Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	11.16
Reference:	14
Title:	Written communication from V. J. Tretter, Georgia-Pacific Corporation, Atlanta, GA, to M. E. Kelly, Radian Corporation, Durham, NC, November 14, 1979.

Georgia-Pacific Corporation
Suite 200
2310 Parkla
Atlanta, Ge
Telephone (

GYPSUM
MANUFACTURING
AP-42 Section 8.14
Reference Number
14

A-80-15

II-D-5

November 14, 1979

Ms. Mary E. Kelly, Chemical Engineer
Radian Corporation
3024 Pickett Road
P. O. Box 8837
Durham, North Carolina 27707

Subject: Emission Data, Georgia-Pacific
Gypsum Board Plants

Dear Ms. Kelly:

Enclosed are copies of emission test reports that you requested in your letter of November 2nd. The results of the testing are summarized in the attached Table.

The data shown in the summary should be fairly representative of the type of performance that can be expected from installed precipitators at existing plants. The test data were taken at the request of State Air Pollution Control agencies to demonstrate compliance with their standards. To my knowledge, we have never been requested to test emissions from board dryers or from bag filters. Normally if visible emissions do not occur from these two sources, the State will accept calculated emission values based on manufacturers performance guarantees.

I hope that the enclosed tests will assist you in formulating whether or not New Source Performance Standards are required. If you have any further questions after review of the data, please call me in Atlanta at area code (404) 491-6550.

Yours very truly,

V. J. Tretter, Jr.

V. J. Tretter, Jr.
Chief Environmental Engineer

VJT/jl

Enclosure

cc: J. A. McAlister

TABLE I - TEST DATA SUMMARY

PLANT	SOURCES TESTED	PROCESS CONTROLLED	#TESTS	AVG. FLOW SCFM Dry	AVG. OUT LOADING Grains/SCF Dry
Acme, TX	Research Cottrell ESP	7 Calcining Kettles	3	19,960	0.12
Brunswick, GA	Research Cottrell ESP	6 Calcining Kettles 3 Roller Mills	3	51,610	0.21
Ft. Dodge, IA	Research Cottrell ESP	5 Calcining Kettles 1 Roller Mill 2 Screw Conveyors	3	28,450	0.04
Wilmington, DE	Precipitair ESP	1 Calcining Kettle 1 Roller Mill 1 Conveyor	3	9,280	0.02

MEMORANDUM

MAR 1979 RECEIVED AIR QUALITY LANDER

TO: Charles A. Collins CAC
Air Quality Supervisor

FROM: Bernie Dailey BD
Air Quality Engineer

SUBJECT: Short Term SO_2 and Particulate Model - Georgia Pacific

DATE: March 12, 1979

A short-term particulate and SO_2 model was run for the ESP stack and for the board dryer stacks. The board dryer stacks were combined into an average stack with the stack parameters of emission point 18 used in the model. The model was a short-term model programmed on the H.P. 9821 to give maximum centerline concentrations.

Model input and output as follows:

Input

	ESP	Board Dryer
Stack Ht.	96 ft (29.3 m)	35 ft (10.7 m)
Stack Dia.	4.25 ft (1.3 m)	3.5 ft (1.07 m)
Stack Vel.	22.8 ft/sec (6.94 m/sec)	52 ft/sec (15.85 m/sec)
Stack Temp.	150°F (338°K)	325°F (436°K)
Emission Rate Part.	20 lb/hr (2.52 g/sec)	———
Emission Rate SO_2	13.3 lb/hr (1.68 g/sec)	22.0 lb/hr (2.77 g/sec)

Output - 10 min GLC - SO_2

Source	Stability	Wind Speed	10 Min GLC Part.	10 Min GLC SO_2	Downwind Dist.
ESP	A	1.0 m/sec	56 ug/m^3	37 ug/m^3	.40 km
	B	2.0	51	34	.40
	C	2.0	48	32	.70
	D	3.0	34	23	1.10
	E	1.0	30	20	3.50
	F	1.0	26	17	6.50
Dryer	A	5.0 m/sec		88* ug/m^3	.10
	B	5.0		97	.20
	C	8.0		105	.20
	D	8.0		93	.40
	E	1.0		29	3.80
	F	1.0		28	6.50

*not a realistic condition under stability classification system

The particulate concentrations were calculated by the ratio of the SO_2 emission rate to the particulate emission rate and the calculated SO_2 concentrations.

With the different stack heights, one can see that the maximum concentrations of both stacks do not occur at the same downwind distance or under the same wind speeds. However, to serve as a screening tool the maximum concentrations under C Stability were added and 3 hour and 24 hour concentrations were extrapolated with the following results:

ESP -	32 ug/m^3	SO_2
Dryer -	105 ug/m^3	SO_2
Total	137 ug/m^3	

$$137\ ug/m^3 \left(\frac{10}{180}\right)^{.44} \Rightarrow 38\ ug/m^3 \quad \text{3 hr Max } SO_2$$

$$137\ ug/m^3 \left(\frac{10}{1440}\right)^{.44} \Rightarrow 15\ ug/m^3 \quad \text{24 hr Max } SO_2$$

$$56\ ug/m^3 \left(\frac{10}{1440}\right)^{.44} \Rightarrow 6\ ug/m^3 \quad \text{24 hr Max Particulate}$$

Since it has been shown that the emissions are well below the short-term standards, no violation of the annual standard would be projected. The plant shows compliance with the short-term standards even when very conservative modeling approaches are used.

Georgia-Pacific

intracompany memo

RECEIVED MAR 1 3 1980

RECEIVED SEP 1 8 1978 ENERGY & ENVIRONMENT

to	Mr. Al Mick	location	Portland, Oregon
from	Gary DuTell	location	Springfield, Oregon
subject	~~Particulate~~ Sampling at Acme, Texas — AP	date	August 23, 1978

Rec'd 11/19

1.0 Introduction

This report describes the particulate samples taken of the exhaust gases from the electrostatic precipitator at the Georgia-Pacific Gypsum Plant in Acme, Texas. These tests were performed at the request of Mr. Ray Coates to comply with air quality regulations in the State of Texas.

The field portions of these tests were conducted on August 16 and 17, 1978. The results of these tests are presented in this report. Grain loadings calculated from weights of the particulate samples taken indicate an emission rate of the following: (dry basis)

	Test #1	Test #2	Test #3	Average
Grains/SCF	0.09	0.11	0.17	0.12
Lbs./hour	13.79	19.47	27.87	20.38
* Allowable lbs./hour	28.94	29.54	29.92	29.47

2.0 Description of Source

The gypsum mill at Acme uses a Research Cottrell Electrostatic Precipitator (with magnetic and impulse rappers) to control the exhaust gases of seven calcining kettles.

2.1 Process Material Flow Rates, Fuel Rates

Six of the seven "EHRSAM" calcining kettles were operating during the entire test period. They were producing 43.2 tons/hour or 7.2 tons/hour each.

2.2 Source Design, Type, Size, Etc.

The "Cottrell" Precipitator is the perforated plate type, rated at 40,000 ACFM.

The calcining kettles are the suspended type with combustion controls by "Hawk."

The exhaust stack from the precipitator is steel and had an effective I.D. of 48" at the sampling ports.

2.3 Process Material Composition, Fuel Composition, Etc.

The condition of the precipitator, production rates and the related mill site operations were reported by mill personnel as normal.

* See Appendix for calculation: based on ACFM p. 162 "Texas Air Laws."

2.4 Special Conditions

No special conditions were observed.

3.0 Sampling and Analytical Procedures

Velocities, air flow rates, and sampling rates were computed from differential pressure data and obtained with an "S" type pitot and diaphragm operated manometer readings, using standard ASME traverse methods. The sampling ports used were determined to comply with disturbance minimums necessary for an accurate sampling traverse.*

The sampling train used is an EPA type, commercially available through Joy Mfg. Co. with modification for use by Georgia-Pacific personnel. The train, with the exception of the 6-foot stainless steel probe, is all glass. The probe is followed by a 4-inch filter and four impinger bottles.

The first, third and fourth impingers (fourth filled with silica gel) are modified bubblers, the second being of the Greenburg-Smith design. A schematic of the sampling train is included in the appendix of this report.

3.1 Field Equipment - Dates of Calibration

	Calibrated
"Joy" "S" type pitot	August 1978
"Barber Colman" digital thermocouple	August 1978
"Rockwell" dry gas meter	August 1978
"Torbal" balance	April 1978

I am currently certified for plume evaluation by the Oregon Department of Environmental Quality (Air Quality Control Division). Next certification due March 1979 - Certificate No. 150.

All other related sampling test equipment, manometers, balance, etc. are checked and calibrated before and after each field trip.

3.2 Field Procedures

Each test consists of the usual ninety degree traverse with six points on each traverse, or 12 points total per test. All weights were measured on the same "Torbal" precision balance calibrated to $\pm$ 0.03 mg.

3.3 Analytical Methods

No deviations from standard method.

* See 3.2

3.4 Special Problems or Considerations

New 12-inch rotary seals were installed under each of the three precipitator hoppers. Six of the seven kettles had transition pipes installed that reduce the velocity of air coming out of the kettles. The plant also spent a great deal of time training the employees in air quality awareness and production techniques that have apparently produced significant reductions in grain loadings to the precipitator.

4.0 Sampling Point Description

Two 3-inch diameter ports approximately 33 feet down stream from the blower and 20 feet from the top of the exhaust stack.

5.0 Detailed Results

They are presented in summary form in the appendix of this report.

5.1 Emission Rates

	Test #1	Test #2	Test #3	Test #4
Grains/SCF (Dry)	0.08	0.11	0.17	0.12
Lbs./hour	13.79	19.47	27.87	20.38
Allowable emission rate lbs./hour	28.94	29.54	29.92	29.47

5.2 Gas Volumes, Etc.

Stack ACFM	30,493	31,524	32,187	31,401
Stack SCFM	20,107	20,652	19,131	19,963
Dry gas meter, meter conditions	29	30.81	28.73	29.51

5.3 Percent Isokinetic Sampling Rate

	94.08	96.98	99.46	96.84

5.4 Duration of Test

Tested two days.
Actual sampling time - three hours - one hour each test.

The opacity of the exhaust gases from the precipitator averaged less than 15% during the time the plume was observed through each test period. At no time was the plume observed to have an opacity greater than 25%.

If we can provide any further information about these tests, please call.

H. Gary DuTell
(503)689-1221, Ext. 407

HGD:jk

Attachments

cc: Messrs. Ray Coates; Acme, Texas
Mitch Steffensen; Springfield, Oregon
George Turner; Portland, Oregon
T. W. Richards; Tigard, Oregon

[illegible]
LABORATORY REPORT

PLANT [illegible]

TEST DATE [illegible]

TEST # [illegible]

ANALYST [illegible]

CONTAINER #	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTERS # 1	0.9273	0.7056	0.1217
# 2	—	—	—
FILTER CONTROL	0.7497	0.7504	-0.0007
UPSTREAM WASHINGS	100.6634	100.4437	0.2277
CONTROL	94.3736	94.3097	0.0639
IMPINGER WASHINGS (Acetone)			
CONTROL			
IMPINGER WASHINGS (Water)	103.2705	103.1759	0.0946
CONTROL	94.3736	94.3097	0.0639
$CHCL_3$ & $(C_2H_5)_2O$			
CONTROL			

If control shows weight gain it is subtracted from total. If control shows weight loss it is added to total.

TOTAL 0.3155 grams

TOTAL 315.5 mg.

IMPINGER WATER VOLUME COLLECTED	IMPINGER H_2O (ml)	IMPINGER SILICA GEL (grams)
FINAL	367	605
INITIAL	200	600
TOTAL VOLUME, (ml)	167	5

TOTAL 175 grams

[illegible]-63

Plant _____ Test No. _____

Source _____ Test Date _____

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$28.73 \left(\frac{530}{545}\right)\left(\frac{29.97 + \frac{.7417}{13.6}}{29.92}\right) = 28.04 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (175) = 8.3 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{8.3}{(8.3) + (28.04)} \times 100 = 22.83 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (.85)\ (0.63)\ \sqrt{\frac{659}{(29.96)\ (26.47)}} = 42.67 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts \left[\frac{Vic}{(MH2O)}\frac{(pH_2O)}{(454)}\frac{R}{} + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{689\left[\frac{175}{(18)}\frac{(1)}{}\frac{21.83}{(454)} + \left(\frac{28.73}{545}\right)\left(29.97 + \frac{.7417}{13.6}\right)\right]}{60 \times 60 \times 42.67 \times 29.96 \times} \times 100 \quad 99.4\% \text{ percent}$$

ACFM = (V_s) (60) (As)

(42.67))60) (12.57) = 32,179 ACFM

$$\text{SCFM (dry basis)} = \text{ACFM} \left(\frac{P\ bar_{std}}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B}{100}\right)$$

$$\underline{\quad\quad} \left(\frac{\quad}{29.92}\right)\left(\frac{530}{\quad}\right)\left(1 - \frac{\quad}{100}\right) = \underline{\quad\quad} \text{ SCFM}$$

$$C^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{\text{Vm std}}\right)$$

$$(0.0154)\left(\frac{315.5}{28.04}\right) = \underline{\quad} \text{ gr/scf}$$

$$C^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.17)\ (19,131) = \underline{27.87} \text{ lbs/hr}$$

$$0.048\ (32,187^{0.62}) = \underline{29.92} \text{ lbs/hr}$$

allowable

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	.2293	18.0	4.11
Carbon Dioxide		44.0	—
Carbon Monoxide		28.0	—
Oxygen	[illegible]	32.0	[illegible]
Nitrogen + Inerts	[illegible]	28.2	17.[illegible]
		Total	26.47

	Emissions	Allowable
Ta	13-79	28.94
Tb	19.47	29.54
Tc	27.87	29.92
	20.38 = avg	= 29.47

lb / lb mole

11

VMST=
27.87

VWST=
5.64

BWO=
16.83

LIST VEL PTS
0.55
0.4
0.4
0.4
0.3
0.3

0.3
0.3
0.4
0.4
0.4
0.4
4.550 =SUM
0.379 ÷PTS

7.360 ΓSUM
0.613 ÷PTS

VS AV=
40.43

ISO=
94.08

ACFM=
30493.

SDCFM=70'
20107.

CIS=
0.08

0. 00
0.7375 01
30. 02
94. 03
29. 04
27.86814679 05
119. 06
5.6406 07

VMST=
29.51

VWST=
5.78

BWO=
16.39

LIST VEL PTS
0.35
0.35
0.4
0.4
0.4
0.4

0.55
0.45
0.4
0.4
0.4
0.4
0.3
4.800 =SUM
0.400 ÷PTS

7.571 ΓSUM
0.631 ÷PTS

VS AV=
41.80

ISO=
96.98

ACFM=
31524.

SDCFM=70'
20652.

CIS=
0.11

0. 00
0.8308 01
30. 02
96. 03
30.81 04
29.50773574 05
122. 06
5.7888 07

VMST=
28.04

VWST=
8.30

BWO=
22.83

LIST VEL PTS
0.5
0.45
0.45
0.45
0.3
0.3

0.45
0.4
0.4
0.4
0.4
0.3
4.800 =SUM
0.400 ÷PTS

7.563 ΓSUM
0.630 ÷PTS

VS AV=
42.68

ISO=
99.46

ACFM=
32187.

SDCFM=70'
19131.

CIS=
0.17

0. 00
0.7417 01
29.97 02
85. 03
28.73 04
28.03688238 05
175. 06
[illegible] 07

SUMMARY OF PARTICULATE SAMPLING DATA

PLANT: Acme Terrace SOURCE: Pump DATE: 8-16-17-197

Sample Number	1	2	3	Avg
Number of Points Sampled	12	12	12	12
Total Duration of Sample, Min.	60	60	60	60
Nozzle Diameter, In.	0.239	0.239	0.239	0.239
Nozzle Area, Sq. Ft.	0.000031	0.000031	0.000031	0.000031
Calibration Factors				
1. Probe Pitot Tube	.85	.85	.85	.85
2. Gas Meter	1.006	1.006	1.006	1.006
Barometric Pressure, "Hg.	30.0	30.0	29.99	29.99
Gage Static Pressure in Stack, "H_2O	-0.15	-0.15	-0.15	-0.15
Stack Gas Temperature, °F	210	217	229	219
Average Square Root Velocity Head of Points Sampled	0.613	0.631	0.634	0.625
Average Gas Meter Temperature, °F	94	96	85	92
Average Gas Meter Pressure, "H_2O	0.7375	0.7398	0.7417	0.77
Gas Meter Volume, Actual, Cu. Ft.	29	30.91	29.73	29.51
Gas Meter Volume, @ STP, Cu. Ft.	27.97	29.51	28.04	28.47
Liquid Volume of Water Condensed, ML.	119	122	175	139
Vapor Volume of Water Condensed at STP, Cu. Ft.	5.64	5.77	8.3	6.57
Total Gas Sampled Through Nozzle, @ STP, Cu. Ft.	33.51	35.29	36.34	35.05
Percent Moisture in Stack	16.83	16.39	22.94	18.48

S. Dry Gas Composition: $\%O_2$	[illegible]	[illegible]	[illegible]	[illegible]
$\%CO_2$	[illegible]			
%CO				
$\%N_2$	79.5	79.5	[illegible]	[illegible]
% Other _____				
T. Density of Stack Gas:				
1. Dry, @ STP, Lbs./Cu. Ft.				
2. Wet, @ STP, Lbs./Cu. Ft.	0.0714	0.0715	0.0496	0.0715
U. Weight of Gas Sampled:				
1. Dry Gas, Lbs.				
2. Moist Gas, Lbs.	27.13	27.15	26.47	26.93
V. Total Weight Particulate Collected, Grams	0.1454	0.2017	0.3145	[illegible]
W. Percent Moisture Before Collector	16.93	16.39	[illegible]	[illegible]
X. Particulate Concentration:				
1. Lbs./1000 Lbs., Actual				
2. Lbs./1000 Lbs., Dry				
*3. Lbs./1000 Lbs., Wet @ 50% Excess Air				
*4. Lbs./1000 Lbs., Dry @ 50% Excess Air				
5. Grains/Dry Standard Cubic Feet	0.07	0.11	0.17	0.12
6. Lbs./Hr.	17.79	19.47	27.77	20.57
Y. Percent Isokinetic	94.08	96.98	99.46	96.74

TP = 70°F, 29.92 "Hg.

If applicable.

152069

"Wet" or "Moist" Refers to the condition of the gas with actual water content.

