Background Report Reference

AP-42 Section Number: 8.12

Background Chapter: 4

Reference Number: 30

Title: Particulate Stack Sampling Reports

Texasgulf, Inc.

September 1978

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Section ~~5.16~~
Reference ~~#30~~

MEMORANDUM

TO: RANDOLPH WOOD, ADMINISTRATOR
AIR QUALITY DIVISION

THROUGH: CHARLES COLLINS, SUPERVISOR
AIR QUALITY DIVISION

FROM: WOODY RUSSELL, DISTRICT ENGINEER
AIR QUALITY DIVISION - LANDER

SUBJECT: TEXASGULF STACK TEST REVIEW

DATE: DECEMBER 15, 1978

Texasgulf submitted stack tests reports for sources #4,5,7,8,9,10,11 on November 29, 1978.

The tests were reviewed and determined acceptable and in compliance with Section 14,g Table I, of the Wyoming Air Quality Standards and Regulations. The sources, average measured particulate emissions, and allowable emission rates are listed below:-

Source No.	Measured Particulate Emissions (Ave). lb/hr	Allowable Particulate Emissions lb/hr.
4	6.67	36.21
5	3.48	36.91
7	1.52	33.35
8	2.11	32.73
9	2.55	31.42
10	.58	32.50
11	.86	35.96

These units were operating at a rate that varied from 57% to 86% of the design capacity.

Company Texasgulf

Location

Testing Firm

Tests Conducted By Texasgulf

Date Tested 9-14,15-1978

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT #4
CALCINER #1

Stack Data

Stack ht (ft) 130

Stack dia (ft) 9.44

Process venting through stack

Traverse Points

Nozzle diameter: Test 1 1/4 Test 2 1/4 Test 3 1/4

Location of sampling ports 8.5 dia downstream - 5.3 dia upstream

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No

Comments:

Emissions

			Test 1	Test 2	Test 3	Average
Process wt rate	(ton/hr)	dry coal	93.9	93.9	95.2	94.33
Allowable emission	(lb/hr)		6.3	6.3	6.4	6.4
Measured emission	(lb/hr)		36.18	36.18	36.26	36.21
% Isokinetic			13.9	4.0	2.12	6.67
			99	100	101	100

Comments and recommendations:

The back-half particulates are included in this analysis. The back-half particulates account for about 8% of total particulates

The tests are acceptable. This unit is in compliance.

Applicable Regulation, Section 14.j, Table I. Operating at a rate 73% of design or 82% of normal.

Data Sheet

P_{std} = 29.92 in Hg

T_{std} = 530° R

		9/13/78 Test 1	9/14/78 Test 2	9/15/78 Test 3
P_{bar}	= barometric pressure at site (in Hg)	23.88	23.88	23.97
P_s	= absolute stack gas pressure (in Hg)	23.89	23.89	23.98
T_s	= absolute average stack gas temp. (°R)	900	907	908
T_m	= absolute average dry gas meter temp. (°R)	~~525~~ 530	530	530
V_{lc}	= total volume of water collected (ml)	121	121	142
V_m	= volume of gas through dry gas meter (ft^3)	37.71	36.35	38.21
ΔH	= average pressure drop across orifice (in H_2O)	.53	.52	.56
C_p	= pitot tube coefficient	.84	.84	.84
$(\sqrt{\Delta p})_{ave}$	= average velocity head of stack gas (in H_2O)	.749	.720	.758
A_s	= cross-sectional area of stack (ft^2)	70.87	70.87	70.87
M_n	= total amount of particulate collected (g)	.02996	.00868	.00469
θ	= total sampling time (min.)	60	60	60
A_n	= cross-sectional area of nozzle (ft^2)	.000341	.000341	.000341

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	4.5	4.5	3.0
% O_2	12.0	12.5	15.0
% CO	0	0	0
% N_2	83.5	83.0	82.0

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

$V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

$V_{w\ std} =$ 5.74, 5.74, 6.73 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\ std} = \left(17.71\ \frac{^oR}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

$V_{m\ std} =$ 30.14, 29.05, 30.66 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

$B_{wo} =$ .16, .16, .18

4. Molecular weight (lb/lb mole)

$M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

$M_d =$ 29.2, ~~29.27~~ 29.27, 29.08 lb/lb mole

$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

$M_s =$ 27.41, ~~27.42~~ 27.42, 27.09 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ Cp\ (\sqrt{\Delta p})ave \sqrt{\frac{T_s}{P_s\ M_s}}$$

$V_s =$ 63.05, 60.83, 64.35 ft/sec

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

$Q_s =$ 105,892.7, 101,375.1, 104,940 ft^3/min

actual
268,101
258,661
273,679
266,797 avg

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3}\ \frac{M_n}{V_{m\ std}}$$

$C_s =$ 2.19×10^{-6}, 6.59×10^{-7}, 3.31×10^{-7} lb/ft^3

8. E = emission rate lb/hr

$$E = C_s \cdot Q_s \cdot 60$$

E = 13.9, 400, 2.12 lb/hr

9. % Isokinetic

$$I = \frac{1.657\ T_s \left(0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 98, 100, 101 %

Company TEXASGULF Location

Testing Firm TEXASGULF Tests Conducted By TEXASGULF

Date Tested 10/19-20/78

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT #5
CALCINER #2

Stack Data

Stack ht (ft) 130

Stack dia (ft) 9.45

Process venting through stack

Traverse Points

Nozzle diameter: Test 1 1/4" Test 2 1/4" Test 3 1/4"

Location of sampling ports 8.5 dia downstream; 5.3 dia upstream

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No

Comments:

Emissions		Test 1	Test 2	Test 3	Average
Design (ton/hr) 130 ore 12 c-al		110.6	103.5	103.5	105.9
Process wt rate	(ton/hr)	9.8	9.8	9.8	9.8
Allowable emission	(lb/hr)	37.15	36.79	36.79	36.91
Measured emission	(lb/hr)	3.00	5.44	2.01	3.48
% Isokinetic		105	100	101	102

Comments and recommendations:

The tests are acceptable. The unit is in compliance

Applicable Regulation: Section 14, g, Table I. Operating at a rate 81 % of design or 92% of normal

Data Sheet

P_{std} = 29.92 in Hg

T_{std} = 530° R

		10/19/78 Test 1	10/20/78 Test 2	10/20/78 Test 3
P_{bar}	= barometric pressure at site (in Hg)	24.10	23.90	23.90
P_s	= absolute stack gas pressure (in Hg)	24.14	23.94	23.94
T_s	= absolute average stack gas temp. (°R)	872	855	863
T_m	= absolute average dry gas meter temp. (°R)	530	530	530
V_{lc}	= total volume of water collected (ml)	77.8	120.2	127.8
V_m	= volume of gas through dry gas meter (ft^3)	48.83	47.92	45.66
ΔH	= average pressure drop across orifice (in H_2O)	.90	.91	.85
C_p	= pitot tube coefficient	.83	.83	.83
$\overline{\Delta p})_{ave}$	= average velocity head of stack gas (in H_2O)	.864	.905	.863
A_s	= cross-sectional area of stack (ft^2)	70.86	70.86	70.86
M_n	= total amount of particulate collected (g)	.00689	.01185	.00444
θ	= total sampling time (min.)	60	60	60
A_n	= cross-sectional area of nozzle (ft^2)	.000341	.000341	.000341

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	10.1	5.5	5.0
% O_2	12.0	15.0	16.5
% CO	0.0	0	0
% N_2	77.9	79.5	78.5

A-2 (ALCINGTC

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

   $V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

   $V_{w\ std}$ = 3.69, 5.70, 6.06 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\ std} = \left(17.71\ \frac{^oR}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

   $V_{m\ std}$ = 39.43, 38.38, 36.56 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

