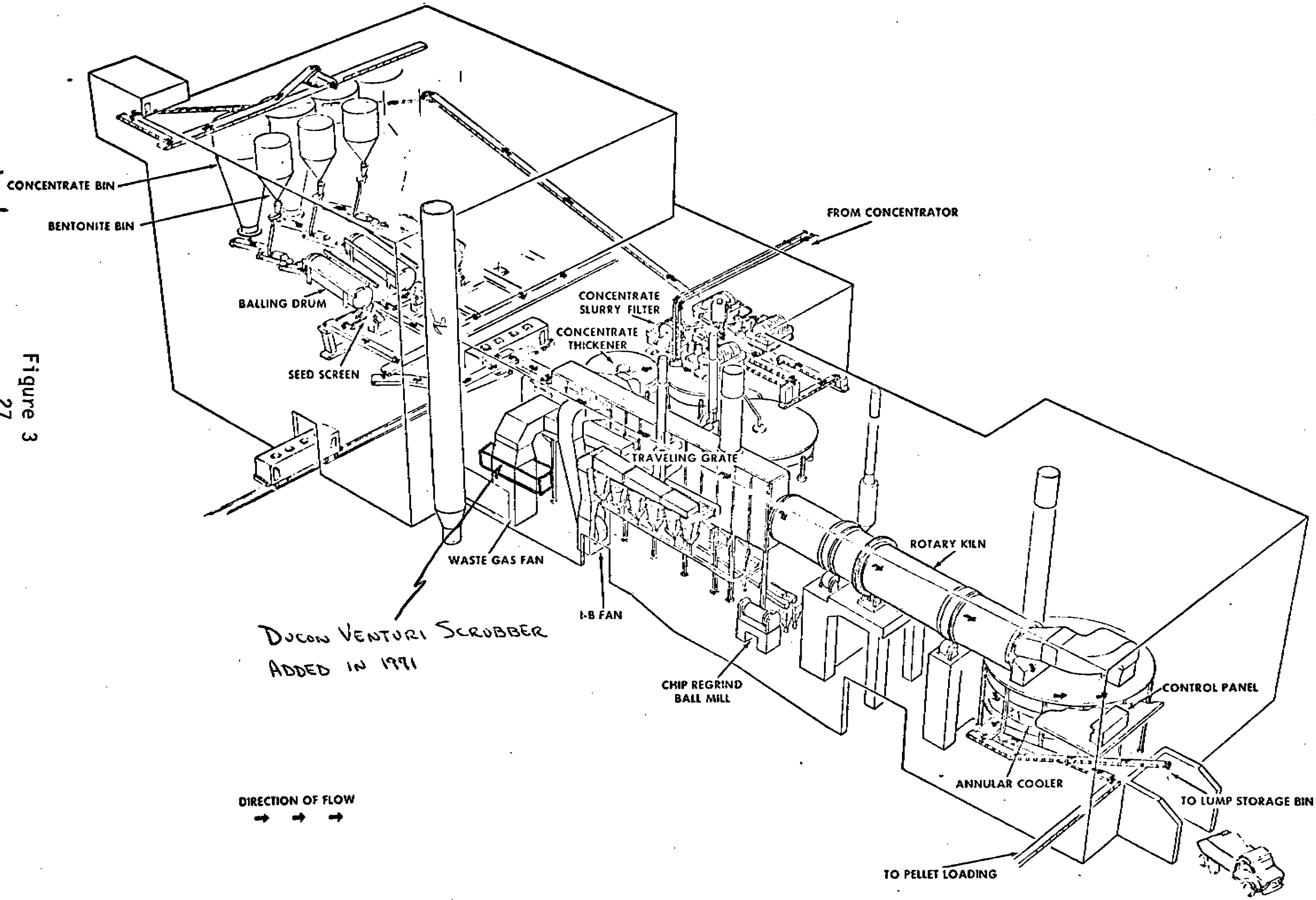


Figure 3

IV. LOCATION OF SAMPLING PORTS

(Waste Gas Scrubber)

Figure 1 shows the relative location of sampling points across the Ventrui Scrubber controlling the waste gas emissions. The sampling points on the inlet (Point A) are shown on Figure 2. Forty-eight points were required due to the configuration of the ductwork.

The location of points at the outlet (Point B) are presented in Figure 3. Twenty-four points, 6 on each 90^{o} radius, were selected to keep the simultaneous sampling coordinated with time.

The inlet ports were located in a horizontal plane on an inclined duct 12 feet wide by 8 feet 6 inches deep. The duct being inclined approximately 15^{o} in the direction of flow. This required modification to Method 5 as shown in Figure 4.

(Grate Discharge Scrubber)

Illustration of the Sampling locations on the grate discharge scrubber can be seen on Figure 5. A preliminary traverse indicated cyclonic flow, consequently straightening vanes were installed to correct this problem. The location of these vanes can be seen on Figure 6. Also found in Figure 6 is the location of sampling Points at the outlet (Point D).

Figure 7 shows the location of 16 individual points on the inlet.