Plant _____ Test No. 1

Source _____ Test Date _____

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$29 \left(\frac{530}{[illegible]}\right)\left(\frac{[illegible] + \frac{[illegible]}{13.6}}{29.92}\right) = 27.87 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (119) = 5.64 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{5.64}{(5.64) + (27.87)} \times 100 = 16.83 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (.85)\ (.613) \sqrt{\frac{670}{(29.99)\ (27.13)}} = 40.43 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts \left[\frac{Vic}{(MH20)}\frac{(pH_2O)}{(454)}\frac{R}{} + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{670 \left[\frac{119}{(18)}\frac{(1)}{(454)}\frac{21.83}{} + \left(\frac{[illegible]}{[illegible]}\right)\left(30.0 + \frac{.7[illegible]}{13.6}\right)\right]}{60 \times 60 \times 40.43 \times 29.99 \times} \times 100 \quad 94.08 \text{ percent}$$

ACFM = $(V_s)\ (60)\ (As)$

$$(40.43)\ (60)\ (12.57) = 30,493 \text{ ACFM}$$

$$\text{SCFM (dry basis)} = \text{ACFM}\left(\frac{P\ bar}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$30,973\left(\frac{29.92}{29.92}\right)\left(\frac{530}{670}\right)\left(1 - \frac{16.[illegible]}{100}\right) = \underline{20,107}\ \text{SCFM}$$

$$C^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154)\left(\frac{145.4}{27.87}\right) = \underline{0.08}\ \text{gr/scf}$$

$$C^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.08)\ (20,107) = \underline{13.79}\ \text{lbs/hr}$$

Allowable from Texas State Air Laws (p. 162)

$$E = 0.048\ Q_0^{0.62}$$

where: Q = ACFM

$$0.048\ (30,973^{0.62}) = \underline{28.94}\ \text{lbs/hr}$$

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	.1623	18.0	3.03
Carbon Dioxide	—	44.0	—
Carbon Monoxide	—	28.0	—
Oxygen	.205	32.0	6.56
Nitrogen + Inerts	.795	28.2	22.45
		Total	27.13 lb/lb mole

16

Plant _____ Test No. _____

Source _____ Test Date _____

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$30.91 \left(\frac{530}{556}\right)\left(\frac{29.92 + \frac{.8307}{13.6}}{29.92}\right) = 29.51 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (122) = 5.78 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{5.78}{(5.78) + (29.51)} \times 100 = 16.39 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (0.85)\ (0.631) \sqrt{\frac{677}{(29.99)\ (28.8)}} = 41.8 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts \left[\frac{Vic\ (\rho H_2O)\ R}{(MH2O)\ (454)} + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{677 \left[\frac{122 - (1)\ 21.83}{(18)\ (454)} + \left(\frac{30.91}{556}\right)\left(30.04 + \frac{.8307}{13.6}\right)\right]}{60 \times 60 \times 41.8 \times 29.99 \times 0.00031} \times 100 \quad 96.90 \text{ percent}$$

ACFM = $(V_s)\ (60)\ (As)$

$$(41.8)\ (60)\ (12.57) = 31,024 \text{ ACFM}$$

$$\text{SCFM (dry basis)} = \text{ACFM} \left(\frac{P}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{ws}}{100}\right)$$

$$\underline{\quad\quad} \left(\frac{\quad}{29.92}\right)\left(\frac{530}{\quad}\right)\left(1 - \frac{\quad}{100}\right) = \underline{\quad\quad} \text{ SCFM}$$

$$C^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{\text{Vm std}}\right)$$

$$(0.0154)\left(\frac{201.7}{29.51}\right) \quad = \underline{0.11} \text{ gr/scf}$$

$$C^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.11)\ (20{,}652) = \underline{19.47} \text{ lbs/hr}$$

$$0.048\ (31{,}524\ 0.62) = \underline{29.54} \text{ lbs/hr}$$

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	.1639	18.0	2.95
Carbon Dioxide		44.0	—
Carbon Monoxide		28.0	—
Oxygen	.205	32.0	[illegible]
Nitrogen + Inerts	.779	28.2	[illegible]
		Total	28.17 lb / lb mole

18

LABORATORY REPORT

PLANT Acme Tr[illegible]

TEST DATE [illegible]

TEST # 1

ANALYST [illegible]

CONTAINER #	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTERS # 1	0.9707	0.8529	0.1178
FILTERS # 2	—	—	—
FILTER CONTROL	-.0490	0.8501	-0.[illegible]
UPSTREAM WASHINGS	94.9137	94.7337	0.1800
CONTROL	94.3772	94.3077	0.0695
IMPINGER WASHINGS (Acetone)			
CONTROL			
IMPINGER WASHINGS (Water)	91.6000	91.5249	0.0751
CONTROL	94.3736	94.3097	0.0639
$CHCL_3$ & $(C_2H_5)_2O$			
CONTROL			

If control shows weight gain it is subtracted from total. If control shows weight loss it is added to total.

TOTAL 0.1454 grams

TOTAL 145.4 mg.

IMPINGER WATER VOLUME COLLECTED	IMPINGER H_2O (ml)	IMPINGER SILICA GEL (grams)
FINAL	310	609
INITIAL	200	600
TOTAL VOLUME, (ml)	110	9

TOTAL 119 grams

LABORATORY REPORT

PLANT [illegible]

TEST DATE [illegible]

TEST # [illegible]

ANALYST GD

CONTAINER #	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTERS # 1	0.9444	0.9460	0.0004
FILTERS # 2			
FILTER CONTROL	0.7491	0.7504	-0.0007
UPSTREAM WASHINGS	[illegible]	[illegible]	0.1615
CONTROL	94.3736	94.3097	0.0639
IMPINGER WASHINGS (Acetone)			
CONTROL			
IMPINGER WASHINGS (Water)	100.7672	100.7110	0.05627 = 0
CONTROL	94.3736	94.3097	0.0639 S
$CHCL_3$ & $(C_2H_5)_2O$			
CONTROL			

If control shows weight gain it is subtracted from total. If control shows weight loss it is added to total.

TOTAL 0.2017 grams

TOTAL 201.7 mg.

IMPINGER WATER VOLUME COLLECTED	IMPINGER H_2O (ml)	IMPINGER SILICA GEL (grams)
FINAL	214	608
INITIAL	200	600
TOTAL VOLUME, (ml)		8

TOTAL 122 grams

NS-63

DRY GAS METER CALIBRATION FORM II
BY STANDARDIZED DRY GAS METER

DATE: _____

CONTROL TERMINAL: _____

PURPOSE: _____

CALIBRATED: _____

STDCF = _____

STD DGM Readings Final _____ ft^3

Initial _____ ft^3

STDV = _____

Temperatures	STD DGM In	STD DGM Out	DGM In	DGM Out
Initial				
Final				
Sum				
Tave	T_M = _____ °F		Tm = _____ °F	

Dry Gas Meter Readings Final _____ ft^3

Initial _____ ft^3

DGMV = _____

$$DGMCF = \frac{(STDV)\ (STDCF)\ (460 + T_m)}{(DGMV)\ (460 + T_M)} = _____$$

$$\frac{_____}{_____} = _____$$

Figure B-5

PITOT TUBE CALIBRATION

Pitot Tube Number [illegible] 6

Date [illegible] Calibrated By [illegible]

Cps	"S" Type Pitot ΔP in H_2O	Standard Type Pitot ΔP in H_2O
0.790	0.015	0.024
0.866	0.2	0.15
0.886	.42	0.33
0.841	0.89	0.63
0.848	1.6	1.15
0.845	1.65	1.25
0.866	2.0	1.5
0.855	2.6	1.9
0.854	2.95	2.15
0.852	3.4	2.47

0.79 +
0.866 +
0.886 +
0.841 +
0.848
0.845 -
0.866 -
0.855 -
0.854 +
0.852 =
8.503
8.503
10.
0.8503

Figure B-17

$3.503 / 10 = 0.850$

Instrument Fixed Calibration Chart

Instrument Number _____

Date Calibrated	Calibrated by	Date Calibrated	Calibrated by
1-11-78	[illegible]	5-9-78	
1-16-78	[illegible]	5-10-78	
1-17-78	[illegible]	5-27-78	[illegible]
1-31-78	[illegible]	6-8-78	
2-13-78	H.J.C.	6-9-78	
2-23-78	H.J.C.	6-23-78	H.J.C.
[illegible]	[illegible]	6-26-78	[illegible]
[illegible]	[illegible]	6-27-78	[illegible]
[illegible]	[illegible]	7-7-78	H.J.C.
[illegible]		7-26-78	
4-4-78	J.C.	8-10-78	H.J.C.
4-8-78	[illegible]	8-16-78	
5-2-78	J.C.	[illegible]	

Rockwell International

CHART NO.

METER PX

TEST METER PERFORMANCE

TYPE SI-ESCO-SS

S/N

CUSTOMER

CERTIFIED AS TO ACTUAL TEST DATA

DATE

MASTER CALIBRATED

DATE

BY

0 10 20 30 40 50 60 70 80 90

PERCENT OF CAPACITY FLOWRATE (%)

Rockwell International

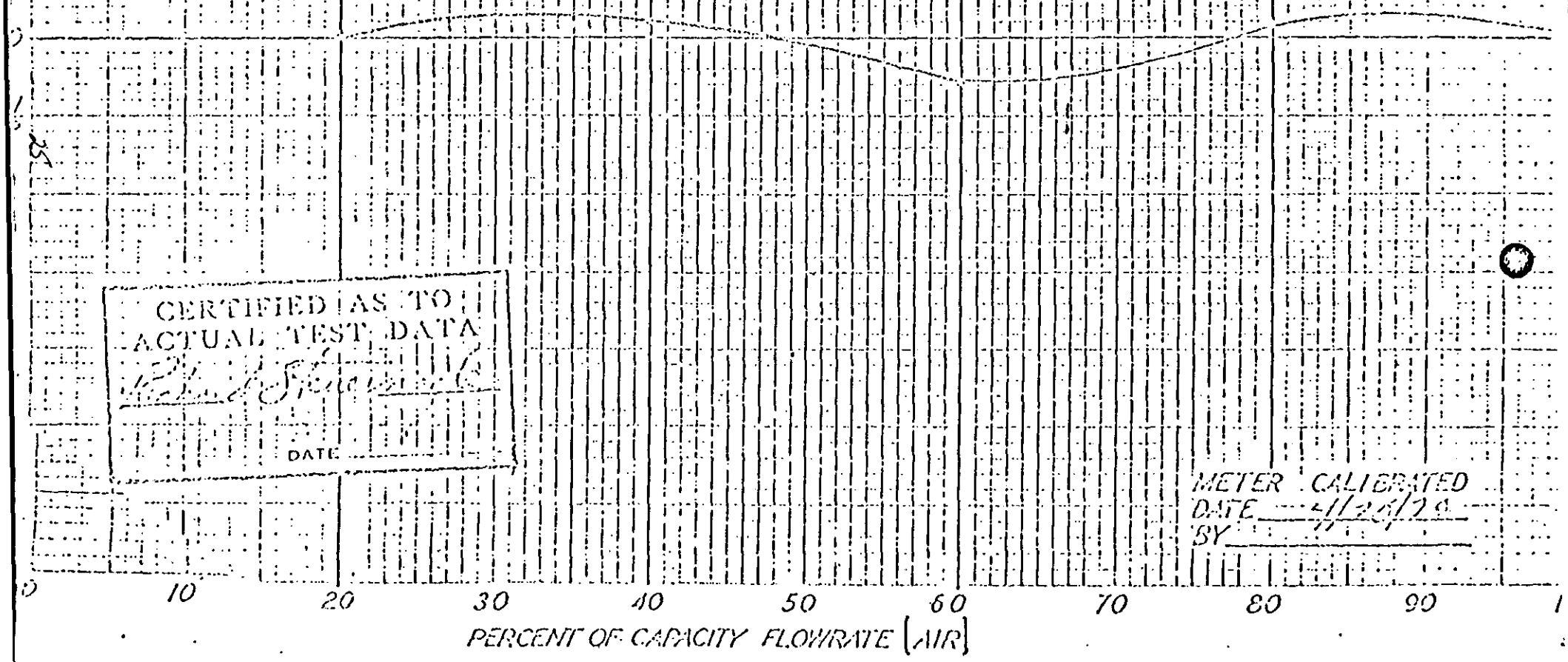
DUBOIS, PA

TEST METER PERFORMANCE
METER SIZE 3 1/2
S/N 156921
CUSTOMER INDUSTRIAL
COMPRESS. CO
692-00329-001

CURVE NO. _____

CERTIFIED AS TO
ACTUAL TEST DATA
[illegible]
DATE _____

METER CALIBRATED
DATE 4/24/2[illegible]
BY _____



TRAVERSE DATA — SAMPLING DATA — LOCATION [illegible]

Trav. Point No.	Trav. ΔP in.H_2O	Stack or Duct °F	Sampl. Rate CFM	ORI ΔP in.H_2O	Actual ΔP in.H_2O	$\sqrt{\Delta P}$	CR ΔP in.H_2O	Stack or Duct °F	Drifire Temp. °F	Filter Temp. (pre) °F	Box Temp. °F	Actual Sampl. Rate CFM	Sampl. Time (min)
1		[illegible]	[illegible]		.55		1.07	210	94		[illegible]	[illegible]	5
2		[illegible]	[illegible]		.40		[illegible]	210	94		[illegible]	[illegible]	5
3		[illegible]	[illegible]		.40		[illegible]	210	94		[illegible]	[illegible]	5
4		[illegible]	[illegible]		.40		[illegible]	210	94		[illegible]	[illegible]	5
5		[illegible]	[illegible]		[illegible]	.63	[illegible]	210	94		[illegible]	[illegible]	5
6		[illegible]				.63	[illegible]	210	94		[illegible]	[illegible]	5
7													
8													
9													
10													
11													
12													
1			[illegible]		.3		[illegible]	210	94		[illegible]	[illegible]	5
2			[illegible]		.3		[illegible]	210	94		[illegible]	[illegible]	5
3			[illegible]	[illegible]	.4		.73	210	94		[illegible]	[illegible]	5
4			[illegible]		.4		[illegible]	210	94		[illegible]	[illegible]	5
5			[illegible]		.4		[illegible]	210	94		[illegible]	[illegible]	5
6			[illegible]		.4		.73	210	94		[illegible]	[illegible]	5
7													
8													
9													
10													
11		[illegible]											
12													
TOTAL							.7375	210	94				

Type [illegible]
[illegible]

Bar Pressure
30.0

Stack Dia.
[illegible]

Meter Stop
[illegible]

Meter Start
[illegible]

Time-Date
[illegible]

Test # [illegible] Filt. # [illegible]
Run # [illegible]

Meter Stop
[illegible]

Meter Start
[illegible]

Time - Date
[illegible]

Test # Filt. #
Run #

29

ORZAT Run 2

		O_2	CO_2		O_2	CO_2			O_2	CO_2		O_2	CO_2			O_2	CO_2			O_2	CO_2
FYRITE TEST # 1	1			5			ORZAT Test # 1	1	[illegible]	[illegible]	5			FYRITE Run # 2	1			5				1		
	2			6				2			6				2			6				2		
	3			7				3			7				3			7				3		
	4			8				4			8				4			8				4		

TRAVERSE DATA | SAMPLING DATA | LOCATION

Trav. Point No.	Trav. ΔP in.H_2O	Stack or Duct	Sampl. Rate CFM	ORI ΔP in.H_2O	Actual ΔP in.H_2O	$\sqrt{\Delta P}$	CR ΔP in.H_2O	Stack or Duct °F	Drifire Temp. °F	Filter Temp. (pre) °F	Box Temp. °F	Actual Sampl. Rate CFM	Sampl. Time (min)
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
TOTAL							.831	216	96				

Type

Bar Pressure

Stack Dia.

Meter Stop

Meter Start

Time-Date

Test # | Filt

Run #

Meter Stop

Meter Start

Time - Date

Test # | Filt #

Run #

ORZAT Run

		O^2	CO^2		O^2	CO^2			O^2	CO^2			O^2	CO^2			O^2	CO^2			O^2	CO^2
FYRITE TEST # 1	1			5			ORZAT Test # 1	1			5			FYRITE Run # 2	1			5			1		
	2			6				2			6				2			6			2		
	3			7				3			7				3			7			3		
	4			8				4			8				4			8			4		

TRAVERSE DATA | SAMPLING DATA | LOCATION [illegible]

Trav. Point No.	Trav. ΔP in.H_2O	Stack [illegible]	Sampl. Rate [illegible]	ORI ΔP in.H_2O	Actual ΔP in.H_2O	$\sqrt{\Delta P}$	OR ΔP in.H_2O	Stack or Duct °F	Orifice Temp. °F	Filter Temp. (pre) °F	Box Temp. °F	Actual Sampl. Rate CFM	Sampl. Time (min)
1		101	[illegible]		.6		.93	330	[illegible]	330	[illegible]	.886	5
2		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
3		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
4		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
5		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
6		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
7													
8													
9													
10													
11													
12													
1		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
2		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
3		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
4		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
5		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
6		[illegible]	[illegible]		[illegible]		[illegible]	330	[illegible]	[illegible]	[illegible]	[illegible]	5
7													
8													
9													
10													
11													
12													
TOTAL							.7417	229 [illegible]	[illegible]				

Type [illegible]

Bar Pressure 29.97

Stack Dia. [illegible]

Meter Stop [illegible]

Meter Start [illegible]

Time-Date [illegible]

Test # [illegible] | Filte[illegible]

Run # [illegible] | [illegible]

Meter Stop

Meter Start

Time - Date

Test # | Filte[illegible] #

Run #

[illegible]