   B_{wo} = .09, .13, .14

4. Molecular weight (lb/lb mole)

   $M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

   M_d = 30.10, 29.48, 29.46 lb/lb mole

   $M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

   M_s = 29.01, 27.99, 27.86 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ C_p\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$$

   V_s = 68.40, 67.53, 69.65 ft/sec

   acfm
   290,809
   308,369
   296,124
   } 298,434 avg

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

   Q_s = 129,773.2, 133,064.3, 125,140.0 ft^3/min

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3}\ \frac{M_n}{V_{m\ std}}$$

   C_s = 3.85×10^{-7}, 6.81×10^{-7}, 2.68×10^{-7} lb/ft^3

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = 3.00, 5.44, 2.01 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{ic} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 105, 100, 101 %

Coal Analysis

	Moist	Ash	S	BTU
8-21-78	21.10	2.95	.57	10,152
8-23-78	19.84	3.42	.58	10,218
8-25-78	20.13	3.43	.54	10,132

Allowable Emissions

Coal feed rate (9.2) Less H_2O

Test 1 $17.31\ (110.6 + 7.7)^{.16} = 37.15$

Test 2 $17.31\ (103.5 + 7.9)^{.16} = 36.79$

Test 3 $17.31\ (103.5 + 7.8)^{.16} = 36.79$

Company TEXASGULF

Location

Testing Firm

Tests Conducted By

Date Tested 9/21/78

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT #7
#1 Product Dryer

Stack Data

Stack ht (ft) 118

Stack dia (ft) 4.25

Process venting through stack

Traverse Points

Nozzle diameter: Test 1 1/4" Test 2 1/4" Test 3 1/4"

Location of sampling ports 17 DIA. DOWNSTREAM ; 12 DIA. UPSTREAM

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No

Comments:

Emissions

		Test 1	Test 2	Test 3	Average
Design Proc. wt. (ton/hr)					70.1
Process wt rate	(ton/hr)	60.2	60.2	60.2	60.2
Allowable emission	(lb/hr)	33.35	33.35	33.35	33.35
Measured emission	(lb/hr)	1.93	1.93	.70	1.52
% Isokinetic		91	100	96	96

Comments and recommendations:

The back-half particulates account for 41% of total particulates collected. This value is considerably higher than that measured in previous tests. The tests are acceptable and the unit is in compliance

Applicable Regulation Section 14, g, Table I. Operating at a rate 86% design or 96% of normal

#1 Product Dryer

Data Sheet

P_{std} = 29.92 in Hg

T_{std} = 530° R

		9/21/78 Test 1	9/21/78 Test 2	9/21/78 Test 3
P_{bar}	= barometric pressure at site (in Hg)	24.09	24.09	24.09
P_s	= absolute stack gas pressure (in Hg)	24.12	24.12	24.12
T_s	= absolute average stack gas temp. (°R)	626	632	628
T_m	= absolute average dry gas meter temp. (°R)	530	530	530
V_{lc}	= total volume of water collected (ml)	300	350	316
V_m	= volume of gas through dry gas meter (ft^3)	25.13	23.34	23.22
ΔH	= average pressure drop across orifice (in H_2O)	.28	.24	.25
C_p	= pitot tube coefficient	.83	.83	.83
$(\sqrt{\Delta p})_{ave}$	= average velocity head of stack gas (in H_2O)	.619	.573	.568
A_s	= cross-sectional area of stack (ft^2)	14.18	14.18	14.18
M_n	= total amount of particulate collected (g)	.01899	.02105	.00743
θ	= total sampling time (min.)	60	60	60
A_n	= cross-sectional area of nozzle (ft^2)	.000341	.000341	.000341

	Test 1	Test 2	Test 3
Front half	.00751	.01129	.00298
Back half	.00848	.00976	.00445
total	.01899	.02105	.00743

Orsat Analysis ★

	Test 1	Test 2	Test 3
% CO_2	0	0	0
% O_2	21	21	21
% CO	0	0	0
% N_2	79	79	79

★ Note these are assumed values.

1. $V_{w\,std}$ = volume of water vapor in gas @ STP (ft^3)

$V_{w\,std} = 0.0474\ ft^3/ml \cdot V_{ic}$

$V_{w\,std} =$ 14.22, 16.59, 14.98 ft^3

2. $V_{m\,std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\,std} = \left(17.71 \frac{^\circ R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

$V_{m\,std} =$ 20.25, 18.80, 18.71 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\,std}}{V_{w\,std} + V_{m\,std}}$$

$B_{wo} =$ .41, .47, .45

4. Molecular weight (lb/lb mole)

$M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

$M_d =$ 28.84, 28.84, 28.84 lb/lb mole

$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

$M_s =$ 24.40, 23.75, 23.96 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ C_p\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$$

$V_s =$ 45.29, 42.70, 42.01 ft/sec

after
38533
36329
35,747
} 36,868 avg

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

$Q_s =$ 15516.7, 13016.8, 13374.4 ft^3/min

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3} \frac{M_n}{V_{m\,std}}$$

$C_s =$ 2.07×10^{-6}, 2.47×10^{-6}, 8.76×10^{-7} lb/ft^3

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = 1.93 , 1.93 , .703 lb/hr

9. % Isokinetic

$$I = \frac{1.657\ T_s \left(0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\Theta\ V_s\ P_s\ A_n}$$

I = 91 , 100 , 96 %

Company TEXASGULF Location

Testing Firm Tests Conducted By

Date Tested 9/25-26/78

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT #8
#2 Product Dryer

Stack Data

Stack ht (ft) 118

Stack dia (ft) 4.25

Process venting through stack

Traverse Points

Nozzle diameter: Test 1 1/4" Test 2 1/4" Test 3 1/4"

Location of sampling ports 17 DIA DOWNSTREAM; 12 DIA UPSTREAM

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No

Comments:

Emissions

		Test 1	Test 2	Test 3	AVERAGE
DESIGN 73; NORMAL 63TPH					
Process wt rate	(ton/hr)	57	52	52	54
Allowable emission	(lb/hr)	33.05	32.57	32.57	32.73
Measured emission	(lb/hr)	2.25	2.01	2.08	2.11
% Isokinetic		101	104	105	103

Comments and recommendations:

EMISSION RATES INCLUDE BACK-HALF

~~Allowable~~ Applicable Regulation: Section 14, g. TABLE I

THE TESTS ARE ACCEPTABLE AND UNIT IS IN COMPLIANCE

OPERATING AT A RATE THAT IS 74% OF DESIGN OR 86% OF NORMAL

Data Sheet

#2 Product Dryer

P_{std} = 29.92 in Hg

T_{std} = 530° R

		Test 1	Test 2	Test 3
P_{bar}	= barometric pressure at site (in Hg)	24.12	24.06	24.06
P_s	= absolute stack gas pressure (in Hg)	24.15	24.08	24.08
T_s	= absolute average stack gas temp. (°R)	637	636	628
T_m	= absolute average dry gas meter temp. (°R)	530	530	530
V_{ic}	= total volume of water collected (ml)	317	303	310
V_m	= volume of gas through dry gas meter (ft^3)	26.58	23.25	22.54
ΔH	= average pressure drop across orifice (in H_2O)	.31	.25	.23
C_p	= pitot tube coefficient	.83	.83	.83
$(\overline{\sqrt{\Delta p}})_{ave}$	= average velocity head of stack gas (in H_2O)	.595	.522	.506
A_s	= cross-sectional area of stack (ft^2)	14.18	14.18	14.18
M_n	= total amount of particulate collected (g)	.02457	.02257	.02399
θ	= total sampling time (min.)	60	60	60
A_n	= cross-sectional area of nozzle (ft^2)	.000341	.000341	.000341

	Test 1	Test 2	Test 3
Front half	.01497	.0088	.01383
Back half	.0096	.01366	.01016
total	.02457	.02257	.02399

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	0	0	0
% O_2	21	21	21
% CO	0	0	0
% N_2	79	79	79

Assumed values.