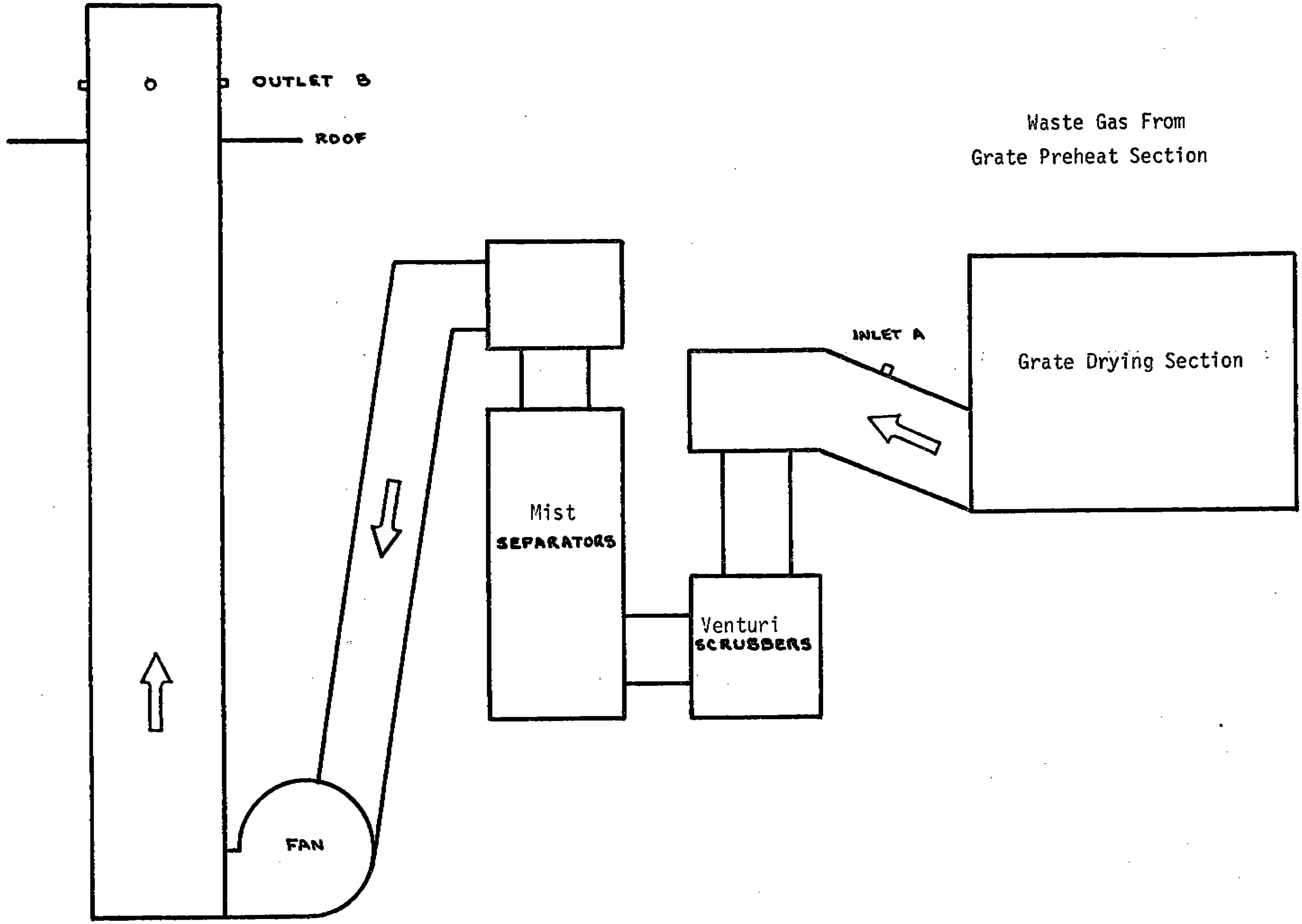


FIGURE 4 - Waste Gas Scrubber

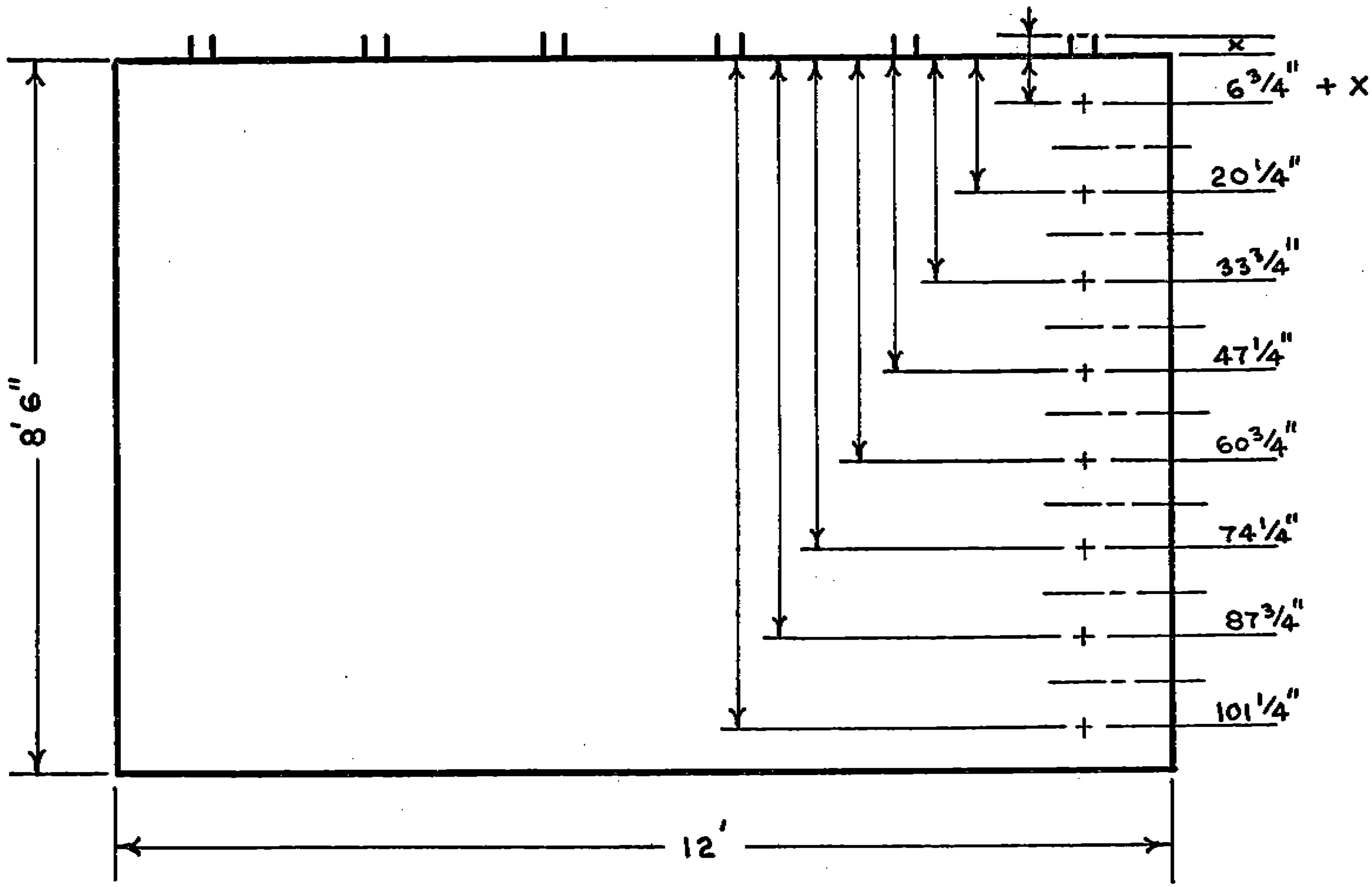


FIGURE 5 - Waste Gas Scrubber Inlet, Point A

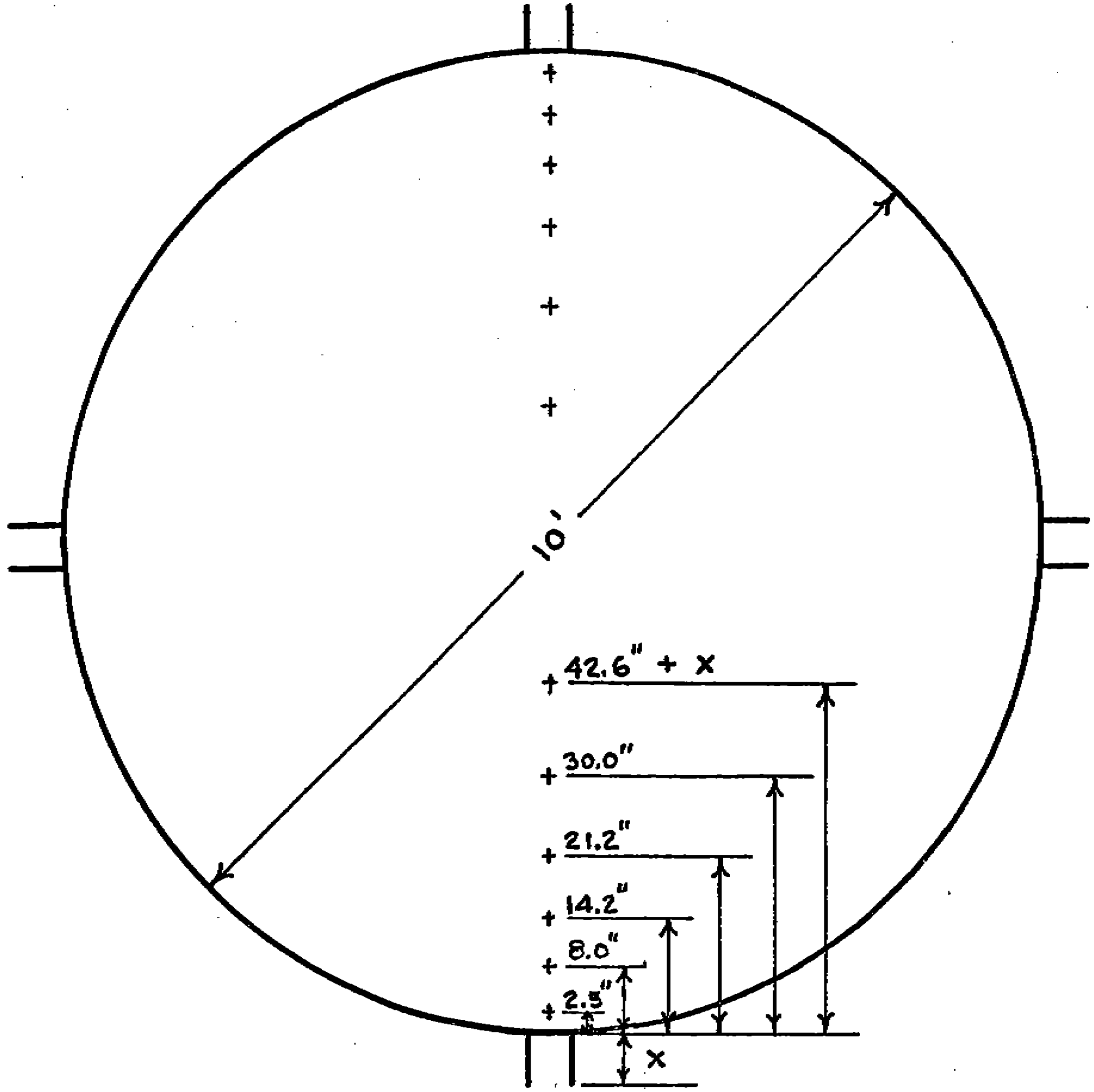


FIGURE 6 - Waste Gas Scrubber Outlet, Point B

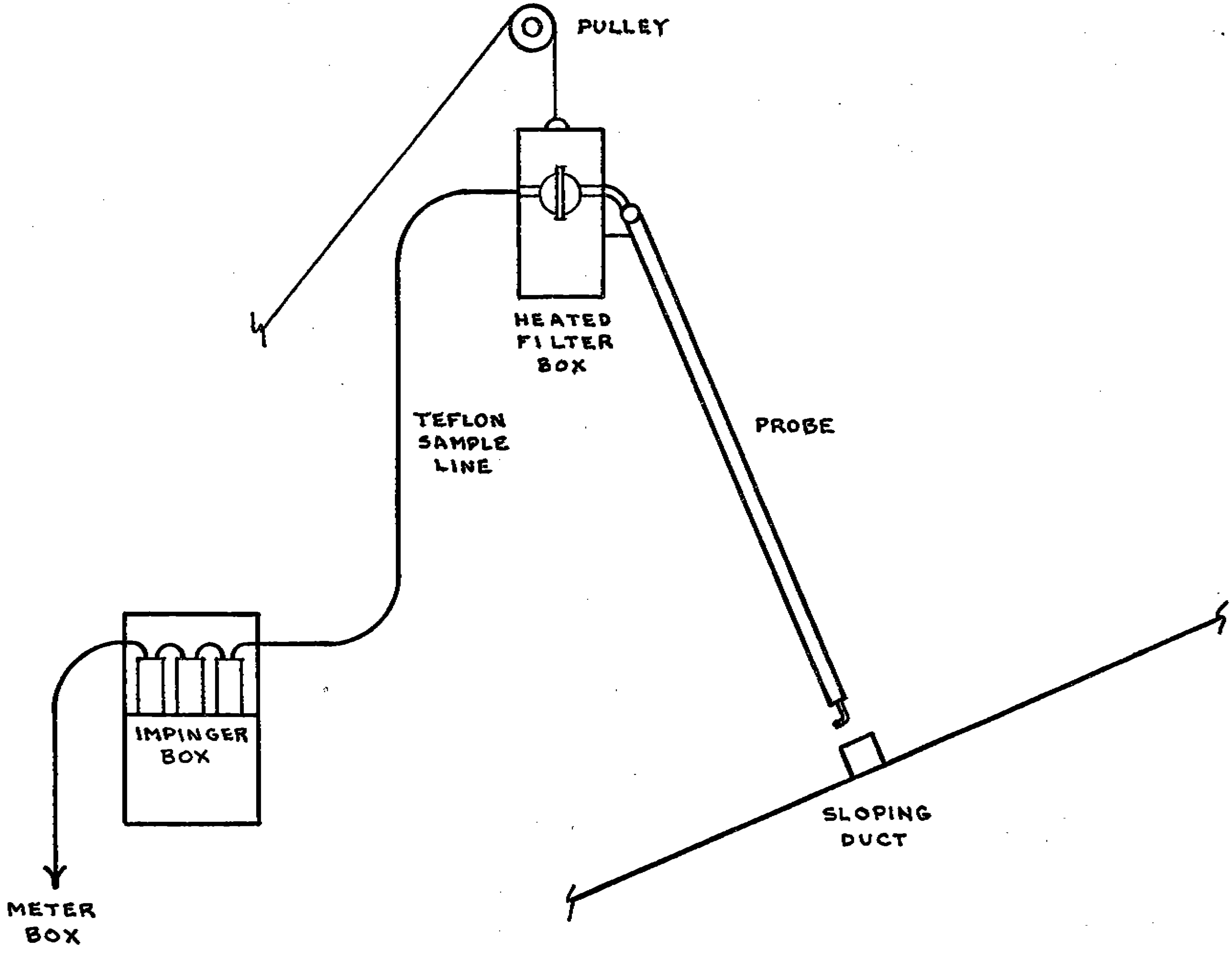


FIGURE 7 - Point A, Inlet Setup

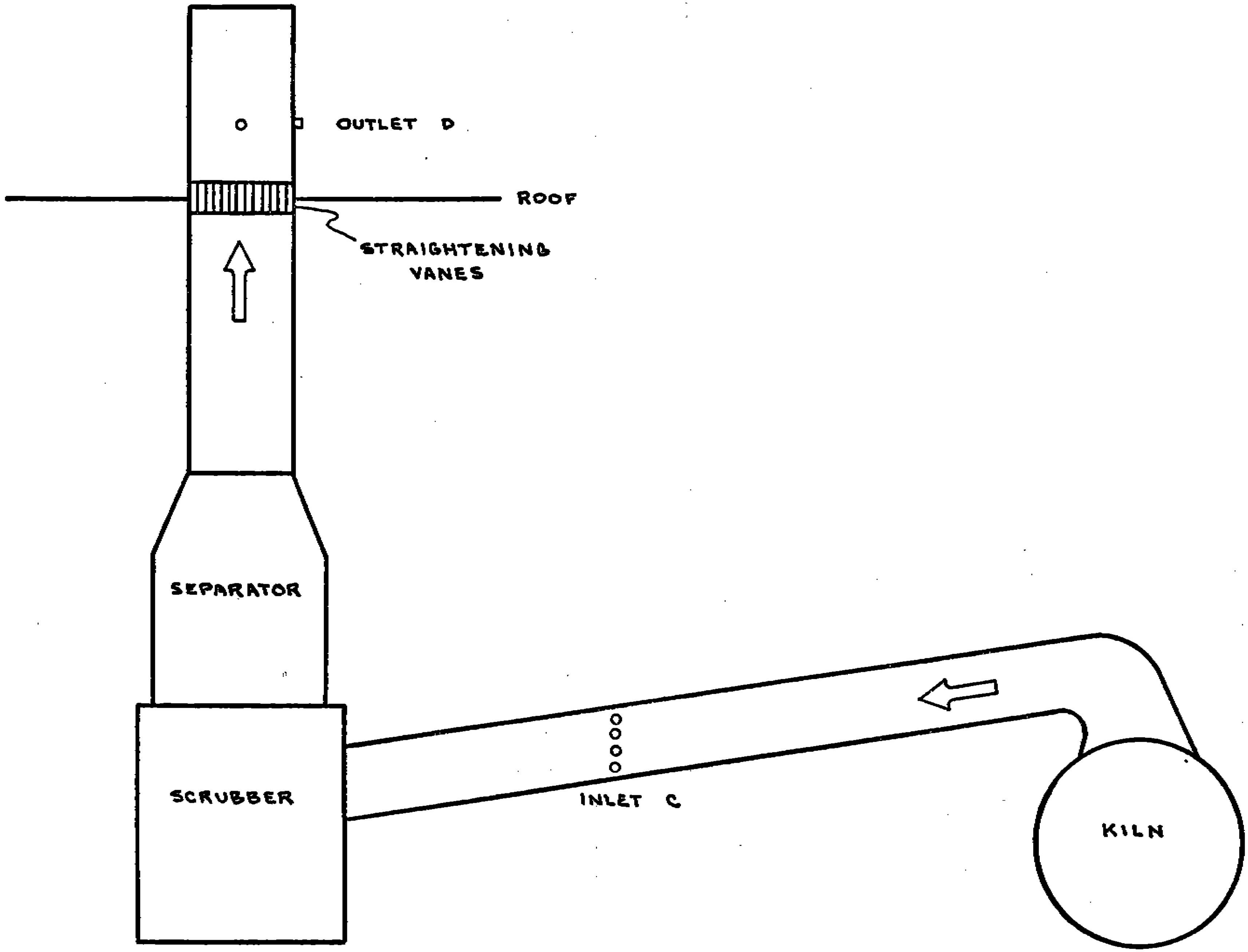


FIGURE 8 - Grate Discharge End Scrubber

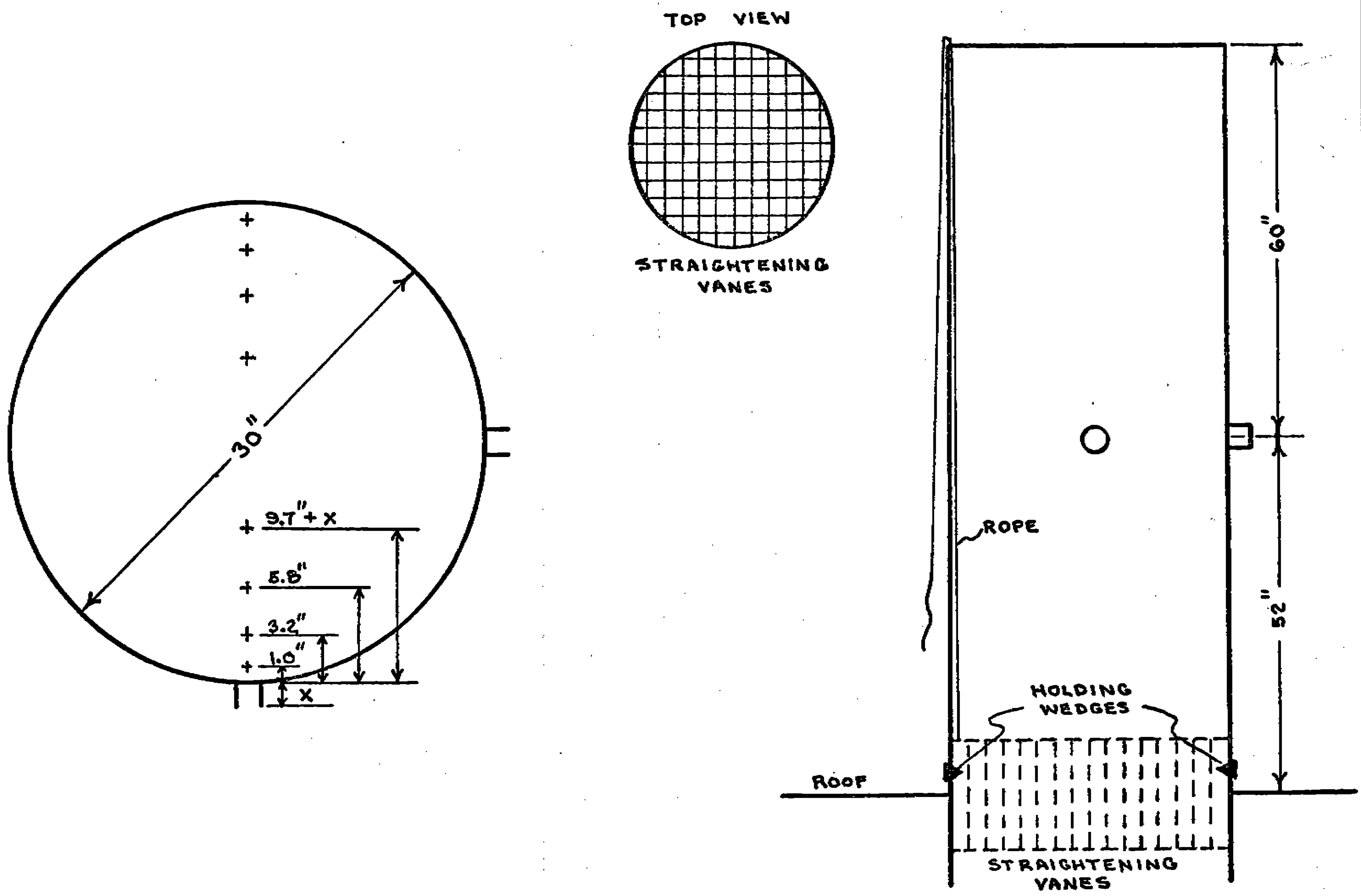


FIGURE 9 - Grate Discharge End Scrubber Outlet, Point D

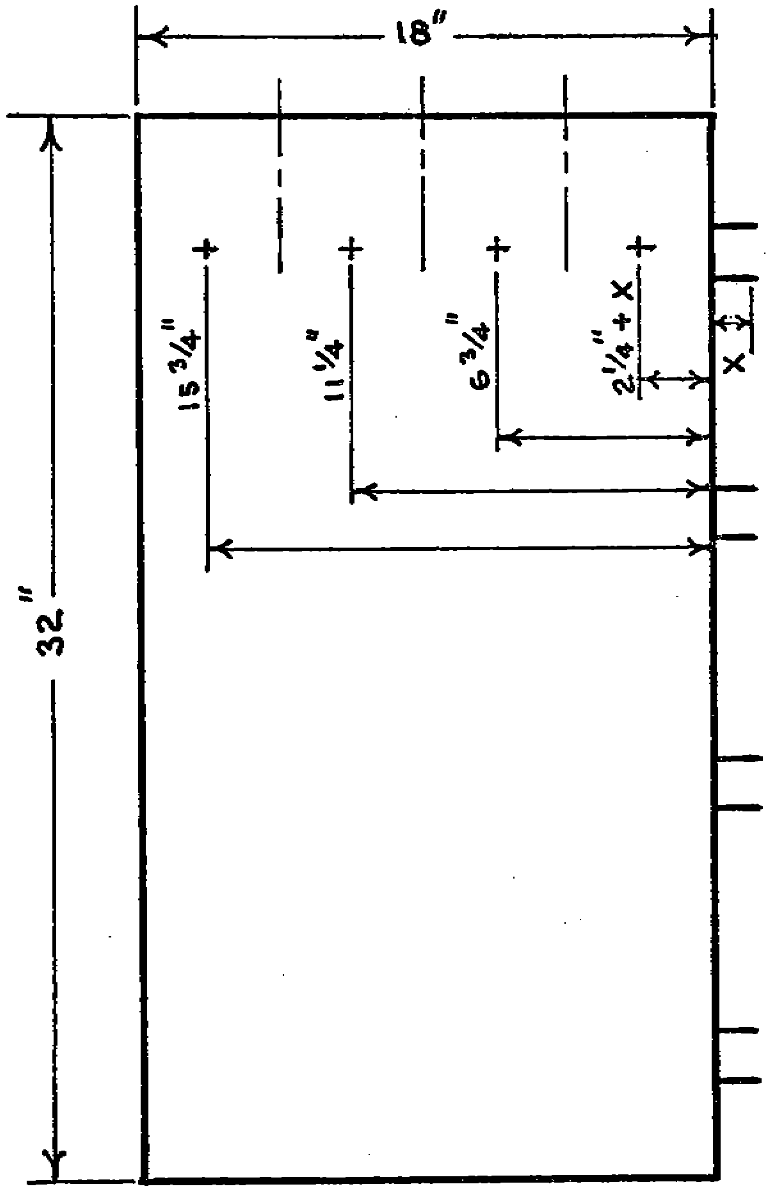


FIGURE 10 - Grate Discharge End Scrubber Inlet, Point C

V. SAMPLING AND ANALYTICAL PROCEDURES

Particulate and Asbestos

Particulate sampling was conducted according to Method 5 as prescribed in the*FEDERAL REGISTER with minor modifications. A millipore filter was used in place of the usual glass fiber filter in order to conduct subsequent asbestos analysis. Asbestos analysis requires the dissolution of the millipore filter so that asbestos fibers can be isolated for microscopic analysis. Use of millipore filters require that filter temperature be maintained under 200°F to prevent degradation of the filter.

SO_2

SO_2 sampling was conducted according to Method 6 in the *FEDERAL REGISTER.