ORZAT Run 2

		O_2	CO_2		O_2	CO_2
FYRITE Run # 1	1			5		
	2			6		
	3			7		
	4			8		

		O_2	CO_2		O_2	CO_2
ORZAT Test # 1	1	[illegible]	—	5		
	2			6		
	3			7		
	4			8		

		O_2	CO_2		O_2	CO_2
FYRITE Run # 2	1			5		
	2			6		
	3			7		
	4			8		

		O_2	CO_2		O_2	CO_2
ORZAT Run 2	1			5		
	2			6		
	3			7		
	4			8		

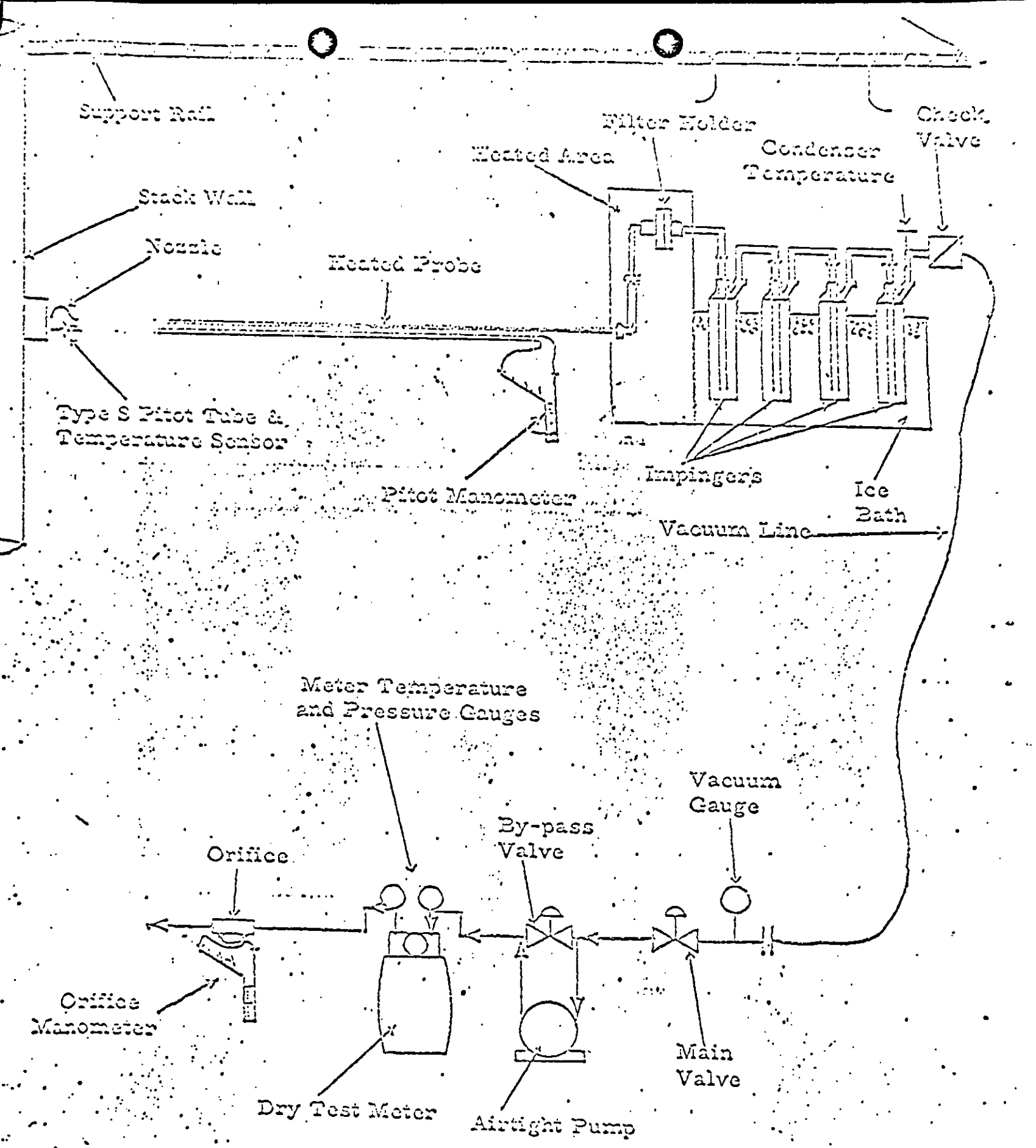


Figure - 16. Sampling Train Schematic.

One arrangement of an out-of-stack sampling train. Other arrangements are acceptable.

emissions of particulate matter from [illegible] or all sources associated with a specific process to exceed the allowable levels specified in Table 3 and/or Figure 3, except as provided by Rule 107.3

107.3 Any person affected by Section 3.10 (e) of the Texas Clean Air Act who does not wish to be controlled by the process weight method, established by Rule 107.2 may select an alternate method of control which the Executive Director finds will provide emission control efficiency and measurement to achieve the same goal as Rule 107.2

107.4 Any person affected by Section 3.10 (e) of the Texas Clean Air Act who does not select an alternate method and notify the Executive Director, in writing, prior to any plant investigation by the staff of the Texas Air Control Board, shall be controlled by the process weight method established by Rule 107.2, unless the Executive Director, at his discretion, chooses to accept proposals for an alternate method at that time.

107.5 Nothing herein is intended to affect the limitations on burning set out in Rule 101.

107.6 Persons affected by Rule 107 shall be in compliance with the provisions set forth herein by February 15, 1973.

Rule 108. Persons affected by this Regulation shall be in compliance with the provisions contained herein no later than December 31, 1973. Not later than six months after the effective date of this Regulation, any person affected by this Regulation shall submit to the Texas Air Control Board a written report on his compliance status, including but not limited to, the minimum time required to design, procure, install and test abatement equipment or procedures. Progress reports shall be submitted to the Board every four months commencing in July of 1972 until compliance is achieved.

All persons shall continue to be governed by the provisions of Regulation I, which became effective on March 16, 1967, and amended on January 23, 1969, September 12, 1969, and May 18, 1971, and Regulation II, which became effective February 22, 1968, and amended on September 12, 1969, until December 31, 1973, at which time this Regulation shall supersede the previous Regulation I and II.

TABLE 1

ALLOWABLE PARTICULATE EMISSION RATES

FOR SPECIFIC FLOW RATES

Effluent Flow Rate acfm	Rate of Emission lb/hr
1,000	3.5
2,000	5.3
4,000	8.2
6,000	10.6
8,000	12.6
10,000	14.5
20,000	22.3
40,000	34.2
60,000	44.0
80,000	52.6
100,000	60.4
200,000	92.9
400,000	143.0
600,000	184.0
800,000	219.4
1,000,000	252.0

Interpolation and extrapolation of the data in this table shall be accomplished by the use of the equation $E = 0.048\ q^{0.62}$ where E is the allowable emission rate in lb/hr and q is the stack effluent flow rate in acfm.

U.S. DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY CONTROL DIVISION

CERTIFICATION OF COMPLETION

PLUME EVALUATION TRAINING

H. Gary DuTell

SMOKE X OPACITY X

CERTIFICATE NO. 150 EXPIRATION DATE 4/12/79

William H. Hardy
CERTIFICATION OFFICER

SOURCE EVALUATION SOCIETY

MEMBER

H. GARY DUTELL

EXPIRES 12-31-78

SECRETARY

171
NUMBER

Plant [illegible] Location [illegible]

Process Type [illegible] Rated Production [illegible]

Date [illegible] Time [illegible] Actual Production [illegible]

Air Flow Data [illegible]

Mechanical Collector:

Tube Diameter____in. No. of Tubes____. Design Δp.____ in. H_2O. Gas Temp.____°F.

Observed Δp_____in H_2O. Design cfm/tube @ Observed Δp _____ @ _____°F.

Fan Rated H.P._____. Operating Volts_____. Operating Amps_____.

Electrostatic Precipitator:

Field No.	Primary Voltage (volts)	Primary Current (amps)	Secondary Voltage (KV)	Secondary Current (ma)	Spark Rate (per min.)
1 E	[illegible]	[illegible]	[illegible]	[illegible]	0
1 W	[illegible]	[illegible]	[illegible]	[illegible]	0
2 E	[illegible]	[illegible]	[illegible]	[illegible]	0
2 W	[illegible]	[illegible]	[illegible]	[illegible]	0
3 E	[illegible]	[illegible]	[illegible]	[illegible]	0
3 W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Scrubber:

Type_____. Δp (across scrubber)_____in. H_2O.

Fan Rated H.P._____. Operating Volts_____. Operating Amps_____.

Liquid Circulation Rate_____gal/min. % Make-up_____. Slowdown_____gpm.

Scrubbing Water Change Interval_____.

Settling Tank Cleaning Interval_____.

Baghouse:

Pressure-Positive_____ Negative_____. No Compartments_____.

Type Cleaning_____. Clean Cycle_____min.

Avg. Baghouse Δp_____in H_2O. Δp Range_____in. H_2O.

Fan: Rated H.P._____. Operating Volts_____. Operating Amps_____.

Cyclone:

Type_____. Δp_____in. H_2O. Diameter_____.

Fan Rated H.P._____. Operating Volts_____. Operating Amps_____.

Person Responsible for Data: H. Gary Dr[illegible]

Signature:_____

Title/Position: [illegible]

Location _____

Type _____ Rated Production _____

Time _____ Actual Production _____

Flow Data _____

Mechanical Collector:

Tube Diameter ____ in. No. of Tubes ____. Design Δp. ____ in. H_2O. Gas Temp. ____ F.

Observed Δp _____ in H_2O. Design cfm/tube @ Observed Δp _____ @ _____ F.

Fan Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Electrostatic Precipitator:

Field No.	Primary Voltage (volts)	Primary Current (amps)	Secondary Voltage (KV)	Secondary Current (ma)	Spark Rate (per min.)
1 E	[illegible]	[illegible]	—	[illegible]	0
2 W	[illegible]	[illegible]	[illegible]	[illegible]	0
1 E	[illegible]	[illegible]	[illegible]	[illegible]	0
2 W	[illegible]	[illegible]	[illegible]	[illegible]	0
1 E	[illegible]	[illegible]	[illegible]	[illegible]	0
2 W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Scrubber:

Type _____. Δp (across scrubber) _____ in. H_2O.

Fan Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Liquid Circulation Rate _____ gal/min. % Make-up _____. Blowdown _____ gpm.

Scrubbing Water Change Interval _____.

Settling Tank Cleaning Interval _____.

Baghouse:

Pressure-Positive _____ Negative _____. No Compartments _____.

Type Cleaning _____. Clean Cycle _____ min.

Avg. Baghouse Δp _____ in H_2O. Δp Range _____ in. H_2O.

Fan: Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Cyclone:

Type _____. Δp _____ in. H_2O. Diameter _____.

Fan Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Person Responsible for Data: H. Gary [illegible]

Signature: _____

Title/Position: [illegible]

RECEIVED
SEP 18 1978
ENERGY & ENVIRONMENT

Georgia-Pacific

intracompany memo

RECEIVED
SEP 14 1979
ENERGY & ENVIRONMENT

to Mr. Keith Bently — location Atlanta, Georgia

from Gary DuTell — location Springfield, Oregon

subject Particulate Sampling at Brunswick, Georgia — date September 4, 1979

1.0 Introduction

This report describes the particulate samples taken of the exhaust gases from the electrostatic precipitator at the Georgia-Pacific Gypsum Plant in Brunswick, Georgia. These tests were performed at the request of Mr. Charles DeCurtis to comply with air quality regulations in the State of Georgia.

The field portions of these tests were conducted on September 1 and 2, 1979. The results of these tests are presented in this report. Grain loading calculated from weights of the particulate samples taken indicate an emission rate of the following: (dry basis)

	Test #1	Test #2	Test #3	Average
Grains/SCF	0.19	0.22	0.23	0.21
Lbs./hour	85.97	98.44	98.22	94.21
Allowable lbs./hour*	99.65	99.65	99.65	99.65
Total process tons	117	117	117	117

2.0 Description of Source

The Brunswick Gypsum Mill uses a Research Cottrell Electrostatic Precipitator (perforated plate type with a magnetic-impulse rapper) to control the exhaust gases to three "Raymond" roller mills and six calcining kettles.

2.1 Process Material Flow Rates, Fuel Rates

Five of the "EHRSAM" calcining kettles were operating during the entire test period. They were each producing 8.4 tons/hour. Three roller mills were in production during each test conducted. Two produce 25 tons/hr. each. The third roller mill produces 25 to 29 tons/hr.

2.2 Source Design, Type, Size, Etc.

The "Cottrell" Precipitator is rated at 60,000 ACFM with a 100 hp. blower. It is the perforated plate type, with a new solid state electronic rectifier unit that had been installed just prior to last years compliance tests.

The calcining kettles are the suspended type with combustion controls by "Midwest Heat Service" and "Hawk."

* See Appendix for calculation.

The exhaust stack from the precipitator is steel and is 66 inches I.D. at the sampling ports.

2.3 Process Material Composition, Fuel Composition, Etc.

The condition of the precipitator, production rates and the related mill site operations were reported by mill personnel as normal.

2.4 Special Conditions

Dust from the land plaster bins were being temporarily ducted directly to the precipitator. This seemed to produce periodic opacity increases. Damper controls will be added to these ducts.

3.0 Sampling and Analytical Procedures

Velocities, air flow rates and sampling rates were computed from differential pressure data and obtained with an "S" type pitot and diaphragm operated manometer readings, using standard ASME traverse methods. The sampling ports used were determined to comply with disturbance minimums necessary for an accurate sampling traverse.

The sampling train used is an EPA type, commercially available through Anderson Sampling Co. with modification for use by Georgia-Pacific personnel. The train, with the exception of the 6-foot stainless steel probe, is all glass. The probe is followed by a 5-inch filter and four impinger bottles.

The first, third and fourth impingers (fourth filled with silica gel) are modified bubblers, the second being of the Greenburg-Smith design. A schematic of the sampling train is included in the appendix of this report.

3.1 Field Equipment - Dates of Calibration

	Calibrated
"S" type pitot(s)	July 1979
"Barber Colman" digital thermocouple(s)	July 1979
"Rockwell" gas meter(s)	July 1979
"Torbal" scale(s)	July 1979

I am certified for plume evaluation by the Oregon Department of Environmental Qaulity (Air Quality Control Division), Certificate No. 150.

All related sampling test equipment, manometers, etc. are checked and calibrated before and after each field trip.

3.2 Field Procedures

Each test consists of the usual ninety degree traverse with 8 and 12 points on each traverse, or 16 and 24 points total per test. All weights were measured on a "Torbal" precision balance calibrated to ± 0.03 mg.

3.3 Analytical Methods

No deviations from standard method.

3.4 Special problems or Considerations

Plume was in compliance, but not as good as last year.

4.0 Sampling Point Description

Two 3-inch diameter ports approximately 30 feet down stream from the 100 hp. blower and 25 feet from the top of the exhaust stack.

5.0 Detailed Results

They are presented in tabular form in the appendix of this report. (Table #1).

5.1 Emission Rates

	Test #1	Test #2	Test #3	Average
Grains/SCF	0.19	0.22	0.23	0.21
Lbs./hour	85.97	98.44	98.22	94.21
Allowable Emission rate lbs./hour	99.65	99.65	99.65	99.65

5.2 Gal Volumes, Etc.

Stack/CFM	72,077	72,272	69,239	71,196
Stack SCFM (dry)	52,800	52,212	49,830	51,614
Dry gas meter, meter conditions	45.2	45.995	44.75	45.315

5.3 Percent Isokinetic Sampling Rates

	99.63	101.25	101.9	100.93

5.4 Duration of Test

Tested over a two day period.
Actual sampling time - three hours - one hour each test.

The opacity of the exhaust gases from the precipitator averaged less than 20% during the time the plume was observed through each test period. At times the plume was observed to have an opacity greater than 20%.

If we can provide any further information about these tests, please call.

H. Gary DuTell

HGD:dkn

Attachments

cc: Messrs. Oscar Covington - Brunswick
Jim Franklin
Mitch Steffensen - Springfield
Charles DeCurtis - Brunswick

SUMMARY OF PARTICULATE SAMPLING DATA

PLANT: Brunswick, Ga Cottrell SOURCE: Precip DATE: 8-2-7c

A.	Sample Number	T-1-1	T-2-2	T-3-3	Avg.
B.	Number of Points Sampled	16	16	24	18.67
C.	Total Duration of Sample, Min.	60	60	60	60
D.	Nozzle Diameter, In.	0.246	0.246	0.246	0.246
E.	Nozzle Area, Sq. Ft.	0.00033	0.00033	0.00033	0.00033
F.	Calibration Factors				
	1. Probe Pitot Tube	0.857	0.857	0.857	0.857
	2. Gas Meter	1.008	1.008	1.008	1.008
G.	Barometric Pressure, "Hg.	30.0	30.0	30.0	30.0
H.	Gage Static Pressure in Stack, "H_2O	-0.11	-0.11	-0.11	-0.11
I.	Stack Gas Temperature, °F	172	170	176	172.67
J.	Average Square Root Velocity Head of Points Sampled	0.791	0.792	0.756	0.78
K.	Average Gas Meter Temperature, °F	92	99	106	99
L.	Average Gas Meter Pressure, "H_2O	1.71	1.78	1.58	1.69
M.	Gas Meter Volume, Actual, Cu. Ft.	45.2	45.995	44.75	45.315
N.	Gas Meter Volume, @ STP, Cu. Ft.	43.7	43.92	42.18	43.27
O.	Liquid Volume of Water Condensed, ML.	136	155	143	144.7
P.	Vapor Volume of Water Condensed at STP, Cu. Ft.	6.45	7.35	6.78	6.86
Q.	Total Gas Sampled Through Nozzle, @ STP, Cu. Ft.	50.15	51.27	48.96	50.13
R.	Percent Moisture in Stack	12.86	14.33	13.85	13.65

S. Dry Gas Composition:	$\%O_2$	19.5	19.5	19.5	19.5
	$\%CO_2$	1.0	1.0	1.0	1.0
	%CO	0	0	0	0
	$\%N_2$	79.5	79.5	79.5	79.5
	% Other _____				
T. Density of Stack Gas:					
1. Dry, @ STP, Lbs./Cu. Ft.					
2. Wet, @ STP, Lbs./Cu. Ft.					
U. Weight of Gas Sampled:					
1. Dry Gas, Lbs.					
2. Moist Gas, Lbs.		27.67	27.51	27.56	27.58
V. Total Weight Particulate Collected, Grams		0.594	0.6723	0.6715	0.646
W. Percent Moisture Before Collector		Same	Same	Same	Same
X. Particulate Concentration:					
1.					
2.					
*3. Process input tons		117	117	117	117
*4. Lbs Allowable		99.65	99.65	99.65	99.65
5. Grains/Dry Standard Cubic Feet		0.19	0.22	0.23	0.21
6. Lbs./Hr.		85.97	98.44	98.22	94.21
Y. Percent Isokinetic		99.63	101.25	101.9	99.93

STP = 70°F, 29.92 "Hg.

*If applicable.

"Wet" or "Moist" Refers to the condition of the gas with actual water content.