#2 Product Dryer

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

   $V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

   $V_{w\ std}$ = 15.03, 14.36, 14.69 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\ std} = \left(17.71 \frac{^{o}R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

   $V_{m\ std}$ = 21.44, 18.71, 18.13 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

   B_{wo} = .41, .43, .45

4. Molecular weight (lb/lb mole)

   $M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

   M_d = 28.84, 28.84, 28.84 lb/lb mole

   $M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

   M_s = 24.40, 24.18, 23.96 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ Cp\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$$

   V_s = 43.89, 38.71, 37.45 ft/sec

outfan
37,342
32,934
31,862
34,046

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.52}\right)$$

   Q_s = 14795.8, 12590.4, 11902.9 ft^3/min

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3}\ \frac{M_n}{V_{m\ std}}$$

   C_s = 2.53×10^{-6}, 2.64×10^{-6}, 2.82×10^{-6} lb/ft^3

Calculations (Continued)

#2 Product Dryer

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = 2.25, 2.01, 2.08 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 101, 104, 105 %

Company Texasgulf Location

Testing Firm Tests Conducted By

Date Tested 8/25/78

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT #9
#1 Product ~~Dryer~~
SIZING SYSTEM

Stack Data

Stack ht (ft) 36

Stack dia (ft) 3.5

Process venting through stack

Traverse Points

Nozzle diameter: Test 1 1/4" Test 2 1/4" Test 3 1/4"

Location of sampling ports 2 dia downstream; 4 dia upstream

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No

Comments:

Emissions

Design - 73 ton/hr - Ave. 63 TPH

		Test 1	Test 2	Test 3	Average
Process wt rate	(ton/hr)	42.5	42.5	39.5	41.5
Allowable emission	(lb/hr)	31.54	31.54	31.17	31.42
Measured emission	(lb/hr)	2.41	2.98	2.27	2.55
% Isokinetic		101	101	101	101

Comments and recommendations:

The unit was operating about 57% of capacity. The normal range is 86% of capacity.

Applicable Regulation: Section 14g, Table I

The tests are acceptable. The unit is in compliance

Data Sheet

P_{std} = 29.92 in Hg

T_{std} = 530° R

EMISSION At #9
#1 Product Sizing System

		Test 1	Test 2	Test 3
P_{bar}	barometric pressure at site (in Hg)	23.98	23.98	24.05
P_s	absolute stack gas pressure (in Hg)	23.99	23.99	24.06
T_s	absolute average stack gas temp. (°R)	640	639	628
T_m	absolute average dry gas meter temp. (°R)	530	530	530
V_{lc}	total volume of water collected (ml)	4.2	4.5	4.0
V_m	volume of gas through dry gas meter (ft^3)	23.75	23.89	21.28
ΔH	average pressure drop across orifice (in H_2O)	.27	.28	.20
C_p	pitot tube coefficient	.83	.83	.83
$(\sqrt{\Delta p})_{ave}$	average velocity head of stack gas (in H_2O)	.342	.343	.303
A_s	cross-sectional area of stack (ft^2)	9.62	9.62	9.62
M_n	total amount of particulate collected (g)	.03916	.04841	.03693
θ	total sampling time (min.)	60	60	60
A_n	cross-sectional area of nozzle (ft^2)	.000341	.000341	.000341

	Test 1	Test 2	Test 3
Front-half	.02853	.03166	.03095
Back-half	.01063	.01675	.00598
total	.03916	.04841	.03693

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	0	0	0
% O_2	21	21	21
% CO	0	0	0
% N_2	79	79	79

Assumed values

EMISSION PT. #9
#1 Product Sizing Sys

1. V_W std = volume of water vapor in gas @ STP (ft^3)

   V_W std = 0.0474 $ft^3/ml \cdot V_{ic}$

   V_W std = .20, .21, .19 ft^3

2. V_m std = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\,std} = \left(17.71 \frac{^\circ R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

   V_m std = 19.05, 19.16, 17.11 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{W\,std}}{V_{W\,std} + V_{m\,std}}$$

   B_{wo} = .01, .01, .01

4. Molecular weight (lb/lb mole)

   $M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

   M_d = 28.84, 28.84, 28.84 lb/lb mole

   $M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

   M_s = 28.73, 28.73, 28.73 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

   $V_s = 85.48\ Cp\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$

   V_s = 23.38, 23.43, 20.49 ft/sec

acfm
13,495
13,524
11,827
39018

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

   Q_s = 8870.0, 8903.8, 7946.1 ft^3/min

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3} \frac{M_n}{V_{m\,std}}$$

   C_s = 4.53×10^{-6}, 5.51×10^{-6}, 4.76×10^{-6} lb/ft^3

EMISSION PT #9 - #1 Product Sizing Sys.

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = 2.41, 2.98, 2.27 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 101, 101, 101 %

Company TEXASGULF

Location

Testing Firm

Tests Conducted By

Date Tested 8/29/78

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT #10
Product Screening

Stack Data

Stack ht (ft) 40

Stack dia (ft) 3.5

Process venting through stack

Traverse Points

Nozzle diameter: Test 1 1/4" Test 2 1/4" Test 3 1/4"

Location of sampling ports 8 dia. downstream ; 4 dia. upstream

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No

Comments:

Emissions.
DESIGN. 73 TPH ; AVE. 60 TPH

		Test 1	Test 2	Test 3	AVERAGE
Process wt rate	(ton/hr)	51.25	51.25	51.25	51.25
Allowable emission	(lb/hr)	37.50	37.50	37.50	37.50
Measured emission	(lb/hr)	.78	.52	.43	.58
% Isokinetic		102	98	101	100

Comments and recommendations:

Applicable regulation Section 14.9 - Table I
Operating at a rate 70% of design or 85% of normal

The tests are acceptable. This unit is in compliance.

Data Sheet

EMISSION PT #10
Prod. Screening

P_{std} = 29.92 in Hg

T_{std} = 530° R

		Test 1	Test 2	Test 3
P_{bar}	= barometric pressure at site (in Hg)	24.00	24.00	24.00
P_s	= absolute stack gas pressure (in Hg)	24.01	24.01	24.01
T_s	= absolute average stack gas temp. (°R)	637	620	642
T_m	= absolute average dry gas meter temp. (°R)	530	530	530
V_{lc}	= total volume of water collected (ml)	2.1	2.8	3.0
V_m	= volume of gas through dry gas meter (ft^3)	17.74	16.23	15.94
ΔH	= average pressure drop across orifice (in H_2O)	.16	.17	.15
C_p	= pitot tube coefficient	.83	.83	.83
$(\sqrt{\Delta p})_{ave}$	= average velocity head of stack gas (in H_2O)	.252	.236	.231
A_s	= cross-sectional area of stack (ft^2)	9.62	9.62	9.62
M_n	= total amount of particulate collected (g)	.01276	.00829	.00698
θ	= total sampling time (min.)	60	60	60
A_n	= cross-sectional area of nozzle (ft^2)	.000341	.000341	.000341

	Test 1	Test 2	Test 3
Front-half	.00965	.00629	.00489
Back-half	.00311	.00200	.00209
Total	.01276	.00829	.00698

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	0	0	0
% O_2	21	21	21
% CO	0	0	0
% N_2	79	79	79

Analysis assumed.