*FEDERAL REGISTER, December 23, 1971, Vol 36 - Number 247, Standards of Performance for New Shationary Sources.

Particle Sizing

Table II summarizes Particle Size Data.

Brinks at Inlet A - Notes

The initial attempt to do the particle sizing at the inlet consisted of lowering the Brink unit into the inlet stack, however, the unit would not fit into the 3-inch port. The Brink impactor was placed into the heater box that was fabricated by EPA, however, the heater and fan did not work. A probe nozzle, 1.5 mm, was placed on a 1-foot probe (stainless tubing) and placed into the stack. A 6-foot Teflon connector was used between the probe and the impactor. During Run 1-I the impactor was not heated, however, during the next 2 runs a heating tape was wrapped around the impactor and used to keep the impactor at approximately 212°F. The first run lasted 5 minutes and since the loading was not excessive, the length of the next two runs was increased to 8 minutes and 10 minutes. The equation used to calculate the orifice Δ P indicates a Δ P of 0.11" H_2O. However, the vacuum reached 10" Hg. when the Δ P was 0.04" H_2O. The flow rate was approximately 0.10 ft^3/min. which was near the desired 0.09 ft^3/min.

The first 2 runs seemed to provide reasonable results. Run No. 3 proved to be the exception, with the results of the aluminum pan weighings proving to be negative. The same balance (one from the lab at Eveleth Taconite) was used for all the Brinks and Andersen weighings. A significant amount of particulate was in the probe washings. Since there were no sample bottles the probe was washed with acetone and the washing placed in a tared beaker, with the acetone being evaporated in an oven at 100°C and desiccated before weighing. The probe washings included everything from the probe tip to the first stage of impactor. No washing was done on the rest of the stages. The final filter was difficult to weigh since the filter was adhering to the rubber gasket in the filter holder. A very slight greyish color was evident on the final filters even though no particulate collection was indicated by the weighings.

Anderson At Outlet B

Due to an operator error, the first run was performed at a flow rate considerably lower than needed for it to be isokinetic. Also the weighings were suspect (explained on weighing sheet). The last two runs were performed at an isokinetic flow rate. The amount of particulate collected during Run No. 2-0 is considerably