Plant Brunswick

Source Cottrell Precip

Test No. 1-1

Test Date 8-2-79

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$45.2 \left(\frac{530}{552}\right)\left(\frac{30.0 + \frac{1.71}{13.6}}{29.92}\right) = 43.7 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (136) = 6.45 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{6.45}{(6.45) + (43.7)} \times 100 = 12.86 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (0.857)\ (0.791) \sqrt{\frac{632}{(29.99)\ (27.67)}} = 50.56 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts \left[\frac{Vic}{(MH20)}\frac{(pH_2O)}{(454)}\frac{R}{} + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{632 \left[\frac{136}{(18)}\frac{(1)}{(454)}\frac{21.83}{} + \left(\frac{45.2}{552}\right)\left(30 + \frac{1.71}{13.6}\right)\right]}{60 \times 60 \times 50.56 \times 29.99 \times 0.00033} \times 100 = 99.63 \text{ percent}$$

ACFM = $(V_s)\ (60)\ (As)$

$$(50.56)\ (60)\ (23.76) = 72{,}077 \text{ ACFM}$$

B T 1-1

$$\text{SCFM (dry basis)} = \text{ACFM}\left(\frac{P_s\,bar}{P\,bar_{std}}\right)\left(\frac{T\,std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$72{,}077\left(\frac{29.99}{29.92}\right)\left(\frac{530}{632}\right)\left(1 - \frac{12.86}{100}\right) = \underline{52{,}800}\ \text{SCFM}$$

$$C^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154)\left(\frac{552.9}{43.7}\right) = \underline{0.19}\ \text{gr/scf}$$

$$C^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.19)\ (52{,}800) = \underline{85.97}\ \text{lbs/hr}$$

$$4.1\ (117^{0.67}) = 99.65$$

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	0.1286	18.0	2.31
Carbon Dioxide	0.01	44.0	0.38
Carbon Monoxide	—	28.0	—
Oxygen	0.195	32.0	5.44
Nitrogen + Inerts	0.795	28.2	19.54
		Total	27.67 lb/lb mol

117. YX
0.67 X
4.1 =
99.64795355
99.64795355 FI
99.65

Plant Brunswick

Source Cottrell Precip

Test No. 2-2

Test Date 8-2-79

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$45.995\left(\frac{530}{559}\right)\left(\frac{30.0 + \frac{1.78}{13.6}}{29.92}\right) = 43.92 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (155) = 7.35 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{7.35}{(7.35) + (43.92)} \times 100 = 14.33 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (0.857)\ (0.792) \sqrt{\frac{630}{(29.99)\ (27.51)}} = 50.7 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts\left[\frac{Vic}{(MH20)}\frac{(pH_2O)}{(454)}R + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{630\left[\frac{155}{(18)}\frac{(1)}{(454)}21.83 + \left(\frac{45.995}{559}\right)\left(30.0 + \frac{1.78}{13.6}\right)\right]}{60 \times 60 \times 50.7 \times 29.99 \times 0.00033} \times 100 = 101.25 \text{ percent}$$

ACFM = $(V_s)\ (60)\ (As)$

$(50.7)\ (60)\ (23.76) = 22,27$

$$\text{SCFM (dry basis)} = \text{ACFM}\left(\frac{P_s\ \text{bar}}{P\ \text{bar}_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$73,272\left(\frac{29.99}{29.92}\right)\left(\frac{530}{630}\right)\left(1 - \frac{14.33}{100}\right) = 52,212\ \text{SCFM}$$

$$C^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154)\left(\frac{630.9}{43.92}\right) = 0.22\ \text{gr/scf}$$

$$C^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.22)\ (52,212) = 98.44\ \text{lbs/hr}$$

$$4.1\ (117^{0.67}) = 99.65$$

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	0.1433	18.0	2.58
Carbon Dioxide	0.01	44.0	0.38
Carbon Monoxide	0	28.0	0
Oxygen	0.195	32.0	5.35
Nitrogen + Inerts	0.795	28.2	19.21
		Total	27.51 lb/lb mol

43

117 Y^x
0.67 x
4.1 =
99.65

Plant Brunswick

Source Cottrell

Test No. 3-3

Test Date 8-2-79

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$44.75\left(\frac{530}{566}\right)\left(\frac{30.0 + \frac{1.58}{13.6}}{29.92}\right) = 42.18 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (143) = 6.78 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{6.78}{(6.78) + (42.18)} \times 100 = 13.85 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ 0.857\ (0.756) \sqrt{\frac{636}{(29.99)\ (27.50)}} = 48.57 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts \left[\frac{Vic}{(MH2O)}\frac{(pH_2O)}{(454)}\frac{R}{} + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$636 \frac{\left[\frac{143}{(18)}\frac{(1)}{(454)}\frac{21.83}{} + \left(\frac{44.75}{566}\right)\left(30.0 + \frac{1.58}{13.6}\right)\right]}{60 \times 60 \times 48.57 \times 29.99 \times 0.00033} \times 100 \quad 101.9 \text{ percent}$$

$$ACFM = (V_s)\ (60)\ (As)$$

$$(48.57)\ (60)\ (23.76) = 69,239 \text{ ACFM}$$

T 3-3

$$\text{SCFM (dry basis)} = \text{ACFM}\left(\frac{P_{s\,bar}}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$69{,}239\left(\frac{29.99}{29.92}\right)\left(\frac{530}{636}\right)\left(1 - \frac{13.85}{100}\right) = 49{,}830 \text{ SCFM}$$

$$c^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154)\left(\frac{616.8}{42.18}\right) = 0.23 \text{ gr/scf}$$

$$c^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.23)\ (49{,}830) = 98.22 \text{ lbs/hr}$$

$$4.1\ (117^{0.67}) = 99.65$$

$$E = 4.1\ (P^{0.67})$$

where

E = Allowable emission rate lbs/hr

P = process input weight tons / hr.

117.	Y^x
0.67	x
4.1	=
99.65	

Test	Allowable
85.97	99.64
198.44	Y 3
98.22	÷ 3
282.63	99.6
3	
94.21	

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	0.1385	18.0	2.49
Carbon Dioxide	0.01	44.0	0.38
Carbon Monoxide	0	28.0	0
Oxygen	0.195	32.0	5.38
Nitrogen + Inerts	0.795	28.2	19.32
		Total	27.56 lb/lb mol

DRY GAS METER CALIBRATION FORM II
BY STANDARDIZED DRY GAS METER

DATE: 7-27-79

CONTROL TERMINAL: Jay 1

PURPOSE: Go again Test

CALIBRATED: 106 7883

STDCF = 1.003

STD DGM Readings Final 502. ft^3

Initial 473.3 ft^3

STDV = 28.7

Temperatures	STD DGM In	STD DGM Out	DGM In	DGM Out
Initial	70	70	70	71
Final	70	71	70	71
Sum				
Tave	T_M = 70 °F		Tm = 70 °F	

Dry Gas Meter Readings Final 274.1 ft^3

Initial 245.54 ft^3

DGMV = 28.56

$$DGMCF = \frac{(STDV)\ (STDCF)\ (460 + T_m)}{(DGMV)\ (460 + T_M)} = 1.008$$

$$\frac{(28.7)\ (1.003)\ (530)}{28.56\ (530)} = 1.008$$

Figure B-5

PITOT TUBE CALIBRATION

Pitot Tube Number Jay 6

Date 7-27-79 Calibrated By Pete

Cps	"S" Type Pitot ΔP in H_2O	Standard Type Pitot ΔP in H_2O
.858	.19	.14
.851	.40	.29
.841	.89	.63
.869	.98	.74
.845	1.4	1.0
.868	1.7	1.28
.857	2.0	1.47
.866	2.8	2.1
.860	4.0	2.96
7.715/9		0.857

Figure B-17

22

Georgia-Pacific
LABORATORY REPORT

PLANT Brunswick

TEST # 1-1

TEST DATE 8-2-79

ANALYST Pete + Gary

CONTAINER #	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTERS # 1	1.2348	.7533	0.4815
FILTERS # 2			
FILTER CONTROL	0.7545	0.7538	-0.0007
UPSTREAM WASHINGS	92.4823	92.4147	0.0676
CONTROL	83.2944	83.2930	-0.0014
IMPINGER WASHINGS (Acetone)	103.1741	103.1675	0.0066
CONTROL	83.2937	83.2930	-0.0007
IMPINGER WASHINGS (Water)			
CONTROL			
$CHCL_3$ & $(C_2H_5)_2O$			
CONTROL			

If control shows weight gain it is subtracted from total. If control shows weight loss it is added to total.

TOTAL 0.5529 grams

TOTAL 552.9 mg.

IMPINGER WATER VOLUME COLLECTED	IMPINGER H_2O (ml)	IMPINGER SILICA GEL (grams)
FINAL	327	209
INITIAL	200	200
TOTAL VOLUME, (ml)	127	9

TOTAL 136 grams

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Georgia-Pacific
LABORATORY REPORT

PLANT Brunswick

TEST # 2-2

TEST DATE 8-2-79

ANALYST Pete [illegible]

CONTAINER #	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTERS # 1	1.2142	0.7579	0.4563
# 2			
FILTER CONTROL	0.7545	0.7538	-0.0007
UPSTREAM WASHINGS	99.2213	99.1116	0.1097
CONTROL	83.2937	83.2930	-0.0007
~~IMPINGER~~ WASHINGS (Acetone)	95.1038	95.0368	0.0670
CONTROL	83.2937	83.2930	-0.0007
IMPINGER WASHINGS (Water)			
CONTROL			
$CHCL_3$ & $(C_2H_5)_2O$			
CONTROL			

If control shows weight gain it is subtracted from total. If control shows weight loss it is added to total.

TOTAL 0.6309 grams

TOTAL 630.9 mg.

IMPINGER WATER VOLUME COLLECTED	IMPINGER H_2O (ml)	IMPINGER SILICA GEL (grams)
FINAL	340	215
INITIAL	200	200
TOTAL VOLUME, (ml)	140	15

TOTAL 155 grams

S-63

Georgia-Pacific
LABORATORY REPORT

PLANT Brunswick

TEST # 3-3

TEST DATE 8-2-79

ANALYST Amy + Pete

CONTAINER #	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTERS # 1	1.1825	0.7546	0.4279
# 2			
FILTER CONTROL	0.7545	0.7538	0.0007
UPSTREAM WASHINGS	83.0084	82.9111	0.0973
CONTROL	83.2937	83.2930	0.0007
~~IMPINGER~~ WASHINGS (Acetone)	87.7362	87.6425	0.0937
CONTROL	82.2937	83.2930	0.0007
IMPINGER WASHINGS (Water)			
CONTROL			
$CHCL_3$ & $(C_2H_5)_2O$			
CONTROL			

If control shows weight gain it is subtracted from total. If control shows weight loss it is added to total.

TOTAL 0.6168 grams

TOTAL 616.8 mg.

IMPINGER WATER VOLUME COLLECTED	IMPINGER H_2O (ml)	IMPINGER SILICA GEL (grams)
FINAL	330	213
INITIAL	200	200
TOTAL VOLUME, (ml)	130	13

TOTAL 143 grams

ES-63

GEORGIA PACIFIC
BRUNSWICK, GEORGIA

SKETCH/SCHEMATIC DIAGRAM
OF PRECIPITATOR

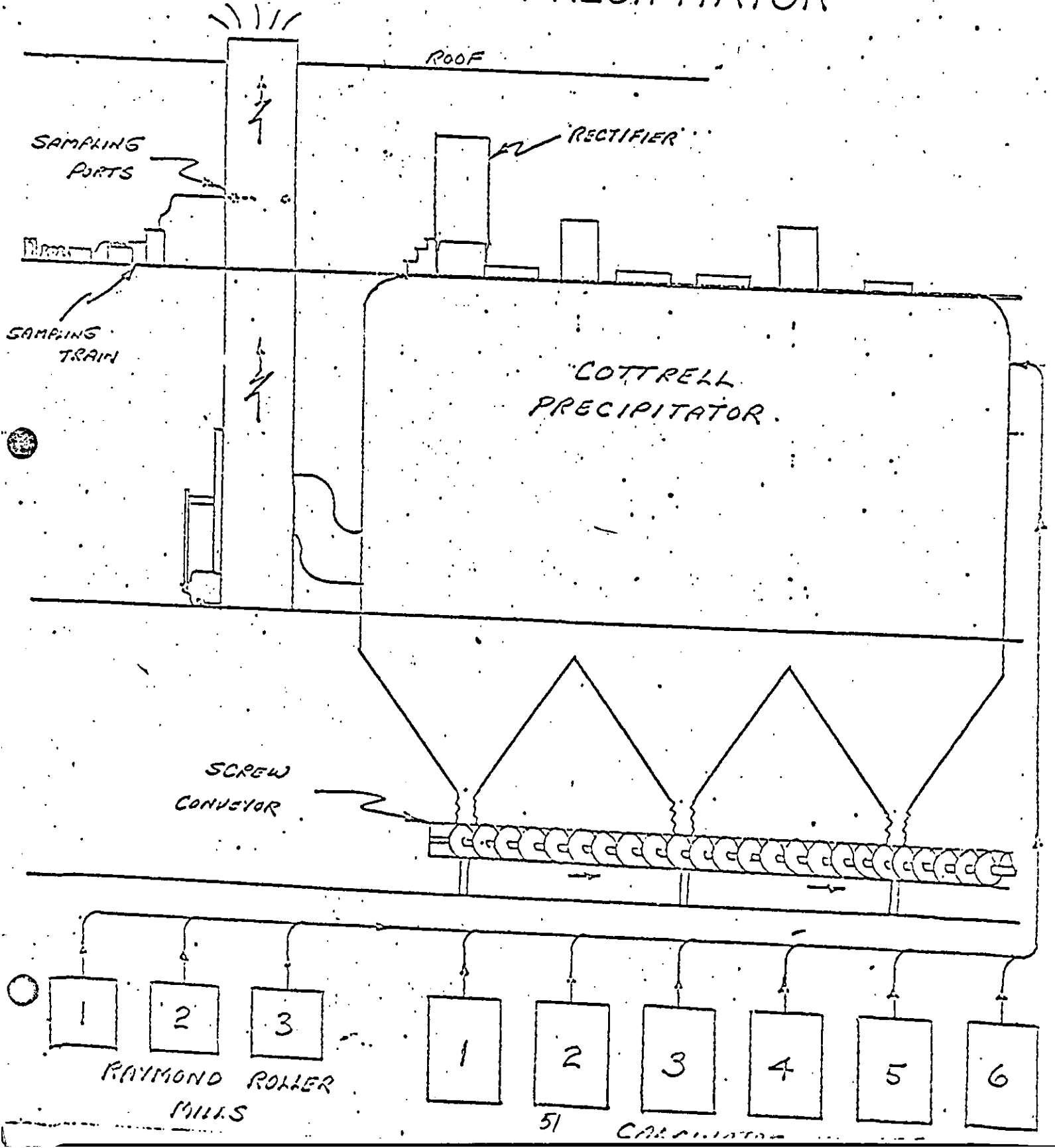


TABLE Ia

ALLOWABLE RATE OF EMISSION BASED ON PROCESS WEIGHT RATE ON NEW EQUIPMENT

Process Input Weight Rate		Rate of Emission	Process Input Weight Rate		Rate of Emission
Lb/Hr	or Tons/Hr	Lb/Hr	Lb/Hr	or Tons/Hr	Lb/Hr
100	0.05	0.551	16,000	8	16.5
200	0.10	0.877	18,000	9	17.9
400	0.20	1.40	20,000	10	19.2
600	0.30	1.83	30,000	15	25.2
800	0.40	2.22	40,000	20	30.5
1000	0.50	2.58	50,000	25	35.4
1200	0.75	3.38	60,000	30	40.0
1400	1.00	4.10	70,000	35	44.3
1600	1.25	4.76	80,000	40	48.5
1800	1.50	5.38	90,000	45	52.6
2000	1.75	5.96	100,000	50	56.4
2200	2.00	6.52	120,000	60	63.3
2400	2.50	7.58	140,000	70	67.5
2600	3.00	8.56	160,000	80	69.0
2800	3.50	9.49	200,000	100	81.2
3000	4.00	10.4	1,000,000	500	69.0
3500	4.50	11.2	2,000,000	1,000	77.6
4000	5.00	12.0	6,000,000	3,000	92.7
4500	6.00	13.6			

TABLE Ib

ALLOWABLE RATE OF EMISSION BASED ON PROCESS WEIGHT RATE ON EXISTING EQUIPMENT

52

Process Input Weight Rate		Rate of Emission	Process Input Weight Rate		Rate of Emission
Lb/Hr	or Tons/Hr	Lb/Hr	Lb/Hr	or Tons/Hr	Lb/Hr
100	0.05	0.551	16,000	8	16.6
200	0.10	0.877	18,000	9	17.9
400	0.20	1.40	20,000	10	19.2
600	0.30	1.83	30,000	15	25.2
800	0.40	2.22	40,000	20	30.5
1000	0.50	2.58	50,000	25	36.4
1200	0.75	3.38	60,000	30	40.0
1400	1.00	4.10	70,000	35	44.35
1600	1.25	4.76	80,000	40	48.4
1800	1.50	5.38	90,000	45	52.5
2000	1.75	5.96	100,000	50	56.4
2200	2.00	6.52	120,000	60	63.5
2400	2.50	7.58	140,000	70	70.6
2600	3.00	8.56	160,000	80	77.0
2800	3.50	9.49	200,000	100	89.7
3000	4.00	10.4	1,000,000	500	282
3500	4.50	11.2	2,000,000	1,000	414
4000	5.00	12.0	6,000,000	3,000	873
4500	6.00	13.6			

To use Tables Ia and Ib, take the process input weight rate (Lb/Hr or Tons/Hr). Then find this figure on the table, opposite is the maximum number of pounds of contaminants which may be discharged into the atmosphere in any one hour.

(e) Particulate Emission from Manufacturing Processes:

1. Except as may be specified in other sectio of this rule no person shall cause, let, permit, suffer, or allow the rate of emission from any source, particulate matter in total quantities equa to or exceeding the amounts shown in Table Ia or Ib Equipment in operation, or under construction contract, on or before July 2, 1968, shall be consider existing equipment. All other equipment put in operation or extensively altered after said date is to be considered new equipment.

(i) The following equations shall be used to calculate the allowable rates of emission from new equipment and shall accompany Table Ia:

$E = 4.1\ P^{0.67}$; for process input weight rate up to and including 30 tons per hour.

$E = 55\ P^{0.11} - 40$; for process input weight rate above 30 tons per hour.

(ii) The following equation shall be used to calculate the allowable rates of emission from existing equipment and shall accompany Table Ib:

$E = 4.1\ P^{0.67}$

E = emission rate in pounds per hour

P = process input weight rate in tons per hour.

Rockwell International

DUBOIS, PA

TEST METER PERFORMANCE

METER SIZE 3120-3

S/N 106,28[illegible]

CUSTOMER [illegible]

CURVE NO.