EMISSION PT #10
Prod. Screening

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

   $V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

   $V_{w\ std} =$ .10, .13, .14 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\ std} = \left(17.71 \frac{^\circ R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

   $V_{m\ std} =$ 14.23, 13.02, 12.79 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

   $B_{wo} =$ .007, .010, .011

4. Molecular weight (lb/lb mole)

   $M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

   $M_d =$ 28.84, 28.84, 28.84 lb/lb mole

   $M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

   $M_s =$ 28.76, 28.73, 28.72 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ C_p\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$$

   $V_s =$ 17.17, 15.87, 15.81 ft/sec

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

   $Q_s =$ 6570.1, 6220.9, 5979.0 ft^3/min

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3} \frac{M_n}{V_{m\ std}}$$

   $C_s =$ 1.98×10^{-6}, 1.40×10^{-6}, 1.2×10^{-6} lb/ft^3

other
9910
9160
9126
} 9999 avg

Calculations (continued)

EMISSION PT. #10
Prod. Screening

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = .78, .52, .43 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 102, 98, 101 %

Company TEXASGULF Location _____

Testing Firm _____ Tests Conducted By _____

Date Tested 8/31/78 - 9/01/78

Test Observed By NO ONE

Test Evaluated By Woody Russell

EMISSION POINT # 11
Product Handling

Stack Data

Stack ht (ft) 90

Stack dia (ft) 7.83

Process venting through stack _____

Traverse Points

Nozzle diameter: Test 1 1/4" Test 2 1/4" Test 3 1/4"

Location of sampling ports .28 DIA. downstream ; 4 DIA upstream

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes ✓ No _____

Comments:

Emissions		8/31/78 Test 1	9/01/78 Test 2	9/01/78 Test 3	Average
Design 146 TPH; Avg. 120 TPH					
Process wt rate	(ton/hr)	111.2	89.8	89.8	96.9
Allowable emission	(lb/hr)	36.79	35.55	35.55	35.96
Measured emission	(lb/hr)	1.16	.74	.67	.86
% Isokinetic		103	100	101	101

Comments and recommendations:

Applicable regulation: Section 14.a, Table I
Operating at a rate 66% Design or 81% Normal.

The tests are acceptable. This unit is in compliance

Data Sheet

EMISSION PT. #1
Wood Handling

P_{std} = 29.92 in Hg

T_{std} = 530° R

		Test 1	Test 2	Test 3
P_{bar}	= barometric pressure at site (in Hg)	23.87	23.90	23.90
P_s	= absolute stack gas pressure (in Hg)	23.88	23.91	23.91
T_s	= absolute average stack gas temp. (°R)	580	556	551
T_m	= absolute average dry gas meter temp. (°R)	530	530	530
V_{lc}	= total volume of water collected (ml)	10	6	6
V_m	= volume of gas through dry gas meter (ft^3)	18.02	20.52	20.77
ΔH	= average pressure drop across orifice (in H_2O)	.13	.18	.18
C_p	= pitot tube coefficient	.83	.83	.83
$(\sqrt{\Delta p})_{ave}$	= average velocity head of stack gas (in H_2O)	.246	.278	.278
A_s	= cross-sectional area of stack (ft^2)	6.3	6.3	6.3
M_n	= total amount of particulate collected (g)	.02926	.01822	.01661
θ	= total sampling time (min.)	60	60	60
A_n	= cross-sectional area of nozzle (ft^2)	.00341	.00341	.00341

	Test 1	Test 2	Test 3
Front Half	.01987	.01126	.01043
Back-half	.00939	.00696	.00618
Total	.02926	.01822	.01661

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	0	0	0
% O_2	21	21	21
% CO	0	0	0
% N_2	79	79	79

Analysis Assumed

EMISSION Pt. #11
Prod. HANDLING.

1. $V_{w\,std}$ = volume of water vapor in gas @ STP (ft^3)

$V_{w\,std} = 0.0474\ ft^3/ml \cdot V_{ic}$

$V_{w\,std} =$ .47, .28, .28 ft^3

2. $V_{m\,std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\,std} = \left(17.71 \frac{^\circ R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

$V_{m\,std} =$ 14.38, 16.40, 16.60 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\,std}}{V_{w\,std} + V_{m\,std}}$$

$B_{wo} =$ .03, .02, .02

4. Molecular weight (lb/lb mole)

$M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

$M_d =$ 28.84, 28.84, 28.84 lb/lb mole

$M_s = M_i\ (1 - B_{wo}) + 18\ B_{wo}$

$M_s =$ 28.51, 28.62, 28.62 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ Cp\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$$

$V_s =$ 16.11, 17.78, 17.70 ft/sec

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

$Q_s =$ 4308.0, 5017.3, 3040.0 ft^3/min

outfall
1090
6721
6691
} 6500 avg

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3} \frac{M_n}{V_{m\,std}}$$

$C_s =$ 4.49×10^{-6}, 2.45×10^{-6}, 2.21×10^{-6} lb/ft^3

EMISSION Pt #11
- Prod. Handling

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = 1.16, .74, .67 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 103, 100, 101 %

Texasgulf Inc.

P.O. Box 100 Granger, Wyoming 82934 (307) 875-2700

November 27, 1978

Mr. R. Woody Russell, Environmental Engineer
Air Quality Division
Department of Environmental Quality
933 Main Street
Lander, Wyoming 82520

Re: Compliance Tests

Dear Mr. Russell:

The reports covering retesting of particulate emissions from sources 4, 5, 7, 8, 9, 10, and 11 are enclosed with this letter.

Documents enclosed include one for each source:

(1) Wyoming Department of Environmental Quality, Air Quality Division, Particulate Stack Sampling Report.
(2) Field Test Data.
(3) Individual Air Pollution Control Equipment Compliance Test Results.

Sincerely,

E H Conroy

E. H. Conroy

EHC:jp

Enc.

cc: w/o enc. Randolph Wood
w/enc. P. V. Bethurum
R. E. Clagett
J. E. Scroggins

[redacted]

INDIVIDUAL AIR POLLUTION CONTROL EQUIPMENT COMPLIANCE TEST RESULTS

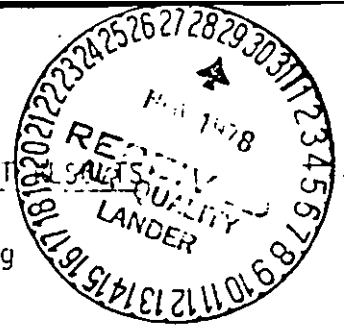
Texasgulf, Inc., Soda Ash Plant, Granger, Wyoming

SOURCE: EMISSION POINT #4 UNIT: CALCINER #1	Average	EMISSION TEST DATA Test 1	Test 2	Test 3
Stack height, ft.	130			
Cross section at exit, ft.^{2}	70.87			
Cross section at ports, ft^2	70.87			
Stack gas flow, 10^3 ACFM	263.4	264.5	255.5	270.1
Stack gas abs. press., in Hg.	23.92	23.89	23.89	23.98
Stack gas abs. temp., °R	905	900	907	908
Stack gas moisture, vol. %	16.81	15.99	16.46	17.97
Feed rate, tons/hr.	94.3	93.9	93.9	95.2
Date of test		9/14/78	9/14/78	9/15/78
PARTICULATES EMITTED				
Concentration, grains/DSCF.	0.0065	0.0146	0.0030	0.0019
Emission rate, pounds/hr.	5.82	13.12	2.52	1.73

INDIVIDUAL AIR POLLUTION CONTRO[illegible] COMPLIANCE TEST RESULTS

Texasgulf, Inc., Soda Ash Plant, Granger, Wyoming

SOURCE: #5 UNIT: #2 CALCINER	EMISSION TEST DATA Average	Test 1	Test 2	Test 3
Stack height, ft.	130			
Cross section at exit, ft.²	70.86			
Cross section at ports, ft²	70.86			
Stack gas flow, 10^3 ACFM	297.6	290.1	307.9	294.8
Stack gas abs. press., in Hg.	24.00	24.14	23.94	23.94
Stack gas abs. temp., °R	863	872	855	863
Stack gas moisture, vol. %	11.87	8.52	12.90	14.19
Feed rate, tons/hr.	105.9	110.6	103.5	103.5
Date of test		10/19	10/20	10/20
PARTICULATES EMITTED				
Concentration, grains/DSCF.	.0026	.0027	.0040	.0012
Emission rate, pounds/hr.	2.93	2.96	4.56	1.27