more than during Run No. 3-0. No explanation can be given for this. The probe washing was done using acetone to rinse the nozzle and the conical part of the Anderson sampler. The filters were weighed on the metal plates along with the gaskets and crossbars. The sampler was placed in the stack for approximately 15 minutes before the run to allow it to reach stack temperature before sampling was started.

Particle Size

Calculations - Brinks

INLET

Flow rate 85.48 (.85) $\frac{672}{28.8 \times 28.5}$ 1.55 = 82 ft/sec.

Nozzle Size for Brinks - No Grease

Needed < 1.0 mm - Used 1.5 mm

Flow rate = 0.09 ACFM

This flow rate is higher than Figure 1 allows, however, it must be used since there is no smaller nozzle.

$$\Delta H = \Delta Hc \ \ Qn \ \ (1 - F_{H_2O})^2 \ \frac{P_s^2}{P_o} \ \ \frac{T_o}{T_s^2} \ \ \frac{M_s}{M_a}$$

$$\Delta H_c = \frac{\Delta P \ T_c}{P_c Q_c} = \frac{1.86}{(0.75)} \ \frac{(530)}{(29.8)} \text{ assumed } = 45.5$$

$$\Delta H = 45.5 \ \ (0.09)(1 - .05)^2 \ \frac{(27.9)^2}{28.8} \ \ \frac{540}{(672)^2} \ \ \frac{28.5}{29} =$$

$$0.11'' \ H_2O$$

$$\Delta H = 0.11'' \ H_2O$$

Particle Size

Calculations - Anderson

OUTLET

Flow rate = $85.48\ (.85)\ \frac{585}{27.57 \times 28.8}\ 2$ = 88 ft/sec.