CERTIFIED AS TO ACTUAL TEST DATA

[illegible]

DATE

METER CALIBRATED

DATE

BY

10 20 30 40 50 60 70 80 90

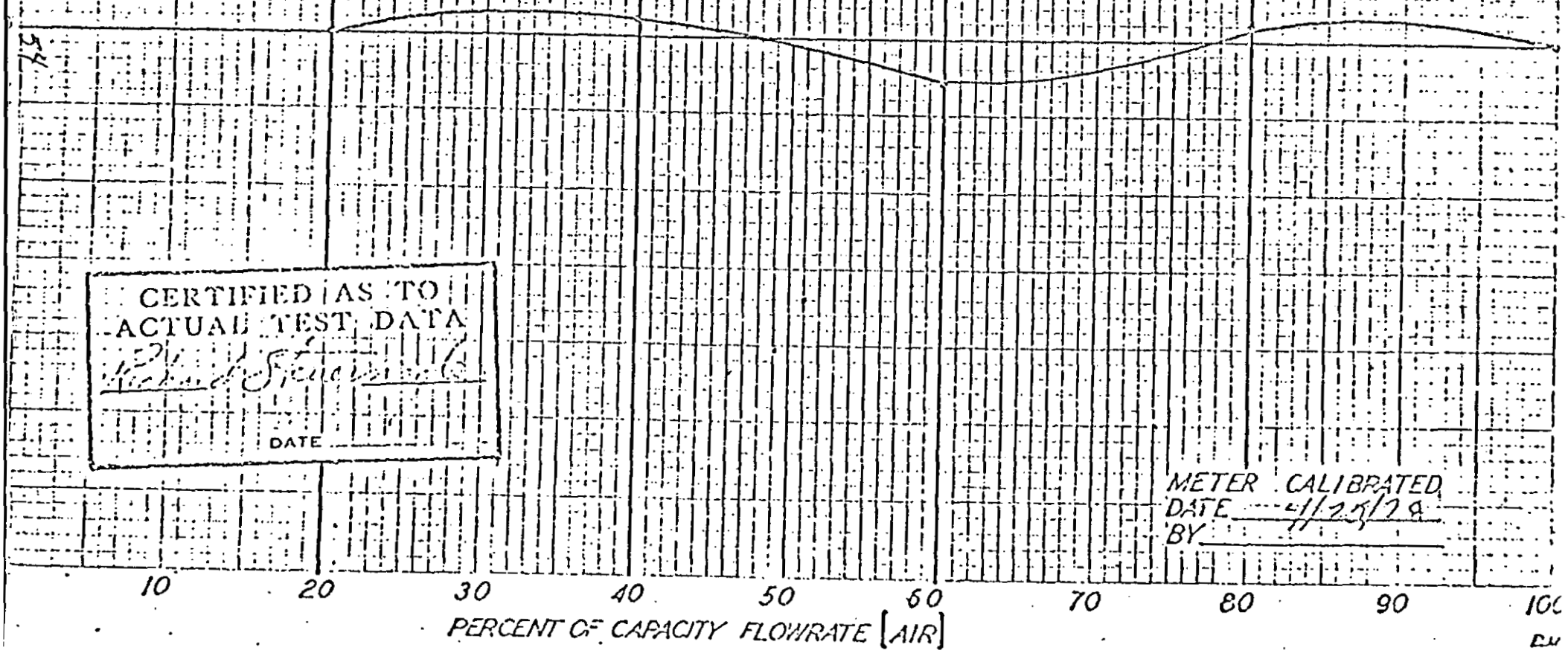
PERCENT OF CAPACITY FLOWRATE (%)

Rockwell International

DUBOIS, PA

TEST METER PERFORMANCE
METER SIZE 5 120
S/N 1569931
CUSTOMER INDUSTRIAL CONTROL CO
672-30329-001

CURVE NO.



CERTIFIED AS TO ACTUAL TEST DATA
[illegible]
DATE

METER CALIBRATED
DATE 4/25/78
BY

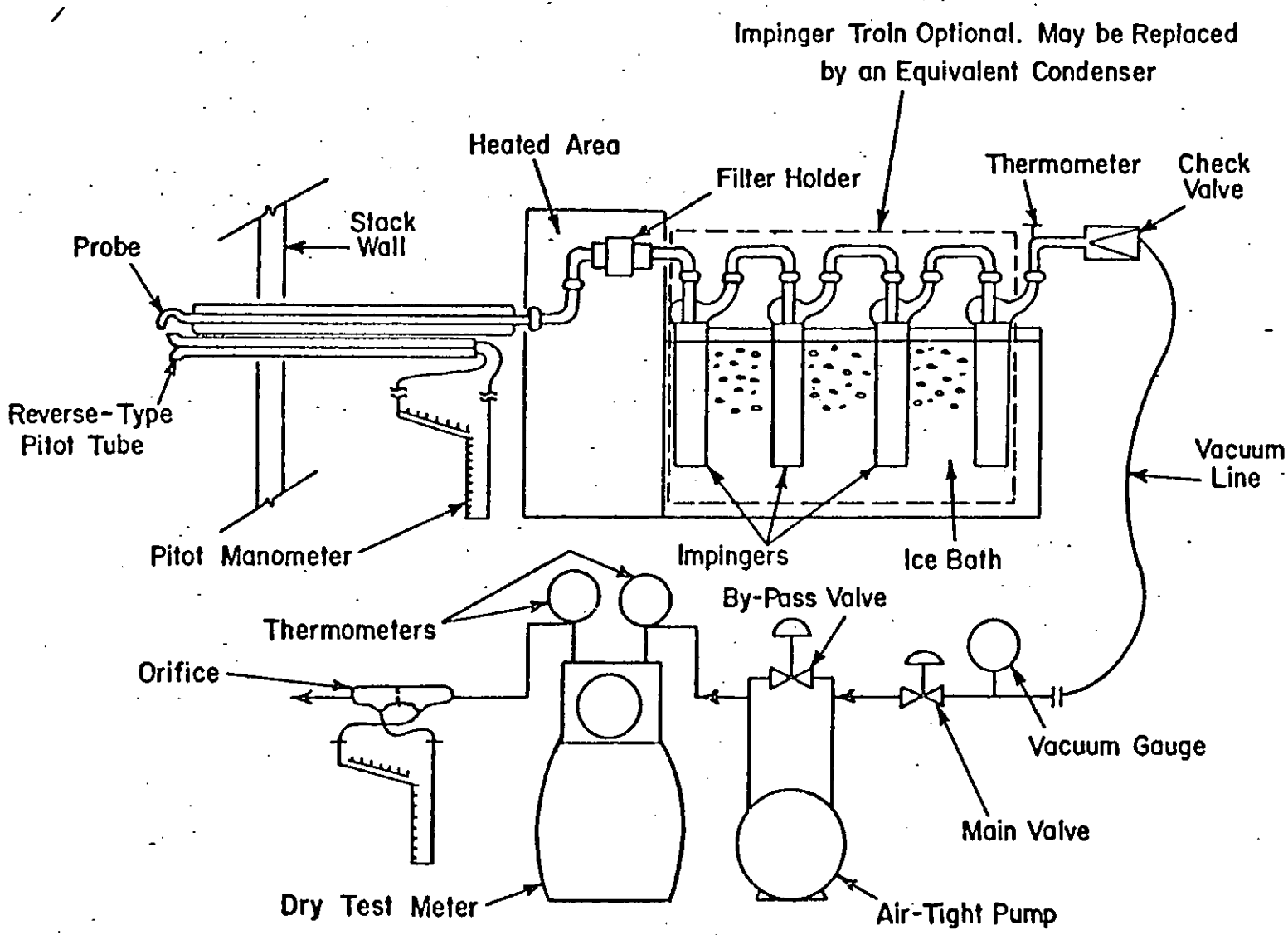


FIGURE 1. EPA PARTICULATE SAMPLING TRAIN

11.25
15

SAMPLING DATA

LOCATION [illegible]

Rect Trans Inlet SIRT 66-33'

Trav. Point No.	Imping. Temp. out °F	I so %	Sampl. Rate Stack or Duct [illegible]	Vac in.Hg.	Actual ΔP in.H_2O Pitot	ΔH Orifice	OR in. °F Temp.	Stack or Duct ±3 °F	Orifice Temp. °F out	Filter Temp. (pre °F)	Meter Reading CF	Actual Sampl. Rate CFM	Sampl. Time (min)
1	70°		40.75	<1	.4	1.06	90	172	90	260	272.3	.605	3.75
2	70		"	<1	.4	1.06	90	172	90	270	279.56	.605	3.75
3	70		"	<1	.4	1.06	90	172	90	280	281.9	.605	3.75
4	70	105	"	<1	.4	1.06	90	172	90	280	284.2	.605	3.75
5	70	96	51.34	1	.65	1.72	90	172	90	280	[illegible]	.772	3.75
6	69	99	53.28	1	.7	1.86	90	172	90	280	290	.801	3.75
7	69		56.96	2	.8	2.12	90	172	90	280	293.2	.856	3.75
8	70		56.96	2	.8	2.12	90	172	90	285	296.32	.856	3.75
9													
10													
11													
12													
1	72		63.65	3.5	1.0	2.65	90	172	90	280	299.9	.957	3.75
2	72		63.68	3.5	1.0	2.65	90	172	90	280	303.5	.957	3.75
3	70		63.68	3.5	1.0	2.65	90	172	90	280	307	.957	3.75
4	70		65.15	1.5	.75	2.0	95	172	92	280	310.1	.833	3.75
5	70		46.08	1.5	.5	1.34	100	172	95	290	312.6	.685	3.75
6	70		46.08	<1	.5	1.34	100	172	95	290	315.3	.685	3.75
7	70		"	<1	.5	1.34	105	172	95	295	317.8	.685	3.75
8	75		"	<1	.5	1.34	105	172	95	290	320.50	.685	3.75
9													
10													
11													
12													
TOTAL						2.37 / 1.71	1495 / 93.44	2052 / 172	1462 / 91.4				

Type Research Cottrell

Bar Pressure 30.0 in

Stack ID inches 66

Meter Stop 320.2

Meter Start 275

Time-Date 8-2-79 8:30

Test # 1-1 Filter #

Run # 1

Meter Stop

Meter Start

Time - Date

Test # Filter #

Run # 45.2

ORZAT Run 2

FYRITE TEST # 1	O_2	CO_2	O_2	CO_2
1			5	
2			6	
3			7	
4			8	

ORZAT Test # 1	O_2	CO_2	O_2	CO_2
1			5	1.0
2			6	1.0
3			7	1.0
4			8	

FYRITE Run # 2	O_2	CO_2	O_2	CO_2
1			5	
2			6	
3			7	
4			8	

ORZAT Run 2	O_2	CO_2	O_2	CO_2
1				
2				
3				
4				

395

SAMPLING DATA

LOCATION Brun[illegible]ick

Trav. Point No.	Imping. Temp. out. °F	Iso %	Sampl. Rate Stack or Duct cfm	Vac in.Hg.	Actual ΔP in.H_2O Pitot	ΔH Orifice	OR °F in. Temp.	Stack or Duct °F	Orifice Temp. °F out	Filter Temp. (pre) °F	Meter Reading CF	Actual Sampl. Rate CFM	Sampl. Time (min)
1	60		58.71	1.5	.85	2.27	92	170	95	220	323.6	.89	3.75
2	60		58.71	1.5	.85	2.27	92	170	95	220	327.0	.89	3.75
3	60		58.71	1.5	.85	2.27	92	170	95	220	[illegible]	.89	3.75
4	65		58.71	1.5	.85	2.27	100	170	95	230	333.5	.894	3.75
5	65		45.03	1.0	.5	2.28	100	170	95	240	336.1	.685	3.75
6	65		45.03	1.0	.5	1.34	100	170	95	270	338.6	.685	3.75
7	65		45.03	1.0	.5	1.34	100	170	95	270	341.2	.685	3.75
8	65		45.03	1.0	.5	1.34	100	170	95	270	343.74	.685	3.75
9													
10													
11													
12													
1	70		40.25		.4	1.08	105	170	96	280	346.1	.615	3.75
2	70				.4	1.08	105	170	96	280	348.4		3.75
3	70				.4	1.08	105	170	96	280	351		3.75
4	70		49.33		.6	1.62	105	170	96	290	353.8	.753	3.75
5	70				.6	1.62	105	170	96	290	356.4	.753	3.75
6	70		55.15		.75	2.02	105	170	96	290	359.6	.842	3.75
7	70		58.71		.85	2.29	105	170	96	290	362.94	.847	3.75
8	70				.85	2.29	105	170	96	290	366.3	.897	3.75
9													
10													
11													
12													
TOTAL						28.46	1616	170	96				
						1.78	101						

Type Cottrell

Bar Pressure 30.0

Stack ID inches 66

Meter Stop 346.3

Meter Start 320.305

Time-Date 11:05 AM

Test # 2 Filte #

Run # 1

Meter Stop

Meter Start

Time - Date

Test # Filte #

Run #

45.995

ORZAT Run 2

FYRITE TEST # 1	O_2	CO_2		O_2	CO_2
1			5		
2			6		
3			7		
4			8		

ORZAT Test # 1	O_2	CO_2		O_2	CO_2
1			5		
2			6		
3			7		
4			8		

FYRITE Run # 2	O_2	CO_2		O_2	CO_2
1			5		
2			6		
3			7		
4			8		

	O_2	CO_2		O_2	CO_2
1			1		
2			2		
3			3		
4			4		

5
7.5
12

SAMPLING DATA

LOCATION [illegible]

Trav. Point No.	Imping. Temp. out °F	Iso %	Sampl. Rate Stack or Duct Ft/sec	Vac in.Hg.	Actual ΔP in.H_2O Pitot	ΔH orifice	OR in. °F Temp.	Stack or Duct °F	Orifice Temp. °F out	Filter Temp. (pre) °F	Meter Reading CF	Actual Sampl. Rate CFM	Sampl. Time (min)
1	60		37.7	<1	.35	.95	105	173	105	270	367.8	.581	2.5
2	60		37.7	<1	.35	.95	105	173	105	280	369.4	.581	2.5
3	63		37.7	<1	.35	.95	105	173	105	280	370.85	.581	2.5
4	63		37.85	<	.35	.95	105	178	105	288	372.3	.579	2.5
5	63		37.85	<	.35	.94	105	178	105	285	373.75	.577	2.5
6	63		45.24	1	.5	1.35	105	178	105	285	375.5	.692	2.5
7	63		49.56	1	.6	1.62	105	178	105	290	377.4	.758	2.5
8	63		49.56	1	.6	1.62	105	178	105	290	379.3	.758	2.5
9	64		57.23	1	.8	2.16	105	178	105	290	381.5	.875	2.5
10	64		57.23	1.5	.8	2.16	108	178	103	290	383.7	.875	2.5
11	65		57.23	1.5	.8	2.16	108	178	103	290	385.9	.875	2.5
12	65		57.23	1.5	.8	2.11	108	178	103	290	388.1	.875	2.5
89 1	67		49.56	<1	.6	1.62	105	178	103	280	389.9	.758	2.5
2	65		"	<1	.6	1.62	108	178	103	280	391.9	.758	2.5
3	65		55.41	<1.5	.75	2.02	108	178	103	280	394.1	.847	2.5
4	65			<1.5	.75	2.02	108	178	103	280	396.15	.847	2.5
5	69		53.53	1.5	.75	2.02	108	178	103	280	398.3	.847	2.5
6	65			2	.7	1.9	112	178	105	280	400.3	.823	2.5
7	65			2	.7	1.9	112	178	105	285	402.44	.823	2.5
8	69		49.56	1.5	.6	1.62	113	172	105	290	404.4	.762	2.5
9	72		45.24		.5	1.37	112	172	105	285	406.2	.7	2.5
10	72		"		.5	1.37	112	172	105	285	407.9	.70	2.5
11	72		42.7		.45	1.23	112	172	105	285	409.1	.663	2.5
12	72		42.7		.45	1.23	112	172	105	285	411.25	.663	2.5
TOTAL						37.89 / 1.58	2593 / 108	4227 / 176	2499 / 104				

Type Cottrell

Bar Pressure 30.0

Stack ID inches 66

Meter Stop 411.25

Meter Start 366.5

Time-Date 31 8-2-79

Test # 3 | Filter #

Run # 1

Meter Stop

Meter Start

Time - Date

Test # | Filter #

Run #

44.75

ORZAT Run 2

	O^2	CO^2	O^2	CO^2		O^2	CO^2	O^2	CO^2		O^2	CO^2	O^2	CO^2	O^2	CO^2
FYRITE TEST # 1	1		5		ORZAT Test # 1	1		5		FYRITE Run # 2	1		5		1	
	2		6			2		6			2		6		2	
	3		7			3		7			3		7		3	
	4		8			4		8			4		8		4	

Georgia-Pacific

intracompany memo

RECEIVED

RECEIVED MAR 1 3 1980 AUG 3 1977

ENERGY & ENVIRONMENT

to Mr. Al Mick

location Portland, Oregon

from Gary DuTell

location Springfield, Oregon

subject Particulate Sampling at Fort Dodge, Iowa

date July 27, 1977

1.0 Introduction

This report describes the particulate samples taken of the exhaust gases from the electrostatic precipitator at the Georgia-Pacific Gypsum Plant in Fort Dodge, Iowa. These tests were performed at the request of Mr. D. M. Watson to comply with air quality regulations in the State of Iowa.

The field portions of these tests were conducted on June 28, 1977. The results of these tests are presented in this report. Grain loadings calculated from weights of the particulate samples taken indicate an emission rate of the following. (dry basis)

	Test #1	Test #2	Test #3	Average
Grains/SCF	0.05	0.04	0.02	0.04
Lbs./hour	12.5	9.8	4.6	9.0
Allowable lbs./hour	52	52	52	52

2.0 Description of Source

The Fort Dodge Gypsum Mill uses a Research Cottrell Electrostatic Precipitator (perforated plate type with a magnetic-impulse rapper) to control the exhaust gases from a "Raymond" roller mill, two screw conveyors and five calcinator kettles.

2.1 Process Material Flow Rates, Fuel Rates

Four of five "EHRSAM" calcinator kettles were operating during all the tests. The plant was producing a total of 36 tons/hour. The two roller mills operated continuously during all tests.

2.2 Source Design, Type, Size Etc.

The "Cottrell" Precipitator is the perforated plate type, rated at 40,000 ACFM with 125 hp blower.

The roller mills are "high side" units with flash drying.

The calcinator kettles are the suspended type, with combustion controls by "Hawk". The kettles and flash dryers can be fired with natural gas, propane, or oil. The exhaust stack from the precipitator is steel and is 60 inches I. D. at the sampling ports.

2.3 Process Material Composition, Fuel Composition, Etc.

The condition of the precipitator, production rates and the related mill site operations were reported by mill personnel as normal during all tests.

2.4 Special Conditions

None were observed.

3.0 Sampling and Analytical Procedures

Sampling and analytical methods follow Method 5 Federal Register. Samples from the back half of the train from each test were weighed and showed a very slight weight gain.

Velocities, air flow rates, and sampling rates were computed from differential pressure data and obtained with an "S" type pitot and incline manometer readings, using standard ASME traverse methods. The sampling ports used were determined to comply with disturbance minimums necessary for an accurate sampling traverse using a 16 point traverse.

The sampling train used is an EPA type, commercially available through Joy Mfg. Co. with modification for use by Georgia-Pacific personnel. The train (Figure I), with the exception of the 6-foot stainless steel probe is all glass. A 4-inch filter is followed by four impinger bottles. The first, third and fourth impingers (fourth filled with silica gel) are modified bubblers, the second being of the Greenburg-Smith design. A schematic of the sampling train is included in the appendix of this report.