INDIVIDUAL AIR POLLUTION CONTROL EQUIPMENT COMPLIANCE TEST RESULTS

Texasgulf, Inc., Soda Ash Plant, Granger, Wyoming

SOURCE: # 7 UNIT: #1 PRODUCT DRYER	EMISSION TEST DATA Average	Test 1	Test 2	Test 3
Stack height, ft.	120			
Cross section at exit, ft.^{2}	14.18			
Cross section at ports, ft^2	14.18			
Stack gas flow, 10^3 ACFM	36.9	38.3	36.8	35.5
Stack gas abs. press., in Hg.	24.12	24.12	24.12	24.12
Stack gas abs. temp., °R	629	626	632	628
Stack gas moisture, vol. %	44.1	41.2	46.8	44.4
Feed rate, tons/hr.	60.2	60.2	60.2	60.2
Date of test		9/21/78	9/21/78	9/21/78
PARTICULATES EMITTED				
Concentration, grains/DSCF.	.0058	.0057	.0093	.0025
Emission rate, pounds/hr.	0.69	0.75	1.03	0.28

INDIVIDUAL AIR POLLUTION CONTROL EQUIPMENT COMPLIANCE TEST RESULTS

Texasgulf, Inc., Soda Ash Plant, Granger, Wyoming

SOURCE: POINT #8 UNIT: #2 PRODUCT DRYER	EMISSION TEST DATA Average	Test 1	Test 2	Test 3
Stack height, ft.	120			
Cross section at exit, ft.^{2}	14.18			
Cross section at ports, ft^2	14.18			
Stack gas flow, 10^3 ACFM	34.0	37.3	32.9	31.8
Stack gas abs. press., in Hg.	24.11	24.15	24.09	24.09
Stack gas abs. temp., °R	634	637	636	628
Stack gas moisture, vol. %	42.91	41.14	43.38	44.20
Feed rate, tons/hr.	53.7	57	52	52
Date of test	9/26/78	9/25/78	9/26/78	9/26/78
PARTICULATES EMITTED				
Concentration, grains/DSCF.	0.0100	0.0108	0.0073	0.0118
Emission rate, pounds/hr.	1.114	1.361	0.777	1.203

INDIVIDUAL AIR POLLUTION CONTROL EQUIPMENT COMPLIANCE TEST RESULTS

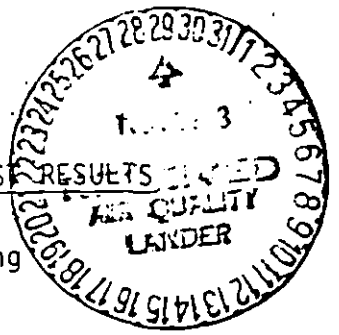
Texasgulf, Inc., Soda Ash Plant, Granger, Wyoming

SOURCE: EMISSION POINT #9 UNIT: #1 PRODUCT DRYER	EMISSION TEST DATA			
	Average	Test 1	Test 2	Test 3
Stack height, ft.	36			
Cross section at exit, ft.^{2}	9.62	8.5		
Cross section at ports, ft.^{2}	9.62			
Stack gas flow, 10^3 ACFM	12.06	12.56	12.59	11.02
Stack gas abs. press., in Hg.	24.01	23.99	23.99	24.06
Stack gas abs. temp., °R	635.7	640	639	628
Stack gas moisture, vol. %	1.09	1.04	1.12	1.12
Feed rate, tons/hr.	44.5	42.5	42.5	39.5
Date of test		8/25/78	8/25/78	8/28/78
PARTICULATES EMITTED				
Concentration, grains/DSCF.	0.0255	0.0231	0.0255	0.0279
Emission rate, pounds/hr.		1.749	1.936	1.891

INDIVIDUAL AIR POLLUTION CONTROL EQUIPMENT COMPLIANCE TEST RESULTS

TEXASGULF, INC., SODA ASH PLANT, GRANGER, WYOMING

SOURCE: #10	EMISSION TEST DATA			
UNIT: PRODUCT SCREENING	AVERAGE	TEST 1	TEST 2	TEST 3
Stack height, ft.	40'			
Cross section at exit, ft.^{2}	9.62			
Cross section ports, ft.^{2}	9.62			
Stack gas flow, 10^3 ACFM				
Stack gas abs. press., in Hg.	24.01	24.01	24.01	24.01
Stack gas abs. temp., °R	633	637	620	642
Stack gas moisture, vol. %	0.93	0.68	1.01	1.12
Feed rate, tons/hr.	51.25	51.25	51.25	51.25
Date of test	8-29-78			
PARTICULATES EMITTED				
Concentration, grains/DSCF.	0.0080	0.0106	0.0075	0.0059
Emission rate, pounds/hr.	0.431	0.596	0.396	0.300



INDIVIDUAL AIR POLLUTION CONTROL EQUIPMENT COMPLIANCE TEST RESULTS

Texasgulf, Inc., Soda Ash Plant, Granger, Wyoming

SOURCE: [illegible] UNIT: PRODUCT HANDLING	EMISSION TEST DATA			
	Average	Test 1	Test 2	Test 3
Stack height, ft.	90'			
Cross section at exit, ft.^{2}	6.305			
Cross section at ports, ft^2	6.305			
Stack gas flow, 10^3 ACFM	6.475	6.071	6.691	6.664
Stack gas abs. press., in Hg.	23.90	23.88	23.91	23.91
Stack gas abs. temp., °R	562	580	556	551
Stack gas moisture, vol. %	2.20	3.18	1.72	1.70
Feed rate, tons/hr.	96.9	111.2	89.8	89.8
Date of test		8-31-78	9-01-78	9-01-78
PARTICULATES EMITTED				
Concentration, grains/DSCF.		0.0213	0.0106	0.0097
Emission rate, pounds/hr.		0.784	0.455	0.418

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

PARTICULATE STACK SAMPLING REPORT

Company TEXASGULF, INC

Address GRANGER, WYO

Unit Tested CALCINER #2 EMISSION POINT #5

Test Date: 10/19 & 10/20/78

SUMMARY OF STACK SAMPLING CALCULATIONS

TEXASGULF, INC. EMISSION POINT #5	TEST 1	TEST 2	TEST 3
P_{bar} = Barometric pressure at site, in. Hg	24.10	23.90	23.90
P_s = Absolute stack gas pressure, in. Hg	24.14	23.94	23.94
T_s = Absolute average stack gas temp., ^{o}R	872	855	863
T_m = Absolute average dry gas meter temp., ^{o}R	530	530	530
V_{ic} = Total volume of water collected, ml	77.8	120.2	127.8
V_m = Volume of gas through dry gas meter, ft^3	48.83	47.92	45.66
H = Average pressure drop across orifice, in. H_2O	0.89	0.91	0.85
C_p = Pitot tube coefficient	0.83	0.83	0.83
$(\sqrt{\Delta p})_{ave}$ = Average velocity head of stack gas, in. H_2O	0.864	0.905	0.860
A_s = Cross-sectional area of stack, ft^2	70.86	70.86	70.86
Front-half particulate collected, gm	0.00679	0.00996	0.00282
Back-half particulate collected, gm	.00010	0.00189	0.00162
M_n = Total amount of particulate collected, gm	.00689	0.01185	0.00444
θ = Total sampling time, min	60.	60.	60.
A_n = Cross-sectional area of nozzle, ft^2	.00034	.00034	.00034
Percent Isokinetic	104.97	100.02	101.54
Emission Rate			
Pounds/hour	2.96	4.56	1.27
Pounds/million BTU	NA	NA	NA
Grains/DSCF	0.0027	0.0040	0.0012