Nozzle size for Anderson from Figure 1

Needed 4.0 mm + .67 ACFM

Used 3.4 mm + .51 ACFM

$$\Delta H = \Delta H_c\ Q_n\ (1 - F_{H_2O})^2\ \frac{P_s^2}{P_o}\ \frac{T_o}{T_s^2}\ \frac{M_s}{M_a}$$

$$\Delta H_c = 44.1$$

$$\Delta H = 44.1\ (0.51)\ (1 - .13)^2\ \frac{(28.8)^2}{28.8}\ \frac{510}{(585)^2}\ \frac{27.57}{29}$$

$$\Delta H = 0.69 \text{ ACFM}$$

[redacted]LE [redacted]

Particle Size Results

Brinks - Inlet Point A

	Geometric Mean Diameter			Low Limit			Cumulative %			Grains/SCDF/Stage			Mass mg.		
Run #	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Stage Cycle	46.4	46.3	46.3	4.30	4.28	4.28	100	100	100	.621	.331	.176	24.7	18.5	12.3
1	3.38	3.42	3.43	2.66	2.74	2.74	5.0	7.55	.811	.0125	.0125	0	.5	.7	0
2	2.04	2.10	2.10	1.57	1.61	1.61	3.08	4.05	.811	.0025	0	0	.1	0	0
3	1.29	1.32	1.32	1.07	1.09	1.09	2.70	4.05	.811	.0025	.0036	.0014	.1	.2	.1
4	.765	.774	.774	.548	.551	.551	2.31	3.05	0	.0075	.0020	0	.3	.11	0
5	.412	.407	.407	.309	.302	.302	1.15	2.50	0	.0075	.0090	0	.3	.5	0
F	.0556	.0549	.0549	---	---	---	0	0	0	0	0	0	0	0	0

Anderson - Outlet B

Run #	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Stage															
1	8.47	6.73	12.2	23.9	15.1	14.9	100	100	100	.0204	.0798	.0099	3.0	22.9	4.0
2	18.9	11.9	11.8	14.9	9.44	9.29	72.2	45.2	56.5	0	.0244	.0012	0	7.0	.5
3	12.3	7.79	7.66	10.2	6.42	6.32	72.2	28.5	51.1	.0041	.0115	0	.6	3.3	0
4	8.38	5.30	5.22	6.93	4.38	4.31	66.7	20.6	51.1	.0094	.0098	.0020	1.4	2.8	.8
5	5.57	3.52	3.46	4.48	2.83	2.79	53.7	13.9	42.4	.0027	.0136	.0037	.4	3.9	1.5
6	3.18	2.01	1.98	2.26	1.43	1.41	50.0	4.55	26.1	.0054	.0042	.0025	.8	1.2	1.0
7	1.79	1.13	1.11	1.41	.892	.878	42.6	1.68	15.2	0	.0007	.0027	0	.2	1.1
8	.890	.560	.551	.561	.352	.346	42.6	1.20	3.27	.0312	.0017	.0007	4.6	.5	.3
Filter	.0749	.0593	.0588	---	---	---	0	0	0	0	0	0	0	0	0

New REF 6

Emission Test Report
Review Checklist

Reviewer: Brian Shrager
Review Date: 3/31/92

A. Background Information

1. Facility name: Eveleth Taconite Company

   Location: Eveleth, Minnesota.

2. Source category: Taconite ore processing

3. Test date: November 17-20, 1975

4. Test sponsor: EPA / EMB

5. Testing contractor: ____________

6. Purpose of test: To determine if particulate or SO_2 emissions are large enough to justify the development of a NSPS for this industry; To determine if asbestos emissions pose a hazardous pollutant problem.

7. Pollutants measured

   (PM) PM-10 CO (SO_2) NO_x VOC Pb CO_2

   Others (list): Asbestos

8. Process overview: On an attached page provide a block diagram of the unit operations and associated air pollution control systems at the facility. Identify process tested with letters from the beginning of the alphabet (A, B, C, etc.) and APC systems with letters from end of alphabet (V, W, X, etc.). Also identify test locations with Arabic numerals (1,2,3, ...). Using the ID symbols from that sketch complete the table below that identifies processes or unit operations tested.

Test ID	Process	Process ID	Emissions tested: Uncontrolled	Emissions tested: Controlled	APCD (controlled emissions only)
1	Traveling Grate	A	✓	~~✓~~	
2	Traveling Grate	~~B~~ A		✓	Venturi Scrubber
3	Traveling Grate	~~C~~ A	✓		
4	Traveling Grate	~~D~~ A		✓	Ducon Collector