3.1 Field Equipment - Dates of Calibration

Six-foot "Joy" "S" type pitot calibrated May 1977 at Oregon State University. The magnehelic gauges were calibrated April 1977 at Brannom Instrument Co.

I am currently certified for plume evaluation by the Oregon Department of Environmental Quality (Air Quality Control Division). Next certification due December 1977 (certificate No. 150).

All other related sampling test equipment, thermometers, etc. are checked and calibrated before and after each field trip.

3.2 Field Procedures

Each test consists of the usual ninety degree traverse with eight points on each traverse, or 16 points total per test. All weights were measured on the same "Torbal" precision balance calibrated May 1977 to $\pm$ 0.03 mg.

3.3 Analytical Methods

No deviations from the standard method.

4.0 Sampling Point Description

Two 3-inch diameter ports approximately 40 feet downstream from the blower and 4.5 feet from the top of the exhaust stack.

5.0 Detailed Results

They are presented in tabular form in the appendix of this report.

5.1 Emission Rates

	Test #1	Test #2	Test #3	Average
Grains/SCF	0.05	0.04	0.02	0.04
Lbs./hour	12.5	9.8	4.6	9.0
Production tons/hour	108	108	108	108
Allowable Emission rate lbs./hour	5.2	5.2	5.2	5.2

5.2 Gas Volumes, Etc.

Stack ACFM	39,986	39,456	39,102	39,515
Stack SCFM (dry)	29,209	28,632	26,904	28,448
Dry gas meter, meter conditions	34.58	30.2	33.6	32.8

5.3 Percent Isokinetic Sampling Rate

	102	91	106	100

5.6 Duration of Test

Tested on June 28, 1977. Actual sampling time - three hours - one hour each test.

The opacity of the exhaust gases from the precipitator averaged less than 5% while the plume was observed during all tests. The plume was never observed to be greater than 10%.

If we can provide any further information about these tests, please call.

H. Gary DuTell

HGD:jk
cc: Messrs. D. M. Watson
Mitch Steffensen
Jack Shuck

Attachments

Plant [illegible]

Source [illegible]

Test No. [illegible]

Test Date [illegible]

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$34.58\left(\frac{530}{541}\right)\left(\frac{29.87 + \frac{1.23}{13.6}}{29.92}\right) = 33.92 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (\ 110\ ) = 5.21 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{5.21}{(5.21) + (33.92)} \times 100 = 13.3 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (0.842)\ (0.54)\ \sqrt{\frac{628}{(29.93)\ (27.16)}} = 33.89 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts\left[\frac{Vic}{(MI20)}\frac{(pH_2O)}{(454)}R + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{628\left[\frac{110}{(18)}\frac{(1)}{(454)}21.83 + \left(\frac{34.58}{541}\right)\left(29.87 + \frac{1.23}{13.6}\right)\right]}{60 \times 60 \times 33.89 \times 29.93 \times 0.00037} \times 100 \quad 102 \text{ percent}$$

ACFM = $(V_s)\ (60)\ (As)$

$(33.95)\ )60)\ (19.63) = 39,986$ ACFM

F.D. 1-1

$$\text{SCFM (dry basis)} = \text{ACFM}\left(\frac{P\ bar}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$39{,}986\left(\frac{29.87}{29.92}\right)\left(\frac{530}{628}\right)\left(1 - \frac{13.3}{100}\right) = 29{,}209 \text{ SCFM}$$

$$C^1_s = (0.0154)\left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154)\left(\frac{106.8}{33.92}\right) = 0.05 \text{ gr/scf}$$

$$C^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.05)\ (29{,}209) = 12.5 \text{ lbs/hr}$$

JMS

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	0.133	18.0	2.39
Carbon Dioxide		44.0	
Carbon Monoxide		28.0	
Oxygen	0.204 x 0.861	32.0	5.65
Nitrogen + Inerts	0.5 x 0.861	28.2	19.56
		Total	27.6 lb/lb mole

TEST RUN DATA SHEET

Test # Run #

F_p = .842	Test 1	Ps = [illegible]	Gd = 27.12	As =	An = .00039 ft²	m = —
θ = 60		Pb 29.87				w = 16.89

Sampling Train Identification:

TEST Time*	TEST Point	Δt	ΔH	T_s	DGR 850.8	ΔDGR (calc.)	T_m	Vac	T_f	P_m (calc.)		qm (calc.)	qo (calc.)	ISK_p (calc.)
3.75	1	3.75	.35	155	852.4	2.7	75	1.4		30.07		2.50	2.64	.95
	2	3.75	.43	145	855.6	2.7	75	1.8		30.00		3.22	2.75	1.07
	3	3.75	.43	145	858.4	2.8	77	1.8		30.00		3.23	2.95	1.13
	4	3.75	.38	145	860.3	1.9	79	1.5		29.98		2.24	2.07	.90
	5	3.75	.3	177	862.2	1.9	80	1.25		29.96		2.12	2.40	[illegible]
	6	3.75	.25	172	865.6	3.4	80	1		29.94		4.00	2.20	1.52
		3.75	.25	172	867.4	1.8	80	1		29.98		2.12	[illegible]	.96
	8	3.75	.25	174	869.3	1.9	80	1		29.94		2.24	2.20	1.02
	1	3.75	.25	174	871.1	1.8	80	1		29.94		2.12	2.20	.96
	2	3.75	.3	174			80	1.25		29.96	—			
	3	3.75	.3	176	875.3	4.2	80	1.25		29.96		4.90	4.81	1.02
	4	3.75	.3	176			85	1.25		29.96		—		
	5	3.75	.3	176	879.4	4.1	85	1.25		29.96		4.74	4.80	1.00
	6	3.75	.25	176	881.5	2.1	85	1.1		29.95		2.45	2.20	1.11
	7	3.75	.21	174	883.6	2.1	87	.86		29.93		2.44	2.01	1.21
	8	3.75	.21	174	885.38	1.78	87	.86		29.93		2.07	2.01	1.03
													2.14	.8
														1.61
						V_m	$\overline{T_m}$	.96/.90		$\overline{P_m}$		Q_m	Q_o	ISK_o

*Local time sampling began at each point.

$$q_0 = 60 \times 2.9(.842)(.00537)\sqrt{\Delta H \; T_s + 460} \times \frac{29.92}{29.93} \; \frac{1.0}{.935} \times$$

$$3.75 \; \frac{530}{T_s + 460} \cdot \frac{29.93}{29.92}$$

$$q_0 = .054 \times 1.03 \times 3.751 \sqrt{\Delta H \; T_s + 460} \; \frac{530}{T_s + 460}$$

$$q_0 = .209 \sqrt{\Delta H \; T_s + 460} \; \frac{530}{T_s + 46} = .209 \sqrt{.35 \times 615} \; \frac{530}{615}$$

$$q_0 = 2.64$$

$$q_0 = .209 \sqrt{.43 \; (145 + 460)} \times \frac{530}{145 + 460} = 2.95$$

$$q_0 = .209 \sqrt{.43 \; (145 + 460)} \times \frac{530}{145 + 460} = 2.95$$

$$q_0 = .209 \sqrt{.38 \; (145 + 460)} \times \frac{530}{145 + 460} = 2.78$$

$$q_0 = .209 \sqrt{.3 \; (177 + 460} \times \frac{530}{177 + 460} = 2.40$$

$$q_0 = .209 \sqrt{.25 \; (172 + 460)} \times \frac{530}{172 + 460} = 2.20$$

$$q_0 = .209 \sqrt{.25 \; (172 + 460} \times \frac{530}{172 + 460} = 2.20$$

$$q_0 = .209\sqrt{.25\,(174+460)}\;\frac{530}{174+460} = 2.20$$

(1) $$q_0 = .209\sqrt{.25\,(174+460}\;\frac{530}{174+460} = 2.20$$

(3) $$q_0 = .054 \times 1.03 \times 7.50\sqrt{.3 \times 175+460}\;\frac{530}{175+460} = 4.81$$

(5) $$q_0 = .054 \times 1.03 \times 7.50\sqrt{.3 \times 176+460}\;\frac{530}{176+460} = 4.80$$

(6) $$q_0 = .209\sqrt{.25\,(176+460}\;\frac{530}{176+460} = 2.20$$

(7) $$q_0 = .209\sqrt{.21\,(174+460}\;\frac{530}{176+460} = 2.01$$

(8) $$q_0 = .209\sqrt{.21\,(174+460)}\;\frac{530}{176+460} = 2.01$$

1) $q_m = (\Delta DCR)\omega \left[\frac{530}{T_m+460} \cdot \frac{P_m}{29.92}\right]$

$= 2.1\,(1.20)\left(\frac{530}{535}\right)\left(\frac{29.97}{29.92}\right) = 2.50$

2) $q_m = 2.7\,(1.20)\left(\frac{530}{535}\right)\left(\frac{30.00}{29.92}\right) = 3.22$

3) $q_m = 2.8\,(1.20)\left(\frac{530}{537}\right)\left(\frac{30.10}{29.92}\right) = 3.33$

4) $q_m = 1.9\,(1.20)\left(\frac{530}{539}\right)\left(\frac{29.98}{29.92}\right) = 2.24$

5) $q_m = (1.9)(1.20)\left(\frac{530}{540}\right)\left(\frac{29.96}{29.92}\right) = 2.24$

7) q_m $(1.8)\,1.20\left(\frac{530}{540}\right)\left(\frac{29.94}{29.92}\right) = 2.12$

6) q_m $(3.4)(1.20)\left(\frac{530}{540}\right)\left(\frac{29.94}{29.92}\right) = 4.00$

8) $1.9 \times 1.20\left(\frac{530}{540}\right)\left(\frac{29.94}{29.92}\right) = 2.24$

1) $1.8 \times 1.20\left(\frac{530}{540}\right)\left(\frac{29.94}{29.92}\right) = 2.12$

2) $4.2 \times 1.20\,\frac{530}{545}\left(\frac{29.96}{29.92}\right) = 4.90$

5) $4.1 \times 1.20\,\frac{530}{545}\left(\frac{29.96}{29.92}\right) = 4.79$

4) $2.1 \times 1.20\,\frac{530}{545}\left(\frac{29.95}{29.92}\right) = 2.45$

7) $2.1 \times 1.20\,\frac{530}{547}\left(\frac{29.93}{29.92}\right) = 2.44$

6) $1.78 \times 1.20\left(\frac{530}{547}\right)\left(\frac{29.93}{29.92}\right)$ 2.07

LABORATORY REPORT

PLANT Fort Dodge

TEST # [illegible]

TEST DATE 7-1-1 5-25-77

ANALYST [illegible]

Container #	Final Weight (g)	Tare Weight (g)	Weight Gain (g)
Filters #1 12-77 #2	0.8306	0.8092	0.0214
Filter Control	0.7422	0.7396	0.0026
Upstream Washings I	94.3698	94.3334	0.0364
Control			0.0023
Upstream Impinger Washings II (Acetone)	97.4981	97.4421	0.0560
Control			0.0023
Impinger Washings (Water)			
Control			
$CHCl_3$ & $(C_2H_5)_2O$			
Control			

TOTAL 113.8 (mg)

NET TOTAL 106.8 (mg)

Impinger Water Volume Collected	Impinger H_2O (ml)	Impinger Silica Gel (grams)
Final		
Initial		
Total Volume, ml		

TOTAL _____ grams

6.8

1/4

TRAVERSE DATA | SAMPLING DATA | LOCATION Fort Dodge

Trav. Point No.	Trav. ΔP in.H_2O	Stack or Duct °F	Sampl. Rate CFM	ORI ΔP in.H_2O	Actual ΔP in.H_2O	$\sqrt{\Delta P}$	CR ΔP in.H_2O	Stack or Duct °F	Drifire Temp. °F	Filter Temp. (pre) °F	Box Temp. °F	Actual Sampl. Rate CFM	Sampl. Time (min)
1					.35		1.45	155	25			852.9	3.75
2					.43		1.8	145	75			855.6	
3					.43		1.8	145	77			854	
4					.38		1.5	145	79			860.3	
5					.3		1.25	177	80			860.2	
6					.25		1	172	80			865.6	
7					.25		1	172	80			867.4	
8					.25		1	174	50			869.2	
9													
10													
11													
12													
1					.25		1.2	174	80			871.1	
2					.3		1.25	174	80				
3					.3		1.25	176	85			875.3	
4					.3		1.25	176	85				
5					.3		1.25	176	85			879.4	
6					.25		1.1	176	85			881.5	
7					.21		.86	174	87			883.1	
8					.21		.86	174	87			885.38	
9													
10													
11													
12													
TOTAL					.5	.54	1.23						60 m

Type Boiler: Cottrell Precip

Bar Pressure: 29.87

Stack Dia.: 60"

Meter Stop: 885.38

Meter Start: 850.8

Time-Date: 12.20 6-28-71

Test # 1 | Filter # 12-71

Run # 1

Meter Stop

Meter Start

Time - Date

Test # | Filter #

Run #

34.58

ORZAT Run 2

		O^2	CO^2		O^2	CO^2			O^2	CO^2		O^2	CO^2			O^2	CO^2		O^2	CO^2		O^2	CO^2
FYRITE TEST # 1	1			5			ORZAT Test #	1			5	20	—	FYRITE Run # 2	1			5			1		
	2			6				2			6	20	—		2			6			2		
	3			7				3			7	20	—		3			7			3		
	4			8				4			8		—										

Plant [illegible] Test No. [illegible]

Source [illegible] Test Date 6-[illegible]-77

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$30.2\left(\frac{530}{545}\right)\left(\frac{29.87 + \frac{1.25}{13.6}}{29.92}\right) = 29.4 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (89) = 4.21 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{4.21}{(4.21) + (29.4)} \times 100 = 12.5 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (.842)\ (.53)\ \sqrt{\frac{638}{(29.93)\ (27.59)}} = 33.5 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts\left[\frac{Vic}{(MH2O)}\frac{(pH_2O)}{(454)}R + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{638\left[\frac{89}{(18)}\frac{(1)}{(454)}21.83 + \left(\frac{30.2}{545}\right)\left(29.87 \frac{1.25}{13.6}\right)\right]}{60 \times 60 \times 33.5 \times 29.93 \times 0.00037} \times 100 = 91 \text{ percent}$$

$$ACFM = (V_s)\ (60)\ (As)$$

$$(33.5)\ (60)\ (19.63) = 39456 \text{ ACFM}$$

$$\text{SCFM (dry basis)} = ACFM \left(\frac{P\ bar}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$34{,}456 \left(\frac{29.87}{29.92}\right)\left(\frac{530}{638}\right)\left(1 - \frac{12.5}{100}\right) = \underline{28{,}632}\ \text{SCFM}$$

$$c^1_s = (0.0154) \left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154) \left(\frac{79.3}{29.4}\right) = \underline{0.04}\ \text{gr/scf}$$

$$c^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.04)\ (28{,}632) = \underline{9.8}\ \text{lbs/hr}$$

$$E = \left[55.0\ (108^{0.11})\right] - 40 = 52\ \text{lbs/hr allowable}$$

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	.125	18.0	2.25
Carbon Dioxide	—	44.0	
Carbon Monoxide	—	28.0	
Oxygen	.20 .875	32.0	5.6
Nitrogen + Inerts	.80 .775	28.2	19.74
		Total	27.59 lb/lb mole

LABORATORY REPORT

PLANT Ford Dal[illegible] TEST # T-2-2 6-24-77

TEST # Cathrell ANALYST D. Toll / F. Hor

Container #	Final Weight (g)	Tare Weight (g)	Weight Gain (g)
Filters #1 #2	0.5546	0.8382	0.0164
Filter Control	0.8422	0.8346	-0.0026
Upstream Washings	94.8053	94.7375	0.0678
Control			-0.0023
Impinger Washings (Acetone)			
Control			
Impinger Washings (Water)			
Control			
$CHCl_3$ & $(C_2H_5)_2O$			
Control			

TOTAL 84.2 (mg)

NET TOTAL 79.3 (mg)

Impinger Water Volume Collected	Impinger H_2O (ml)	Impinger Silica Gel (grams)
Final		
Initial		
Total Volume, ml		

TOTAL _____ grams

TEST RUN DATA SHEET

Test # 3 Run # 3

F_p = .942	Test II	Ps = 29.93	Gd = 27.34 / 29 .951	As =	An = .00534	m =
Θ = 60		Pb = 29.87				w = 12.5 %

Sampling Train Identification:

TEST Time*	Point	Δt	ΔH	T_s	DGR 889.7	ΔDGR (calc.)	T_m	Vac	T_f	P_m (calc.)		qm (calc.)	qo (calc.)	ISK_p (calc.
[illegible]	1	3.75	.21	184	891.6	1.9	92	1.5		29.98		3.08	2.45	.84
	2	3.75	.3	182	890	2.4	92	1.3		29.97		2.03	2.57	1.13
	3	3.75	.3	181	895.9	1.8	92	1.3		29.97		1.97	2.23	.85
	4	3.75	.3	180	6.22	2.0	92	1.3		29.97		2.19	[illegible]	.95
	5	3.75	.35	180	[illegible]	2.0	92	1.5		29.98		2.19	[illegible]	[illegible]
	6	3.75	.3	178	901.6	1.8	90	1.3		29.97		1.97	[illegible]	[illegible]
	7	3.75	.25	175	9.34	1.8	90	1.1		29.95		1.97	2.14	[illegible]
	8	3.75	.2	172		—	90	.85		29.93				
3.75	1	3.75	.25	177	906.4	3.05	88	1.1		29.95		3.36	4.36	.78
	2	3.75	.25	177	908.2	1.75	88	1.1		29.95		1.93	2.11	.91
	3	3.75	.25	177	909.9	1.7	88	1.1		29.95		1.87	2.14	.88
	4	3.75	.3	177	911.5	1.6	88	1.3		29.97		1.76	2.29	.76
	5	3.75	.3	177	913.5	2.0	88	1.3		29.97		2.21	2.34	.95
	6	3.75	.3	177	914	1.9	90	1.3		29.97		2.09	2.31	[illegible]
	7	3.75	.3	177	917.0	1.6	90	1.3		29.97		1.78	2.34	.76
	8	[illegible]	.3	177	919.9	2.9	90	1.3		29.97		3.19	2.34	1.36
													S	1.74
														1.6
						V_m	$\overline{T_m}$			$\overline{P_m}$		Q_m	Q_o	ISK_o

*Local time sampling began at each point.

$$\dot{m} = (\Delta DGR)\,\omega \left[\frac{530}{T_m + 460} \times \frac{P_m}{29.92}\right]$$

1) $q_m = 1.9\,(1.14)\left[\frac{530}{552} \cdot \frac{29.97}{29.92}\right] = 2.08$

2) $q_m = 2.4\,(1.14)\left[\frac{530}{552} \cdot \frac{29.97}{29.92}\right] = 2.63$