Company TEXASGULF, INC. Sampling location CALCINER #2 POINT #5

Stack inside diameter, in. 114 Stack area, sq. Ft. 70.86

Port extension, in. Pitot tube correction factor 0.83

Stack Pressure Pitot tube traverse PRELIM

Traverse Pt. No.	% of Diameter	Distance from inside Wall	Distance from outside of Port
SW - 1	4.4	5.0	20.0
2	14.7	16.4	31.4
3	29.4	33.5	48.5
4	70.6	80.5	95.5
5	85.3	97.25	112.25
6	95.6	109.0	124.0
SE - 1			
2			
3			
4			
5			
6			

Traverse Pt. No.	Velocity Head P	$\sqrt{P}$	Temperature
SW - 1	.90	.949	
2	.87	.933	
3	.88	.938	
4	.64	.800	
5	.52	.721	
6	.51	.714	
SE - 1	.62	.787	
2	.70	.837	
3	.63	.794	
4	.60	.775	
5	.54	.735	
6	.52	.721	
Average $\sqrt{P}$		0.809	
Average Temperature			450

Company: Sampling location:

Stack inside diameter, in.: Stack area, sq. ft.:

Port extension, in.: Pitot tube correction factor:

Stack Pressure: Pitot tube traverse:

Traverse Pt. No.	% of Diameter	Distance from inside wall	Distance from outside of Port

Traverse Pt. No.	Velocity Head		Temperature
	P	$\sqrt{P}$	
Average		$\sqrt{P}$	
Average Temperature			

Company ____________________ Sampling location ____________________

Stack inside diameter, in. ____________ Stack area, sq. ft. ____________

Port extension, in. ____________ Pitot tube correction factor ____________

Stack Pressure ____________ Pitot tube traverse ____________

Traverse Pt. No.	% of Diameter	Distance from inside Wall	Distance from outside of Port

Traverse Pt. No.	Velocity Head p	$\sqrt{p}$	Temperature
Average $\sqrt{p}$			
Average Temperature			

ORSAT FIELD DATA

Company TEXASGULF, INC. Sampling Location CALCINER #2 POINT #5

TEST 1

Date 10/19/78

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	% CO_2 A	% O_2 B-A	% CO C-B	% N_2 100-C
10:30 AM	10:30 AM				10.1	12.0		77.9

TEST 2

Date 10/20/78

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	% CO_2 A	% O_2 B-A	% CO C-B	% N_2 100-C
9:00 AM	9:00 AM				5.5	15.0		79.5

TEST 3

Date 10/20/78

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	% CO_2 A	% O_2 B-A	% CO C-B	% N_2 100-C
12:50 PM	12:50 PM				5.0	16.5		78.5

TEXASGULF, INC.

Plant Location GRANGER, WYO.

Run No. 1

Sampling Location POINT #5 CALCINER #2

Date 10/19/78

Start Time 10:35

Finish Time 11:50

Filter No. 21

Nozzle Diameter, in. 3.0

Probe Tip Diameter, in. 1/4

Probe Length, ft. 10

Ambient Temperature, °F 50.

Bar. Pressure, in. Hg. 24.10

Initial Leak Check, CFS

CFM 0 at 15 in. Hg.

Final Leak Check, CFS

CFM 0 at 15 in. Hg.

Point No.	Time (min)	Dry Gas Meter FT^3	Pitot in. H_2O ΔP	Pitot in. H_2O $\sqrt{\Delta P}$	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	Stac Temp °F
START	10:35	3629.35											
SE-1	40	3632.95	.54	.735		0.40		70	4.0	240	150	24.14	410
2	45	3636.30	.60	.775		0.50		70	5.0	250	150	24.14	405
3	50	3640.55	.70	.837		1.00		70	6.0	240	170	24.14	405
4	11:00	3644.43	.87	.933		1.00		70	6.0	270	180	24.14	410
5	05	3648.95	.70	.837		1.00		70	6.0	280	190	24.14	410
6	10	3653.11	.86	.927		0.90		70	5.5	280	190	24.14	410
START	11:20	3653.11											
SW-1	25	3657.51	.84	.917		1.00		70	6.0	250	170	24.14	415
2	30	3661.65	.86	.927		1.00		70	6.0	270	190	24.14	415
3	35	3666.23	.90	.949		1.20		70	7.5	250	190	24.14	415
4	40	3670.44	.74	.860		1.00		70	6.0	250	190	24.14	415
5	45	3674.21	.72	.849		0.85		70	5.5	250	190	24.14	415
6	50	3678.18	.68	.825		0.90		70	6.0	250	190	24.14	415
Total	60	48.83	9.01	10.371		10.75		840	69.5	3080	2150		4940
Average	5	0.81	0.75	0.864		0.90		70	5.8	257	179	24.14	412

TEXASGULF, INC.

Plant Location GRANGER, WYO.

Run No. 2

Sampling Location POINT #5 CALCINER #2

Date 10/20/78

Start Time 9:10

Finish Time 10:25

Filter No. 22

Probe Tip Diameter, in. 1/4

Probe Length, ft. 10

Ambient Temperature, °F 50

Bar. Pressure, in. Hg. 23.90

Initial Leak Check, CFM:
CFM 0 at 15 in. Hg.

Final Leak Check, CFM:
CFM 0 at 15 in. Hg.

Point No.	Time (min)	Dry Gas Meter FT^3	Pitot in. H_2O P	Pitot in. H_2O V_{ps}	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	Stack Temp °F
START	9:10	3678.20	.90										
SE-1	15	3682.41	.98	.949		1.00		70	6.0	210	160	23.94	390
2	20	3686.60	.90	.949		0.90		70	5.0	240	180	23.94	390
3	25	3690.98	.99	.995		1.20		70	6.0	260	170	23.94	390
4	30	3694.73	.72	.849		0.70		70	4.5	240	170	23.94	400
5	35	3698.49	.70	.837		0.80		70	5.0	225	180	23.94	390
6	40	3701.95	.64	.800		0.70		70	5.0	230	170	23.94	390
START	9:55	3701.95											
SW-1	10:00	3705.62	.68	.825		0.80		70	4.6	210	160	23.94	395
2	05	3709.45	.82	.906	.938	0.90		70	5.5	250	170	23.94	400
3	10	3713.88	.88	.930		0.90		70	5.5	250	180	23.94	400
4	15	3717.56	.78	.883		0.90		70	5.5	250	190	23.94	400
5	20	3722.03	.94	.970		1.00		70	6.0	260	195	23.94	400
6	25	3726.12	.92	.959		1.10		70	6.0	260	190	23.94	400
Total	60	47.92 ✓	9.81	10.57 ? 10.858 0.850		10.90 ✓		840	64.6	2885	2115		4745
Avg	5	0.80	0.82	0.904 .905		0.91		70	5.4	240	176	23.94	395

Plant location: TEXASGULF, INC. GRANGER, WYO.

Run No. 3

Sampling location: POINT #5 CALCINER #2

Date: 10/20/78

Start Time: 13:05

Finish Time: 14:25

Filter No. 20

Probe Tip Diameter, in.: 1/4

Probe Length, ft.: 10

Ambient Temperature, °F: 50

Bar. Pressure, in. Hg.: 23.90

Initial Leak Check, CFM: 0 at 15 in. Hg.

Final Leak Check, CFM: 0 at 15 in. Hg.