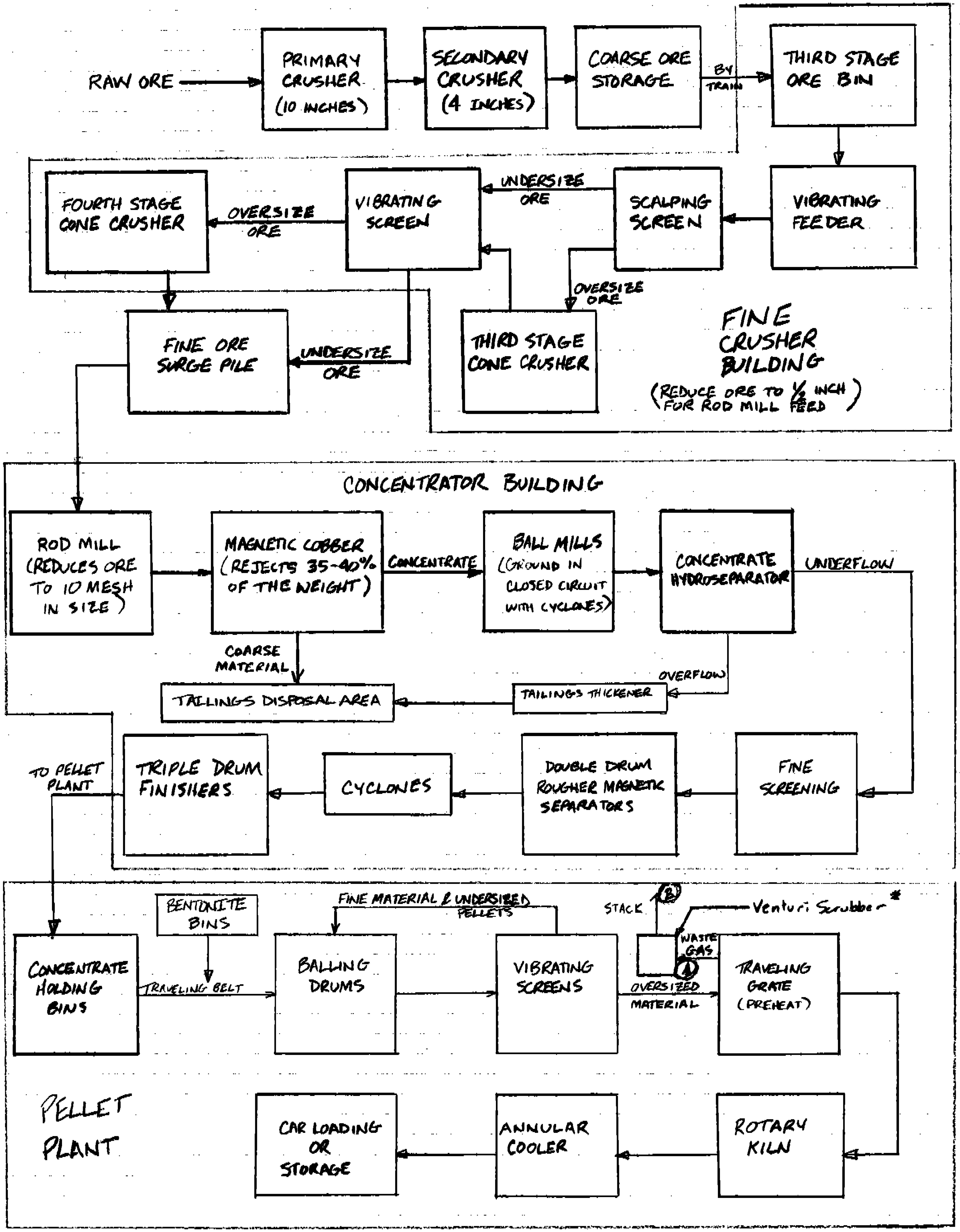
B. Process Information

1. Provide a brief narrative description of the process. With as much detail as possible, (e.g., if a furnace or conveyor system is used, identify the type of unit) describe the equipment used for those operations tested. (Note: If process description provided in test report is adequate, attach copy or reproduce here.)

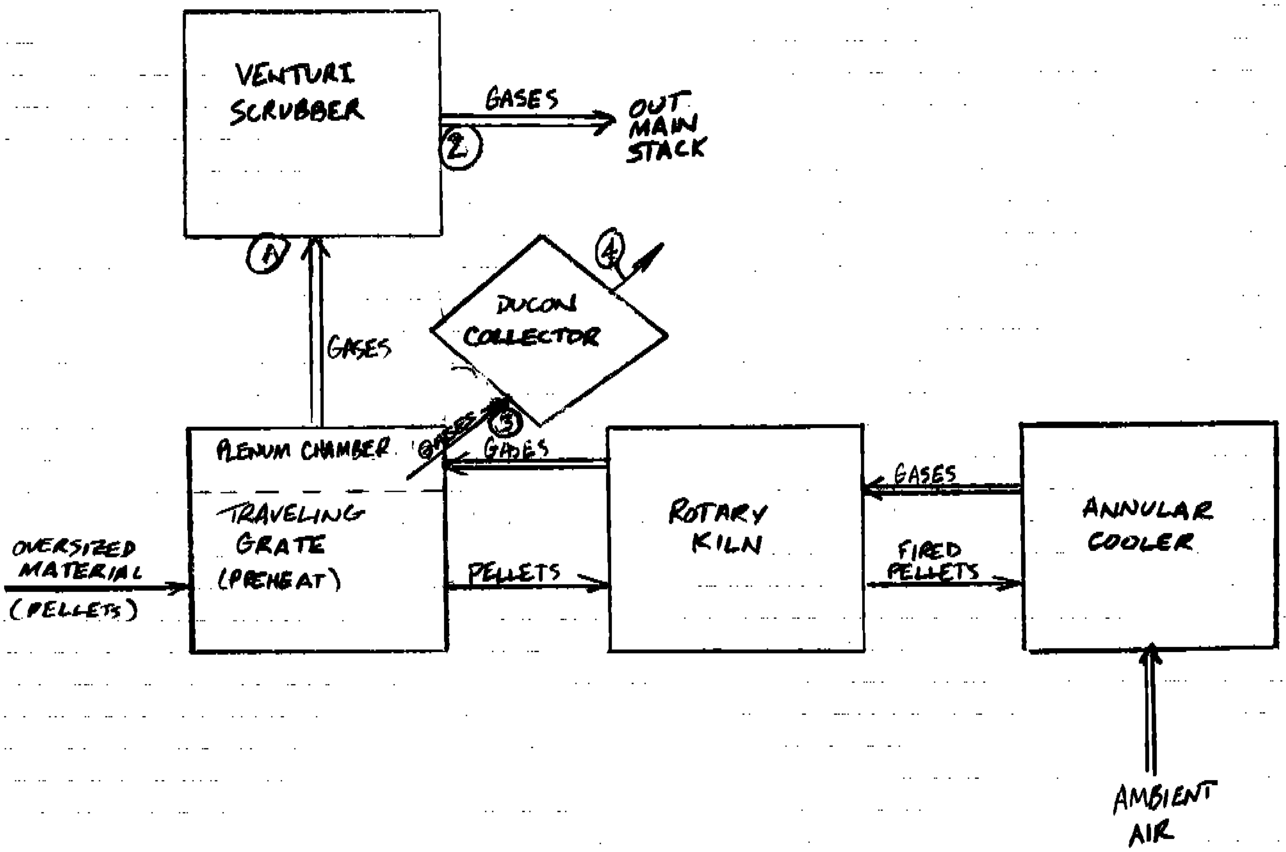
Ore from the mine is crushed to 10 inches in the primary crusher, 4 inches in the secondary crusher, and stored until it is taken, by tram, to the fine crusher building. The ore is then screened for size, and oversize ore is crushed to ½ inch. This material is taken to the concentrator building, where it is reduced to about 10 mesh in size by the rod mill. The rod mill discharge goes to the magnetic cobber, which rejects coarse material (35 to 40 percent) and conveys it to a holding bin. The concentrate from the magnetic cobber goes to ball mills for further grinding, and the overflow from the ball mills goes to hydroseparators. The concentrate from the hydroseparators goes to double drum rougher magnetic separators, cyclones, and triple drum finishers, and then it is pumped to the pellet plant. The overflow from the hydroseparators and the coarse material from the magnetic cobber are tailings, and are transported to the tailings disposal area.

At the pellet plant, bentonite is added to the concentrate, and this mixture is fed to balling drums. From the balling drums, the mixture goes to vibrating screens, which recycle fine material and undersize balls back to the balling drums. The oversize "green balls" pass to a traveling grate/kiln where they are preheated and heated, and then they are cooled in the annular cooler. From the cooler, the finished "green pellets" are stored or car-loaded for shipping.

The emission tests took place in the pellet plant. Tests 1 + 2 measure emissions before and after a venturi scrubber in the main waste gas stack. The emissions come from air that is used to cool pellets in the cooler, and then helps to heat the kiln and preheat the grate before leaving the plant through the main stack. The gases pass through a multiplicity of dry cyclone collectors before reaching the stack (test 1).



* SEE NEXT SHEET


VENTURI SCRUBBER
GASES
OUT MAIN STACK
2
1
4
DUCON COLLECTOR
GASES
PLENUM CHAMBER
GASES
3
GASES
TRAVELING GRATE (PREHEAT)
OVERSIZED MATERIAL (PELLETS)
PELLETS
ROTARY KILN
GASES
FIRED PELLETS
ANNULAR COOLER
AMBIENT AIR

[illegible]

2. For each process tested list feedstock materials and products. Indicate if activity factors are for feed (F) rate or product (P) rate.