3) $q_m = 1.8\,(1.14)\left[\frac{530}{552} \cdot \frac{29.97}{29.92}\right] = 1.97$ Test II

2) $q_m = 2.0\,(1.14)\left[\frac{530}{552} \cdot \frac{29.97}{29.92}\right] = 2.19$

2) $q_m = 2.0\,(1.14\left[\frac{530}{552} \cdot \frac{29.97}{29.92}\right] = 2.19$

3) $q_m = 1.8\,(1.14\left[\frac{530}{550} \cdot \frac{29.97}{29.92}\right] = 1.97$

3) $q_m = 1.8\,(1.14\ \frac{530}{550} \cdot \frac{29.95}{29.92}\Big] = 1.97$

$q_m = 3.05\,(1.14)\ \frac{530}{548} \cdot \frac{29.93}{29.92} = 3.36$

$q_m = 1.75\,(1.14)\ \frac{530}{548}\ \frac{29.95}{29.92} = 1.99$

$q_m = 1.7\,(1.14)\ \frac{530}{548} \times \frac{29.95}{29.97} = 1.89$

$q_m = 1.6\,(1.14)\ \frac{530}{548} \cdot \frac{29.95}{29.92} = 1.78$

$q_m = 2.0\,(1.14)\ \frac{530}{548} \cdot \frac{29.97}{29.92} = 2.27$

3) $1.9\,(1.14)\ \frac{530}{550} \cdot \frac{29.97}{29.92} = 2.09$

$q_m = 1.6\,(1.14)\left(\frac{530}{550} \cdot \frac{29.97}{29.92}\right) = 1.76$

$q_m = 2.9\,(1.14)\ \frac{530}{550}\left(\frac{29.97}{29.92}\right) = 3.19$

Test 1b

$$q_0 = 60 \cdot 842 \cdot .00037 \sqrt{\Delta H (T_s + 460)} \frac{29.92}{29.93} \times \frac{60}{.951} \times$$

$$\times 3.75 \times \frac{530}{T_s + 460} \times \frac{29.93}{29.92}$$

$$q_0 = .050 \times 1.025 \times 3.751 \times \frac{530}{T_s + 460} \times \sqrt{\Delta H (T_s + 460)}$$

$$q_0 = \frac{.203}{\cancel{.192}} \times \frac{530}{T_s + 460} \sqrt{\Delta H (T_s + 460)} =$$

$$q_0 = \frac{.203}{\cancel{.192}} \times \frac{530}{184 + 460} \sqrt{.34 (184 + 460)} = 2.48$$

$$q_0 = \frac{.203}{\cancel{.192}} \times \frac{530}{182 + 460} \sqrt{.3 (182 + 460)} = 2.33$$

$$q_0 = \frac{.203}{\cancel{.192}} \frac{530}{181 + 460} \sqrt{.3 (181 + 460)} = 2.33$$

$$q_0 = \frac{.203}{\cancel{.192}} \frac{530}{180 + 460} \sqrt{.3 (180 + 460)} = 2.33$$

$$q_0 = \frac{.203}{\cancel{.192}} \frac{530}{180 + 460} \sqrt{.35 (180 + 460)} = 2.52$$

$$q_0 = \frac{.203}{\cancel{.192}} \frac{530}{178 + 460} \sqrt{.3 (178 + 460)} = 2.34$$

$$q_0 = \frac{.203}{\cancel{.192}} \frac{530}{175 + 460} \sqrt{.25 (175 + 460)} = 2.14$$

$$q_0 = .054 \times 1.025 \times 7.50 \times \frac{530}{T_s + 460} \sqrt{\Delta H \quad T_s + 460} = 4.36$$

$$.25 \quad 177$$

$$177$$

$$q_0 = \frac{.203}{\cancel{.192}} \cdot .032 \cdot 25.24 \sqrt{\Delta H}$$

$$4.032 \sqrt{.25} \qquad = 2.14$$

(5) $4.032\sqrt{}$ same 0 2 2.14

(5) $4.032\sqrt{.3} = 2.34$

(6)

TRAVERSE DATA — SAMPLING DATA — LOCATION Fab Dolton

Trav. Point No.	Trav. ΔP in.H_2O	Stack or Duct °F	Sampl. Rate CFM	ORI ΔP in.H_2O	Actual ΔP in.H_2O	$\sqrt{\Delta P}$	CR ΔP in.H_2O	Stack or Duct °F	Drifire Temp. °F	Filter Temp. (pre) °F	Box Temp. °F	Actual Sampl. Rate CFM	Sampl. Time (min)
1					.34		1.5	184	92			899.7	3.75
2					.3		1.3	182	92			891.6	
3					.3		1.3	181	92			894	
4					.3		1.3	180	92			896.8	
5					.35		1.5	180	92			897.8	
6					.3		1.3	178	90			899.8	
7					.25		1.1	175	90			901.6	
8					.2		.85	172	90			903.4	
9													
10													
11													
12													
1					.25		1.1	177	88				
2					.25		1.1	177	88			906.4	
3					.25		1.1	177	88			908.2	
4					.3		1.3	177	88			909.9	
5					.3		1.3	177	90			911.5	
6					.3		1.3	177	90			913.5	
7					.3		1.3	177	90			916.4	
8					.3		1.3	177	90			917	
9													
10													
11													
12													
TOTAL						0.53	1.25	635	875				

Type Boiler: Combustion Engineering

Bar Pressure: 29.87

Stack Dia.: 60"

Meter Stop: 919.9

Meter Start: 881.7

Time-Date: 1320 1-25-77

Test # 2 — Filter # 13-77

Run #

Meter Stop

Meter Start

Time - Date

Test # — Filter #

Run #

ORZAT Run 2

	O^2	CO^2		O^2	CO^2
FYRITE TEST # 1	1		5		
	2		6		
	3		7		
	4		8		

	O^2	CO^2		O^2	CO^2
ORZAT Test # 1	1		5	20	
	2		6	20	
	3		7	20	
	4		8	20	

	O^2	CO^2		O^2	CO^2
FYRITE Run # 2	1		5		
	2		6		
	3		7		
	4		8		

	O^2	CO^2		O^2	CO^2
			1		
			2		
			3		

Plant [illegible]

Source [illegible]

Test No. 3

Test Date 6-28-77

Vm =

9.2

$$Vm_{std} = Vm \left(\frac{T\ std}{T\ m}\right)\left(\frac{P\ bar + \frac{\Delta H}{13.6}}{P\ std}\right)$$

$$33.6 \left(\frac{530}{549}\right)\left(\frac{29.89 + \frac{1.33}{13.6}}{29.92}\right) = 32.51 \text{ cubic feet}$$

9.3

$$Vw_{std} = (0.0474\ (Vi_c)$$

$$(0.0474)\ (138) = 6.54 \text{ cubic feet}$$

9.4

$$B_{wo} = \frac{Vw_{std}}{Vw_{std} + Vm_{std}} \times 100$$

$$\frac{6.54}{(6.54) + (32.51)} \times 100 = 16.7 \text{ percent}$$

2.2

$$Vs\ avg. = Kp\ Cp \sqrt{\Delta P\ avg} \sqrt{\frac{(Ts)\ avg.}{(Ps)\ (M_s)}}$$

$$85.48\ (0.842)\ (0.52) \sqrt{\frac{641}{(30.04)\ (27.13)}} = 33.2 \text{ Feet/Second}$$

9.8

$$I = \frac{Ts \left[\frac{Vic}{(MH20)} \frac{(pH_2O)}{(454)} R + \left(\frac{Vm}{Tm}\right)\left(Pbar + \frac{\Delta H}{13.16}\right)\right]}{60 \times min. \times V_s \times P_s \times An} \times 100$$

$$\frac{641 \left[\frac{138}{(18)} \frac{(1)}{(454)} 21.83 + \left(\frac{33.6}{549}\right)\left(29.89 + \frac{1.33}{13.6}\right)\right]}{60 \times 60 \times 33.2 \times 30.04 \times 0.00037} \times 100 \quad 106 \text{ percent}$$

ACFM = $(V_s)\ (60)\ (As)$

$$(33.2)(60)\ (19.63) = 39,102 \text{ ACFM}$$

$$\text{SCFM (dry basis)} = \text{ACFM}\left(\frac{P\ bar}{P\ bar_{std}}\right)\left(\frac{T\ std}{Ts}\right)\left(1 - \frac{B_{wo}}{100}\right)$$

$$57.102\left(\frac{29.89}{29.92}\right)\left(\frac{530}{641}\right)\left(1 - \frac{16.7}{100}\right) = 26,904 \text{ SCFM}$$

$$c^1_s = (0.0154) \cdot \left(\frac{\text{sample net wt.}}{Vm\ std}\right)$$

$$(0.0154)\left(\frac{42.4}{30.57}\right) = 0.02 \text{ gr/scf}$$

$$c^1_s = (0.00857)\ (\text{gr/SC})\ (\text{SCFM})$$

$$(0.00857)\ (0.02)\ (26,904) = 4.6 \text{ lbs/hr}$$

$$* \quad E = 55.0\ P^{0.11} - 40$$

$$55.0\ 108^{0.11} - 40 = 52 \text{ lbs/hr allowable}$$

gms

P. 13 State of Iowa DEQ Air Quality Reg

Molecular weight of stack gas, Ms

Component	Volume Frac.	Mol. Wt.	Weight per mole wet basis
Water	.167	18.0	3
Carbon Dioxide		44.0	
Carbon Monoxide		28.0	
Oxygen	.20 .533	32.0	5.33
Nitrogen + Inerts	.80 .833	28.2	18.8
		Total	27.13 lb/lb mole

79

LABORATORY REPORT

PLANT Fort Dolgo

TEST # 3

TEST DATE 6-28-77

ANALYST [illegible]

Container #	Final Weight (G)	Tare Weight (G)	Weight Gain (G)
Filters #1 #2	.8195	0.8058	0.0137
Filter Control	.8422	0.8396	0.0026
Upstream Washings	86.8848	86.8696	0.0152
Control			0.0023
Impinger Washings (Acetone)	98.1775	98.1568	0.0207
Control			0.0023
Impinger Washings (Water)			
Control			
$CHCl_3$ & $(C_2H_5)_2O$			
Control			

TOTAL 49.6 (mg)

NET TOTAL 42.4 (mg)

Impinger Water Volume Collected	Impinger H_2O (ml)	Impinger Silica Gel (grams)
Final	319	211
Initial	200	200
Total Volume, ml	119	11

TOTAL 130 grams

F_p = .942		Ps = 30.04	Gd = 27.13 / 29 .936	As =	An = .00537	m = [illegible]
Θ = (-)		Pb = 29.89				w = [illegible]

Sampling Train Identification:

TEST Time*	TEST Point	Δt	ΔH	T_s	DGR 929.9	ΔDGR (calc.)	T_m	Vac	T_f	P_m (calc.)		qm (calc.)	qo (calc.)	ISK_p (calc.)
2		3.75	.3	179	932.2	2.3	89	1.25		29.98		2.67	2.40	1.11
3		3.75	.35	180	934.2	2.0	89	1.5		30.0		2.32	2.54	.90
4		3.75	.4	180	936.5	2.3	89	1.65		30.1		2.68	2.77	.97
5		3.75	.4	180	938.8	2.3	89	1.65		30.1		2.68	2.77	.97
6		3.75	.35	182	940.8	2.0	89	1.5		30.0		2.32	2.54	.90
7		3.75	.3	182	942.8	2.0	89	1.25		29.98		2.32	2.34	.77
8		3.75	.2	182	944.7	1.9	89	.86		29.95		2.20	1.96	1.12
18														
		3.75	.25	182	946.4	1.7	89	1.1		29.97		1.97	2.13	.90
1		3.75					89			29.95			1.96	
2		3.75	.25	180	948.5	2.1	89	1.1		29.97	2	2.43	2.20	1.10
3		3.75	.3	180	950.4	1.9	89	1.25		29.98		2.21	2.40	.92
4		3.75	.3	180	952.3	2.4	89	1.25		29.98		2.79	2.40	1.16
5		3.75	.35	180	954.7	1.9	89	1.5		30.00		2.21	2.60	.85
6		3.75	.35	180	956.6	2.3	89	1.5		30.00		2.67	2.60	1.03
7		3.75	.35	180	958.9	2.3	89	1.5		30.00		2.67	2.60	1.03
8		3.75	.4	180	961.5	2.6	89	1.65		30.10		3.03	2.78	1.09
													[illegible]	
						V_m	$\overline{T_m}$			$\overline{P_m}$		Q_m	Q_o	ISK_o

*Local time sampling began at each point.

Stack Test Report

TEST RUN DATA SHEET

Test # Run #

Test III

$$q_m = (\Delta DGR)\,w \left[\frac{530}{T_m + 460} \times \frac{P_m}{29.92}\right]$$

1 $q_m = 2.3 \times 1.20 \left[\frac{530}{548} \times \frac{29.98}{29.92}\right] = 2.67$

2 $q_m = 2.0 \times 1.20 \left[\frac{530}{549} \times \frac{30.1}{29.92}\right] = 2.32$

3 $q_m = 2.3 \times 1.20 \left[\frac{530}{549} \times \frac{30.1}{29.92}\right] = 2.68$

4 $q_m = 2.3 \times 1.20 \left[\frac{530}{549} \times \frac{30.1}{29.92}\right] = 2.68$

5 $q_m = 2.0 \times 1.20 \left[\frac{530}{549} \times \frac{30.0}{29.92}\right] = 2.32$

6 $q_m = 2.0 \times 1.20 \left[\frac{530}{549} \times \frac{29.98}{29.92}\right] = 2.32$

7 $q_m = 1.9 \times 1.20 \left[\frac{530}{549} \times \frac{29.95}{29.92}\right] = 2.20$

8 $q_m = 1.7 \times 1.20 \left[\frac{530}{549} \times \frac{29.97}{29.92}\right] = 1.97$

1

2 $q_m\ 2.1\,(1.20)\left(\frac{530}{549} \times \frac{29.95}{29.92}\right) = 2.43$

3 $q_m\ 1.9\,(1.20)\,\frac{530}{549}\left(\frac{29.98}{29.92}\right) = 2.21$

4 $q_m = 2.4\,(1.20)\,\frac{530}{549} \times \frac{29.98}{29.92}\Big) = 2.79$

5 $q_m = 1.9 \times 1.2 \left[\frac{530}{549} \times \frac{30.0}{29.92}\right] = 2.21$

6 $q_m = 2.3 \times 1.2 \left[\frac{530}{549} \times \frac{30.0}{29.92}\right] = 2.67$

7 $q_m = 2.3 \times 1.2 \left[\frac{530}{549} \times \frac{30.0}{29.92}\right] = 2.67$

8. $q_m = 2.6 \times 1.20 \left[\frac{530}{549} \times \frac{30.1}{29.92}\right] = 3.03$

TEST III

$$Q_s = 60 \times .842 \times 2.9 \times .00037 \sqrt{\Delta H (T_s + 460)} \frac{29.92}{30.04} \times \frac{1.0}{.996}$$

$$\times 3.75 \times \frac{530}{T_s + 460} \times \frac{30.04}{29.92}$$

$$\%I = .054 \times 1.03 \times 3.765 \sqrt{\Delta H (T_s + 460} \times \frac{530}{T_s 460}$$

$$\%I = .209 \sqrt{.3 (639)} \frac{530}{639} = 2.4$$

$$\%2 = .209 \sqrt{.35 (640} \frac{530}{640} = 2.59$$

$$\%3 = .209 \sqrt{.4 (640)} \frac{530}{640} = 2.77$$

$$\%4 = .209 \sqrt{.4 (640)} \frac{530}{640} = 2.77$$

$$\%5 = .209 \sqrt{.35 (642} \frac{530}{642} = 2.59$$

$$\%6 = .209 \sqrt{.3 (642)} \frac{530}{642} = 2.39$$

$$\%7 = .209 \sqrt{.2 (642)} \frac{530}{642} = 1.96$$

$$\%8 = .209 \sqrt{.25 (642)} \frac{530}{642} = 2.19$$

$$\%1 = .209 \sqrt{.2 (642)} \frac{530}{642} = 1.96$$

$$\%2 = .209 \times 25.30 \times .83 \times \sqrt{.25} = 4.39 \sqrt{.25} = 2.20$$

$$3-4 \quad 4.39 \sqrt{.3} = 2.40$$

$$5-7 \quad 4.39 \sqrt{.35} = 2.60$$

$$8 \quad 4.39 \sqrt{.4} = 2.78$$

TRAVERSE DATA — SAMPLING DATA — LOCATION Fort Dodge

Trav. Point No.	Trav. ΔP in.H_2O	Stack or Duct °F	Sampl. Rate CFM	ORI ΔP in.H_2O	Actual ΔP in.H_2O	$\sqrt{\Delta P}$	CR ΔP in.H_2O	Stack or Duct °F	Drifire Temp. °F	Filter Temp. (pre) °F	Box Temp. °F	Actual Sampl. Rate CFM	Sampl. Time (min)
1					.3		1.25	179	88			929.9	
2					.35		1.5	180	89			932.7	
3					.4		1.65	180	89			[illegible]	
4					.4		1.65	180	[illegible]			[illegible]	
5					.35		1.5	182	[illegible]			938.8	
6					.3		1.25	[illegible]	[illegible]			940.8	
7					.2		.86	[illegible]	[illegible]			943.8	
8					.25		1.1	[illegible]	[illegible]			[illegible]	
9													
10													
11													
12													
1					.2		.86	182	89			946.9	
2					.25		1.1	180	[illegible]			[illegible]	
3					.3		1.25	[illegible]	[illegible]			[illegible]	
4					.3		1.25	[illegible]	[illegible]			[illegible]	
5					.33		1.5	[illegible]	[illegible]			[illegible]	
6					.35		1.5	[illegible]	[illegible]			951.1	
7					.35		1.5	[illegible]	[illegible]			[illegible]	
8					.4		1.65	[illegible]	[illegible]			[illegible]	
9												951.5	
10													
11													
12													
TOTAL						.52	1.33	641	549				

Type Boiler: Cotrell

Bar Pressure: 29.89

Stack Dia.: 60

Meter Stop: 941.5

Meter Start: 927.9

Time-Date: 6-27-77 6:13 PM

Test # 3 — Filter 1-77

Run # 1

Meter Stop

Meter Start

Time - Date

Test # — Filter #

Run #

33.6

ORZAT Run 2

FYRITE TEST #1	O_2	CO_2		O_2	CO_2
1			5		
2			6		
3			7		
4			8		

ORZAT Test # 1	O_2	CO_2		O_2	CO_2
1			5	20	
2			6	20	
3			7		
4			8		

FYRITE Run # 2	O_2	CO_2		O_2	CO_2
1			5		
2			6		
3			7		
4			8		

ORZAT Run 2	O_2	CO_2		O_2	CO_2
			1		
			2		
			3		
			4		

5. Calculations.

Use equation 2-2 to calculate the stack gas velocity.

$$(V_s)\ avg. = K_p C_p\ (\sqrt{\Delta p})\ avg. \sqrt{\frac{(T_s)\ avg.}{P_s M_s}}$$

Equation 2-2

Where:

(V_s) avg. = Average stack gas velocity, feet per second (f.p.s.).