Point No.	Time (min)	Dry Gas Meter FT^3	Pitot in. H_2O ΔP	Pitot in. H_2O $V\sqrt{\Delta P}$	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	Stack Temp. °F
START	13:05	3726.19											
E-1	10	3729.86	.70	.837		0.80		70	4.0	210	170	23.94	405
2	15	3733.57	.70	.837		0.80		70	4.0	200	170	23.94	400
3	20	3737.13	.64	.800		0.70		70	4.0	210	170	23.94	400
4	25	3741.08	.80	.894	.980	1.00		70	5.5	250	190	23.94	400
5	30	3745.38	.96	.940		1.10		70	7.0	260	220	23.94	400
6	13:35	3749.25	.80	.894		0.80		70	5.0	270	230	23.94	400
START	13:55	3749.25											
W-1	14:00	3753.28	.86	.927		0.90		70	5.0	200	150	23.94	400
2	05	3757536	.88	.938		1.00		70	6.0	240	180	23.94	400
3	10	3761.63	.86	.927		1.00		70	5.8	260	200	23.94	410
4	15	3765.05	.60	.775		0.65		70	4.0	260	195	23.94	410
5	20	3768.42	.60	.775		0.70		70	4.0	230	180	23.94	410
6	14:25	3771.85	.60	.775		0.75		70	4.5	255	200	23.94	405
				10.359									
Total	60	45.66	9.00	10.319 .863 0.860		10.20		840	58.8	2845	2255		4840
Average	5	0.76	0.75			0.85		70	4.9	237	188	23.94	403

LABORATORY DATA

Company TEXASGULF,-INC. Run No. 1

Sampling Location CALCINER #2 POINT #5 Date 10/19/78

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 2	Final Weight/Volume	261.0	
	Initial Weight/Volume	200.0	
	Increase		61.0
IMPINGER 3	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 4	Final Weight/Volume	216.8	
	Initial Weight/Volume	200.0	
	Increase		16.8
	TOTAL MOISTURE CATCH		77.8

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Filter and Hot Box Glassware)

(1)	Filter & Particulates	0.79425
(2)	Filter Tare Weight	0.79036
(3)	Net Dry Particulates (1-2)	0.00389
(4)	Particulates Caught in Nozzle, Probe & Glassware	0.00290
(5)	Total Front Catch (3 & 4)	0.00679

BACK-HALF ANALYSIS (Impingers, Connecting Glassware)

(1)	Particulate caught in impingers evaporated down at less than 120°F	0.00010

TOTAL PARTICULATE CATCH (Sum of Front and Back-Half Catches)

0.00689

Company TEXASGULF, INC. Run No. 2

Sampling Location CALCINER #2 POINT #5 Date 10/20/78

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 2	Final Weight/Volume	309.0	
	Initial Weight/Volume	200.0	
	Increase		109.0
IMPINGER 3	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 4	Final Weight/Volume	211.2	
	Initial Weight/Volume	200.0	
	Increase		11.2
	TOTAL MOISTURE CATCH		120.2

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Filter and Hot Box Glassware)

(1)	Filter & Particulates	0.80844
(2)	Filter Tare Weight	0.79919
(3)	Net Dry Particulates (1-2)	0.00925
(4)	Particulates Caught in Nozzle, Probe & Glassware	0.00071
(5)	Total Front Catch (3 & 4)	0.00996

BACK-HALF ANALYSIS (Impingers, Connecting Glassware)

(1)	Particulate caught in impingers evaporated down to less than 120°F	0.00189

TOTAL PARTICULATE CATCH (Sum of Front and Back-Half Catches)

0.01185

LABORATORY DATA

Company TEXASGULF, INC. Run No. 3

Sampling location CALCINER #2 POINT #5 Date 10/20/78

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 2	Final Weight/Volume	316.	
	Initial Weight/Volume	200.0	
	Increase		116.0
IMPINGER 3	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 4	Final Weight/Volume	211.8	
	Initial Weight/Volume	200.0	
	Increase		11.8
	TOTAL MOISTURE CATCH		127.8

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Filter and Hot Box Glassware)

(1)	Filter & Particulates	0.79562
(2)	Filter Tare Weight	0.79307
(3)	Net Dry Particulates (1-2)	0.00255
(4)	Particulates Caught in Nozzle, Probe & Glassware	0.00027
(5)	Total Front Catch (3 & 4)	0.00282

BACK-HALF ANALYSIS (Impingers, Connecting Glassware)

(1)	Particulate caught in impingers evaporated down at less than 120°F	0.00162

TOTAL PARTICULATE CATCH (Sum of Front and Back-Half Catches)

0.00444

TEXASGULF, INC. CALCINER #2 POINT #5

I. Electrostatic Precipitators:

Design Efficiency	98.89				
Total No. of Fields	4				
No. of Fields in Operation	4				
Voltages in Each Field	290	265	272	281	
Current in Each Field	1.30	1.30	1.28	1.16	
Fan Motor Amperes		NA			
Sparking Rate: sparks/min.					
Remarks:					

II. Fabric Filter Collector:

Design Efficiency	
Pressure Drop Across Collector, in. H_2O	
Type of Cleaning	
Fan Motor Amperes	
Number of Compartments	
Remarks:	

III. Scrubber:

Scrubber Type: Venturi Plate:
Spray Turbulent Bed Other

Design Efficiency	
Pressure Drop Across Scrubber, in. H_2O	
Liquid Flowrate to Scrubber gal/min.	
Liquid/Gas Ratios	
Recirculation of Scrubber Liquid, %	
Flue Gas to Scrubber, %	
Fan Motor Amperes	
Remarks:	

IV. Mechanical Collectors:

Type Cyclone - Multicyclone - Other

Design Efficiency	70%
Pressure Drop Across Collector, in. H_2O	NA
Fan Motor Amperes	NA
Remarks:	

PROCESS DATA

Company TEXASGULF, INC. Sampling Location CALCINER #2 POINT #5

	DESIGN	NORMAL
Feed rate, tons/hr	130.0	114.8
Steam rate, lb/hr		
KW produced (power boilers)		
~~Million BTU/hr produced~~ Coal Feed rate	12	12

Remarks:

	ACTUAL		
	TEST 1	TEST 2	TEST 3
Feed rate, tons/hr	110.6	103.5	103.5
Steam rate, lb/hr	NA	NA	NA
KW produced (power boilers)	NA	NA	NA
~~Million BTU/hr produced~~ Coal Feed Tons/hr	9.8	9.8	9.8

NOTE: Fuel analysis must accompany all fossil-fuel fired boiler stack tests.

Remarks:

Note: No coal Feed Rate (tons/hr) obtain by phone 12/13/78 CT.

Coal Feedrate less H_2O

Test 1 $17.31\ (110.6 + 7.7)^{.14} = 37.15$

Test 2 $17.31\ (103.5 + 7.9)^{.14} = 36.79$

Test 3 $17.31\ (103.5 + 7.8) \quad 36.79$

DATE	MOIST.	ASH	SULFUR	BTU
~~8-21-78~~	~~21.10~~	~~2.95~~	~~0.57~~	~~10,152~~
~~8-23-78~~	~~19.84~~	~~3.42~~	~~0.58~~	~~10,218~~
8-25-78	20.13	3.43	0.54	10,132

All results are on an as received basis.

Thank you,
The Kemmerer Coal Co. Lab,

Bob Sanders

Bob Sanders, Chemist.