Process ID	Feedstock materials	Products	Basis for activity factor	F/P
A	Green Balls	Fired Pellets	Green Balls	F
~~B~~ A	Green Balls	Fired Pellets	Green Balls	F
~~C~~ A	Green Balls	Fired Pellets	Green Balls	F
~~D~~ A	Green Balls	Fired Pellets	Green Balls	F

Basis for data: ______________________
(Indicate page/table Nos. in test report)

3. For each process or operation tested and each test run note process capacity and operating rate during test.

Process ID	Capacity	Units	Test run	Process rate	Units
A	400	tons/hr	1	360	*tons/hr
			2	360	*tons/hr
			3	330	*tons/hr
			4		
~~B~~ A	400	tons/hr	1	360	*tons/hr
			2	360	*tons/hr
			3	330	*tons/hr
			4		
~~C~~ A	400	tons/hr	1	300	*tons/hr
			2	300	*tons/hr
			3	300	*tons/hr
			4		
~~D~~ A	400	tons/hr	1	300	*tons/hr
			2	300	*tons/hr
			3	300	*tons/hr
			4		

Basis for data: Table 1 Pg 22 *tons of green balls produced/hr

C. Air Pollution Control Systems Tested

1. For each air pollution control system pollution control system identified in A.8, note the following

ID	Type of APCD	Manufacturer	Model No.
Y	Venturi Scrubber	Ducon	
Z	Wet Scrubber	Ducon	UW-4

Note: Be as specific as possible in identifying APCD. For example, indicate "pulse jet fabric filter" rather than simply "fabric filter."

2. For each system identified above, provide a narrative description. For fugitive systems describe capture techniques as well as the removal techniques (use a separate page if necessary)

venturi scrubber: - 4 venturi scrubbers w/ 2 water eliminatory.
- mild steel construction - corrosion problems
- only plant in the industry to use a venturi collector for the main waste gas emissions.

3. Using the attached parameter list for guidance complete the table below. (Use additional pages as needed.)

APCD ID	Parameter	Units	Readings			
			Run 1	Run 2	Run 3	Run 4
Y	ΔP	IN. H_2O		0.67	0.60	
Type of APCD: Venturi Scrubber	L/G					
	MIST ELIM. TYPE					
Z						
Type of APCD: wet Scrubber						
Type of APCD:						

D. Sampling and Analysis Methods

1. Complete the following table

Test location	Pollutant	S & A method	Reference/ conditional method	Deviations noted
ALL	PM	Method 5	(Y)/N	(Y)/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
~~A~~ and ~~B~~ 1 2	SO_2	Method 6	(Y)/N	Y/(N)
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N

2. If a method used was not a reference or conditional method, provide a narrative discussion including any data manipulation needed to make results correspond to reference or conditional method results.

3. Describe any deviations identified above.

In method 5, a millipore filter was used instead of the usual glass fiber filter, so that asbestos analysis could be conducted.

E. Emission Data Documentation

1. Tabulate the following stack gas data from the test report. (Use additional pages as needed.)

Test ID	Parameter	Units	Values reported			
			Run 1	Run 2	Run 3	Run 4
1 ~~A~~	Stack temperature	°F	—	207.0	251.0	
	Moisture	SCF	—	8.77	4.83	
	Oxygen	% BY VOL. DRY	—	19.6	19.6	
	Volumetric flow, actual	ACFM	—	462,694	491,631	
	Volumetric flow, standard	SCFM	—	282,249	300,825	
	Percent isokinetic	%	—	120.1	104.8	
	Pollutant concentration:					
	PM	G/SCF	—	2.7183	1.6166	
	SO_2	PPM	16.29	10.04	9.56	
2 ~~B~~	Stack temperature	°F	127.0	125.0	137.0	
	Moisture	SCF	0	6.92	8.29	
	Oxygen	% BY VOL. DRY	19.1	19.3	19.2	
	Volumetric flow, actual	ACFM	363,863	359,520	384,229	
	Volumetric flow, standard	SCFM	273,044	273,627	278,880	
	Percent isokinetic	%	103.0	107.8	109.8	
	Pollutant concentration:					
	PM	G/SCF	0.05384	0.11010	0.09163	
	SO_2	PPM	<0.23	2.67	15.29	
3 ~~C~~	Stack temperature	°F	193.0	190.0	177.0	
	Moisture	SCF	0.70	1.14	0.59	
	Oxygen	% BY VOL. DRY	21.0	21.0	21.0	
	Volumetric flow, actual	ACFM	18,034	18145	17,471	
	Volumetric flow, standard	SCFM	13,593	13,552	13,523	
	Percent isokinetic	%	113.8	107.3	106.6	
	Pollutant concentration:					
	PM	G/SCF	4.0868	3.3329	3.2587	

E. Emission Data Documentation

1. Tabulate the following stack gas data from the test report. (Use additional pages as needed.)

Test ID	Parameter	Units	Values reported			
			Run 1	Run 2	Run 3	Run 4
4~~B~~	Stack temperature	°F	78.0	73.0	68.0	
	Moisture	SCF	0	0	0	
	Oxygen	% BY VOL. DRY	20.7	20.5	21.0	
	Volumetric flow, actual	ACFM	14,927	14,270	14637	
	Volumetric flow, standard	SCFM	13,254	13,197	13,149	
	Percent isokinetic	%	99.4	97.8	100.4	
	Pollutant concentration:					
	PM	G/SCF	0.00734	0.00479	0.00329	
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					

2. Tabulate pollutant mass flux rates

Test ID	Pollutant	Units	Mass flux rates			
			Run 1	Run 2	Run 3	Run 4
~~A~~ 1	PM	lb/hr	—	6576.56	4168.49	
	SO_2					
~~B~~ 2	PM	lb/hr	126.01	258.22	219.03	
	SO_2					
~~C~~ 3	PM	lb/hr	476.16	385.99	377.73	
~~D~~ 4	PM	lb/hr	0.83	0.54	0.37	

3. Present example emission factor calculations below.

TEST A

PM $\frac{(6576.56 + 4168.49)}{2}$ lb/hr ÷ 360 tons/hr = 14.92 lb/ton

4. Tabulate emission factors

Process	Pollutant	Units	Average emission factor	
			Uncontrolled	Controlled
A	PM	lb/ton green balls		14.92
	SO_2			
~~B~~ A	PM	lb/ton green balls		0.57
	SO_2			
~~C~~ A	PM	lb/ton green balls	1.38	
~~D~~ A	PM	lb/ton green balls		1.93E-03

ATTACHMENT A
APCD PARAMETERS

Type of APCD	Parameters
Fabric filter	Cleaning mechanism Bag type Cleaning frequency Air to cloth ratio (A/C) Pressure drop Inlet temperature
ESP	Type (wet or dry) Number of fields Rapping cycle (if dry) Specific Collection Area (SCA) Particulate resistivity (if known) Spark rate Current and power levels
Venturi (or other high energy) scrubber	Pressure drop Liquid/gas (L/G) ratio Mist eliminator type
Packed-bed scrubber	Packing depth L/G ratio Caustic use (Y/N) pH Mist eliminator type
Carbon absorber	Bed depth Superficial gas velocity Bed temperature Desorption mechanism (media) Flue-gas moisture Cycle length Time-on-line after breakthrough