$K_p = 85.48 \frac{ft.}{sec.} \left(\frac{lb.}{lb.\ mole\text{-}°R}\right)^{1/2}$ when these units are used.

C_p = Pitot tube coefficient, dimensionless.

(T_s) avg. = Average absolute stack gas temperature, °R.

$(\sqrt{\Delta p})$ avg. = Average velocity head of stack gas, inches H_2O (see fig. 2-2).

P_s = Absolute stack gas pressure, inches Hg.

M_s = Molecular weight of stack gas (wet basis) lb/lb-mole.
$= Md\ (1-B_{wo}) - 18B_{wo}$

Md = Dry molecular weight of stack gas.

B_{wo} = Proportion by volume of water vapor in the gas stream.

Figure 2-2 shows a sample recording sheet for velocity traverse data.

9.0 Calculations

9.1 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 2).

9.2 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F, 29.92 inches Hg) by using Equation 9-1.

$$Vm_{std} = Vm \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right) = \left(17.71 \frac{°R}{in.\ Hg}\right)\left(V_m \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

Equation 9-1

where:

Vm_{std} = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at the orifice meter, inches Hg.

ΔH = Average pressure drop across the orifice meter, inches H_2O.

13.6 = Specific gravity of mercury

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

9.3 Volume of water vapor.

$$Vw_{std} = V_{1_c} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{RT_{std}}{P_{std}}\right) = \left(\frac{0.0474 \text{ cu. ft.}}{\text{ml.}}\right) V_{1_c}$$

Equation 9-2

where:

Vw_{std} = Volume of water vapor in the gas sample (standard conditions) cu ft.

V_{1_c} = Total volume of liquid collected in impingers and silica gel (See Figure 3), ml.

ρH_2O = Density of water, 1 g./ml.

M_{H_2O} = Molecular weight of water, 18 lb./lb. - mole.

R = Ideal gas constant, 21.83 inches Hg. - cu.ft./lb.-mole-°R.

T_{std} = Absolute temperature at standard conditions, 530° R.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

9.4 Moisture content

$$B_{wo} = \frac{Vw_{std}}{Vm_{std} + Vw_{std}}$$

Equation 9-3

where:

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless.

Vw_{std} = Volume of water in the gas sample (standard conditions), cu. ft.

Vm_{std} = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

9.5 Total particulate weight. Determine the total particulate catch from the sum of the weights on the analysis data sheet (Figure 3.1.

9.8 Isokinetic variation.

$$I = \left[\frac{T_s \left[\frac{V_{1c}\,(\rho H_2O)\,R}{M_{H_2O} \times \text{min.}} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right]}{\theta V_s P_s A_n} \right] \times 100$$

$$I = \frac{T_s \left(\frac{\text{Min.}}{1.667\ \text{sec.}} \right) \left[\left(0.00267\ \frac{\text{in. Hg-cu ft.}}{\text{ml.}\ ^\circ\text{K}} \right) V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right]}{\theta V_s P_s A_n}$$

Equation 9-7

where:

I = Percent of isokinetic sampling.

V_{1c} = Total volume of liquid collected in impingers and silica gel (see Fig. 3), ml.

ρH_2O = Density of water, 1 g./ml.

R = Ideal gas constant, 21.83 inches Hg-cu. ft./lb. mole-°R.

M_{H_2O} = Molecular weight of water, 18 lb/lb.-mole.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_m = Absolute average dry gas meter temperature (see Figure 2), °R.

P_{bar} = Barometric pressure at sampling site, inches Hg.

ΔH = Average pressure drop across the orifice (see Fig. 2), inches H_2O.

T_s = Absolute average stack gas temperature (see Fig. 2), °R.

θ = Total sampling time, min. sec.

V_s = Stack gas velocity calculated by Equation 9-6, ft./sec.

P_s = Absolute stack gas pressure, inches Hg.

A_n = Cross-sectional area of nozzle, sq. ft.

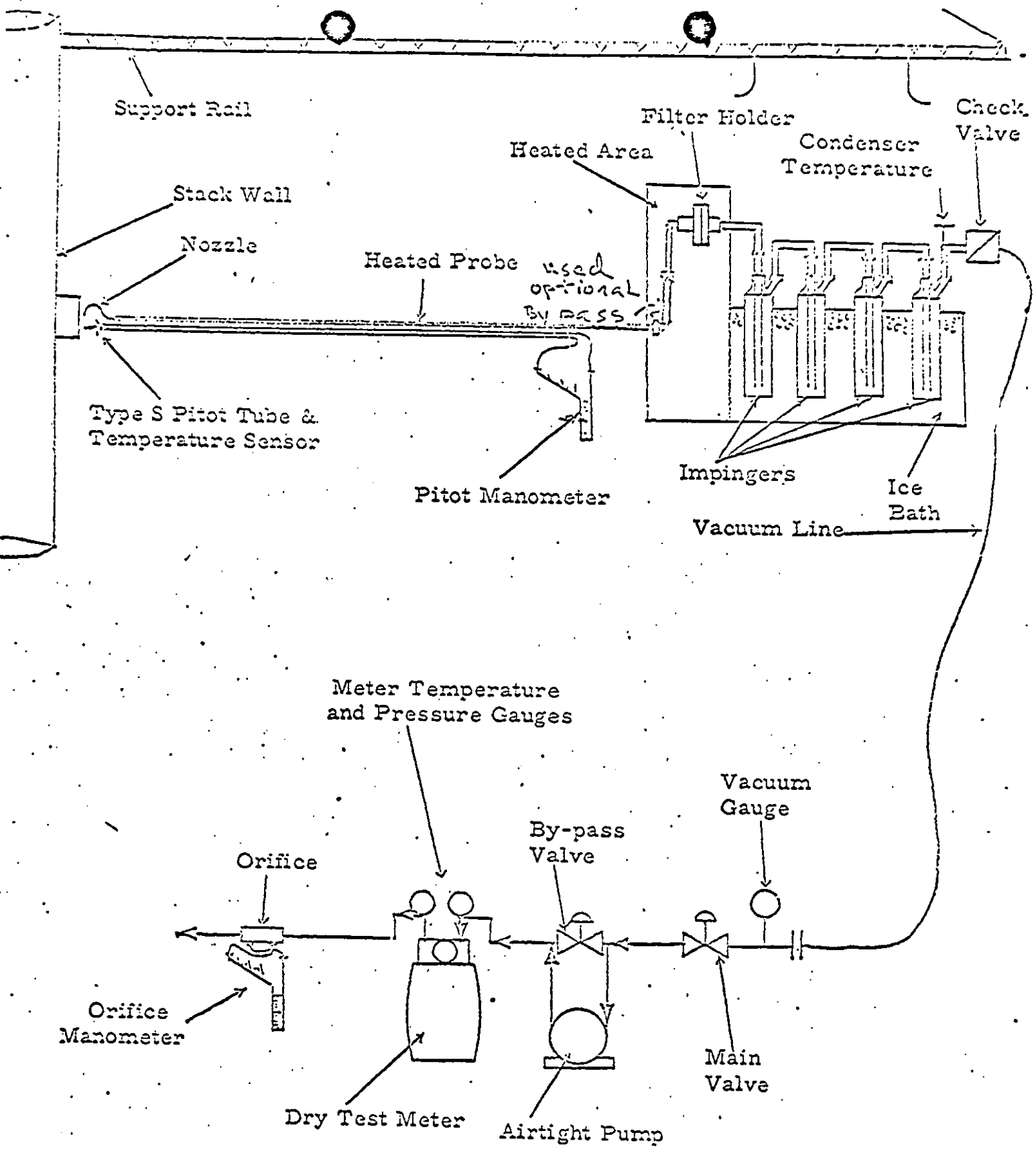
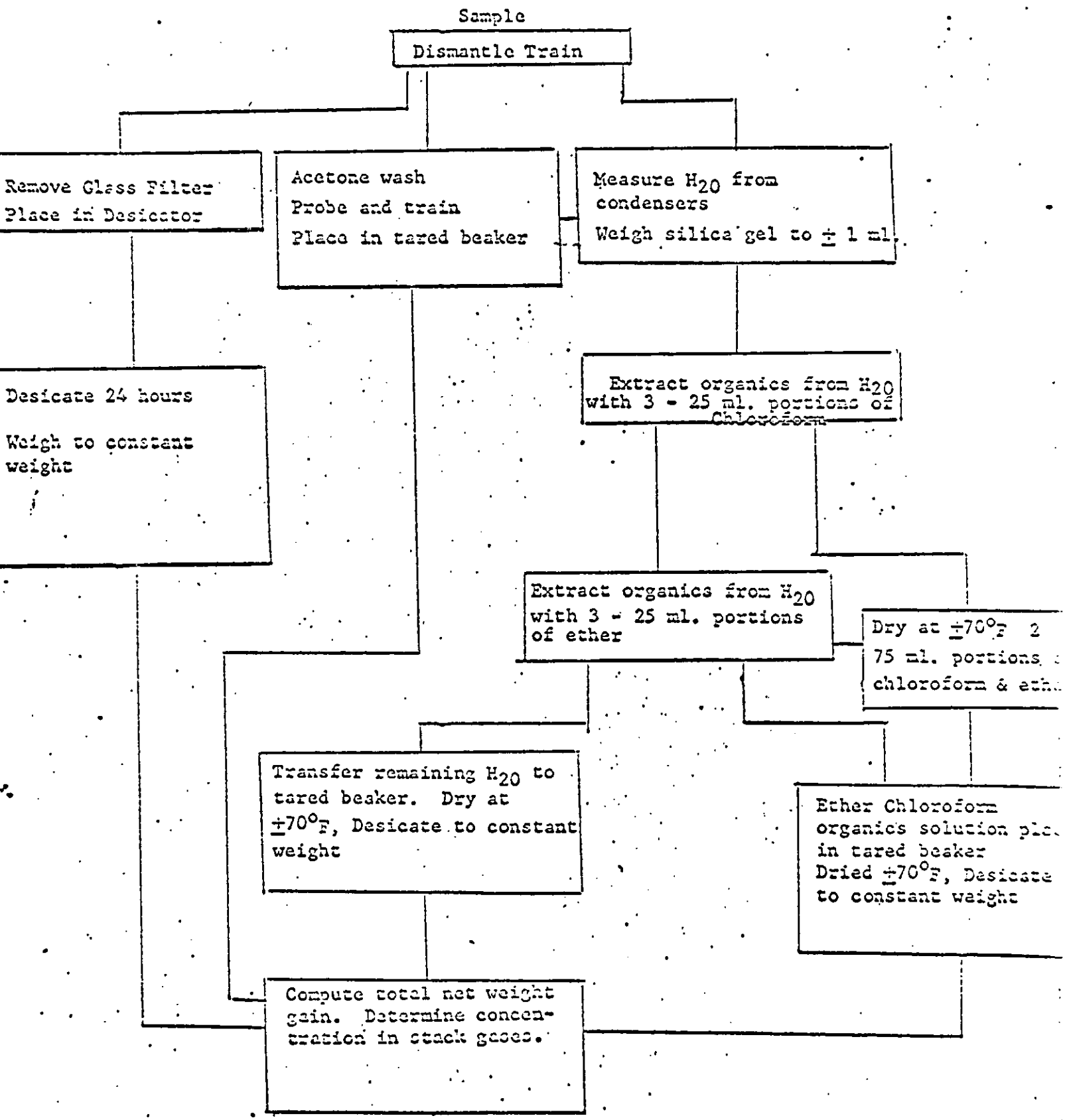


Figure - 1½ Sampling Train Schematic.

One arrangement of an out-of-stack sampling train. Other arrangements are acceptable.

FIGURE 3


Sample
Dismantle Train
Remove Glass Filter
Place in Desiccator
Acetone wash
Probe and train
Place in tared beaker
Measure H_2O from condensers
Weigh silica gel to ± 1 ml.
Desicate 24 hours
Weigh to constant weight
Extract organics from H_2O with 3 - 25 ml. portions of Chloroform
Extract organics from H_2O with 3 - 25 ml. portions of ether
Dry at ±70°F 2
75 ml. portions
chloroform & eth
Transfer remaining H_2O to tared beaker. Dry at ±70°F, Desicate to constant weight
Ether Chloroform organics solution pl
in tared beaker
Dried ±70°F, Desicate to constant weight
Compute total net weight gain. Determine concentration in stack gases.

CALIBRATION OF S-TYPE PITOT TUBES

FOR GEOZON-PACIFIC CO., P.O. Box 1618, EUGENE, OR 97401
(P.O. No. 47147)

Tube "A" – ½" x 8 ft. stainless, bundle with part. + temp. probes (S-tube realigned)
(tested with and without part. tube in place – ⅜" cl. when in place)

Bar. 29.693 71 F
Corr. -0.13
29.56 inHg abs. (corrected)

Fan meter volts	Rdg. No.	ΔP_A Order in H_2O of rdg.	ΔP_v std. Pitot in. H_2O	True vel. fps	K_A conv. const
170	1	1.9930	1.3740	79.5	0.836
150	2	1.5183	1.0698	69.7	0.839
130	3	1.0925	0.7793	59.5	0.844
110	4	0.7614	0.5414	49.6	0.843
90	5	0.4970	0.3540	40.1	0.844
80	6	0.3872	0.2769	35.4	0.846
70	7	0.2913	0.2030	30.4	0.849
60	8	0.2028	0.1477	25.9	0.853
50	9	0.1322	0.0953	20.8	0.849
40	10	0.0803	0.0562	16.0	0.836
30	11	0.0372	0.0271	11.1	0.853
20	12	0.0140	0.0092	6.46	0.811
					0.842 avg.

Air temp. 72 F

Density of air

$$\rho_a = \frac{P_a}{R_a T_a} = \frac{29.56 \times 0.491 \times 144}{53.3(460+72)}$$
$$= 0.0737 \text{ lb/ft}^3$$

True velocity

$$\Delta P = \Delta P_v \times 0.0361 \times 144 \quad (\text{in. } H_2O)$$
$$(\text{lb/ft}^2) = 5.20 \times \Delta P_v$$

$$\bar{V}_a = \sqrt{\frac{2g\,\Delta P}{\rho_a}} \quad (\text{fps})$$
$$= \sqrt{\frac{2 \times 32.2 \times 5.20 \times \Delta P_v}{0.0737}}$$
$$= 67.41\sqrt{\Delta P_v}$$

ΔP_v – in. H_2O std. Pitot

TESTS FOR EFFECT OF PARTICULATE NOZZLE (⅜" clearance)

			Part. Nozzle			
170	13	1.8673	off	1.3306	77.5	0.844
		1.9045	on	1.3403	78.0	0.839
150	14	1.0630	on	0.7520	58.4	0.841
		1.0478	off	0.7480	58.3	0.845
90	15	0.4700	off	0.3346	39.0	0.844
		0.4698	on	0.3377	39.3	0.850
50	16	0.1280	off	0.0950	20.5	0.852
		0.1281	on	0.0963	20.9	0.867
30	17	[illegible]	on	[illegible]	[illegible]	[illegible]

Note – See calibration curve for Tube "A" – removing particulate probe does not affect readings.

Tube "A" erratic above 1.0 in. H_2O

Georgia-Pacific

intracompany memo

RECEIVED
JUL 22 1977
ENERGY & ENVIRONMENT

to Mr. George Turner location Portland, Oregon

from Gary DuTell location Springfield, Oregon

subject Precipitair Efficiency at Willmington date July 20, 1977

1.0 Introduction

On June 30, 1977, a "Rader Hi-Vol" sampler was used to determine the particulate concentration in the exhaust going to the "Precipitair" unit that abates the gypsum emissions from the No. 4 kettle, roller mill and conveyor.

These tests and the EPA tests taken the same day were used to estimate the efficiency of the electrostatic precipitator at the input concentrations, production rates and equipment control settings observed during the test period and indicated in this report.

Emission Concentrations
Input to Precipitator Hi Vol. Test 6/30/77

	SDCFM	Gr./SDCF	Lbs./hr.	Duration Of Test (Min.)	% Isokinetic
Test 1	9,211	4.14	327	2	91
Test 2	9,211	4.23	334	2	91
Avg.	9,211	4.19	330	2	91
	Stack Emission From Precipitator			EPA Test 6-30-77	
Test 1	9,211	0.01	0.8	60	109
Test 2	9,197	0.01	0.8	60	108
Test 3	9,425	0.03	2.4	60	106
Avg.	9,277	0.02	1.3	60	108

The efficiency of the precipitator system (percent) would be calculated as follows:

$$100 - \frac{\text{(outlet concentration Gr./SDCF)}}{\text{(inlet concentration Gr./SDCF)}} 100 = \text{\% Efficiency}$$

$$100 - \frac{(0.02)}{(4.19)} 100 = 99.5\%$$

2.0 Description of Source

The system consists of a primary and secondary electrostatic precipitator unit on the negative pressure side of an exhaust fan. This unit was built for Georgia-Pacific by the "Precipitair" Corporation.

2.2 Design, Size Type

The precipitator collects the particulate emissions entrained in the 19,000 ACFM exhaust flow coming from the kettle, one roller mill, one conveyor and an air heater.

2.3 Material Flow Rates

During the test both the roller mill and kettle were each processing an estimated *20 tons/hour.

2.4 Material Composition

A sizing analysis of the input and output of the precipitator system will be supplied if requested.

2.5 Special Conditions

Each test was conducted during normal plant operations. The day before the test was run, the precipitator was down for repairs. At that time the inlet and outlet of the precipitator were found to be completely clean.

The unit was started and run under production conditions for approximately 16 hours before these tests were conducted.

During the sample periods the dampers in the ducts leading to the precipitator were in the positions indicated below:

Kettle damper - full open
Roller mill damper - full open
Air heater damper - ½ open
Precipitair damper - ½ open

3.0 Detailed Results

Presented in tabular form in the appendix.

4.0 Other Results

The exhaust gases from the precipitator maintained an opacity of less than ten percent during the entire test period.

* Figures obtained from production tests conducted by Mr. Harold Cook.

I am currently certified by the State of Oregon Department of Environmental Quality, Air Quality Control Division, for plume evaluation (Certificate No. 150).

If you have any questions about this test, please call.

H. Gary DuTell
(503) 689-1221, Ext. 408

HGD:jk

Attachment

cc: Messrs. Al Mick, Portland
Harold Cook, Wilmington
Mitch Steffensen, Springfield