GAS VOLUME DATA

JOB: _____

PITOT TUBE TRAVERSE

TEST NUMBER: [illegible]				TEST NUMBER:			
DATE: 7-27-X TIME: 1400				DATE: TIME:			
FLUE OR STACK TEMPERATURE (°F.) 950				FLUE OR STACK TEMPERATURE (°F.)			
POINT	H.	$\sqrt{H.}$	VELOCITY FT./SEC.	POINT	H.	$\sqrt{H.}$	VELOCITY FT./SEC.
Sw-1	.710	.999					
2	.87	.933					
3	.88	.938					
4	.64	.800					
5	.52	.721					
6	.51	.714					
Static	.20						
Total	1.00						
SE 1	.62	.787					
2	.70	.837					
3	.63	.794					
4	.60	.775					
5	.54	.735					
6	.52	.721					
Static	.20						
Total	1.00						
Static Avg		0.60					
Total	10.860						
	.405						
AVERAGE VELOCITY (FT./SEC.)				AVERAGE VELOCITY (FT./SEC.)			
FLUE OR STACK AREA (SQ. FT.)				FLUE OR STACK AREA (SQ. FT.)			
GAS VOLUME (CFM)				GAS VOLUME (CFM)			
AVERAGE GAS VOLUME (CFM) =							

FORM 5-14

GAS ANALYSIS

TEST NO.				
LOCATION				
CO_2				
O_2				
CO				
$\%O_2$				
H_2O				
N_2				

GAS VELOCITY DATA

TEST NUMBER		
PITOT TUBE CORRECTION FACTOR - P_o		
DENSITY OF GAS REF. TO AIR - G_d		
FLUE OR STACK PRESSURE ("Hg) - P_s	29.06	
BAROMETRIC PRESSURE - P_b	29.02	

CALCULATIONS

TEST NUMBER: _____

$$V_s = 2.9\ (\ P_o\ )\sqrt{\frac{29.92}{P_s} \times \frac{1.00}{G_d}\ (\ T_s\ )}\sqrt{\ }$$

$$V_s = 2.9\ (\quad)\sqrt{\frac{29.92}{\quad} \times \frac{1.00}{\quad}\ (\quad)}\sqrt{\ }$$

$$V_s = (\quad)\sqrt{H}$$

TEST NUMBER: _____

$$V_s = 2.9\ (\quad)\sqrt{\frac{29.92}{\quad} \times \frac{1.00}{\quad}\ (\quad)}\sqrt{\ }$$

$$V_s = (\quad)\sqrt{H}$$

PLANT CONDITIONS

FUEL TYPE

FUEL CONSUMPTION RATE

MATERIAL PRODUCTION RATE

SEE PAGE _____ FOR FLUE OR STACK TRAVERSE LAYOUT.

Field Test Data

Plant #2 [illegible]
Location [illegible]
Date 10-19-7X
Run No. #1

Amb. Temp. 50
Bar. Pressure 24.10"
Stack Pressure 0.60"
Nozzle Size 1/4
Heater Box Setting
Probe Heater Setting

K = 0.99

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)		Pressure Differential Across Meter (ΔH) In. H_2O		Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	10:25						3632.32				
SE 1	40	410	.59	.735	.40	4.0	3632.32	50°	240	150°	40°
B 2	45	405	.60	.775	.50	5.0	3636.30	50°	250	150°	35°
3	50	415	.70	.861	1.0	6.0	3640.85	50°	250	150°	40°
4	55	410	.71	.935	1.0	6.0	3645.44	50°	270	170°	45°
5	1:00	410	.70	.737	1.0	6.0	3649.95	50°	270	190	45
6	05	410	.66	.821	.70	5.5	3653.11	60	280	190	50
Start	11:20						3653.11				
1	25	415	.87	.917	1.0	6.0	3657.31	70	250	170	50
2	30	415	.92	.971	1.0	6.0	3661.65	70	250	170	45
3	35	415	.70	.749	1.2	7.5	3666.23	70	250	190	50
4	40	415	.74	.860	1.0	6.0	3670.44	75	250	190	60
5	45	415	.72	.891	.85	5.5	3674.21	80	250	190	70
6	50	415	.65	.825	.90	6.0	3678.18	80	250	190	70
Total				4.311							
Average				.8621							

PARTICULATE TEST NO. _____

I. Total Water Collected

	Silica Gel	Impingers
Final	[illegible]	21.10
Initial	200	200
Net	16.8	4.10

Total = 77.8 ml ✓

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = [illegible] + .39 /13.6
= 24.67 in Hg

Vv = 1.415 x ml/Pm = 1.415 x 77.8/24.67
= 1.55 cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = 1.55/1.55 + 13.33
= 9.52%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O	=	18 x	8.52		=	1.53
CO_2	=	44 x	[illegible]	x	=	4.07
O_2	=	32 x	[illegible]	x	=	3.51
N_2	=	28 x	.779	x	=	19.95
						29.07

Relative Flue Gas Density

Gd = 29.07/28.95 = _____

PARTICULATE TEST NO.

V. Average Flue Gas Velocity

Ps = 29.[illegible] + (.39/13.6) = [illegible] in.Hg

$$Vs = 2.9 \times Fs \times \sqrt{\frac{29.92 \times Ts}{Ps \times Gd}} \times \sqrt{P \text{ avg.}}$$

$$= 2.9 \times 0.83 \times \sqrt{\frac{29.92 \times [illegible]}{24.[illegible] \times 1.004}} \times .864$$

= 6823 ft/sec ✓

VI. Actual Flue Gas Flowrate

V = Vs x Area x 60 = 6823 x 70.[illegible] Sq.ft. x 60

= 290,0[illegible] ACFM

VII. Wet Meter Volume Converted to Stack Conditions

MVm = Vv + Vm = 4.55 + 48.83 = 53.38 cu.ft.

$$MVs = MVm \times \frac{Pm}{Ps} \times \frac{Ts}{530} = 53.38 \times \frac{24.[illegible]}{29.[illegible]} \times \frac{[illegible]}{530}$$

= [illegible] cu. ft.

VIII. Dry Meter Volume Converted to Standard Conditions

MVstd = Vm x Pm/29.92 = 48.83 x 24.7 /29.92

= 39.45 DSCF

IX. Weight of Particulate Collected

	Impinger #5	Probe #1	Filter #1
	110.06496	107.6754	0.79925
Gross			
Tare	110.06486 ✓	107.66769 ✓	0.79588
	.00010	.00771	.00337 ✓
Net			

D = ~~TOTAL~~ [illegible] = .01077 grams

Blank .00010

Total .00689 ✓

PARTICULATE TEST NO. _____

X. Dust Concentration

Grains/ACF = 15.43 x D/MVs = 15.43 x .00679/87.93

= .0012 grains/ACF

Grains/DSCF = 15.43 x D/MVstd = 15.43 x .00679 / 39.95

= .0037 grains/DSCF

XI. Emission Rate

Pounds/Hr = D x V x 60/(MVs x 454)

= .00679 x 799.086 x 60/(87.93 x 454)

= 2.96 lb/hr

Pounds/Million Btu = lb/hr / x 10^6 Btu/hr

= _____ lb/million Btu

XII. Percent Isokinetic Sampling

% = 305.6 x MVs/(Vs x t x d^2)

= 305.6 x 37.23/(68.23 x 10 x ( )^2)

= 104.97 %

[illegible]

Field Test Data

6.10
5.76
9.12

Plant
Location
Date 10-20-78
Run No. 2

Amb. Temp. 50
Bar. Pressure 23.90
Stack Pressure
Nozzle Size [illegible]
Heater Box Setting
Probe Heater Setting

[illegible] 28

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)		Pressure Differential Across Meter (ΔH) In. H_2O		Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	9:10						3678.20				
SE 1	9:15	390°	90	.949	1.0	6.0	3682.21	60°	200°	160	70
2	:20	390°	[illegible]	[illegible]	0.9	5.0	3686.10	65°	210	150	60°
3	:25	390°	.99	.995	1.2	6.0	3690.91	65°	260°	[illegible]	60°
4	:30	400°	.75	.799	0.7	4.5	3694.75	70°	210°	[illegible]	70°
5	:35	[illegible]	.73	.737	0.8	5.0	3697.99	70°	225°	[illegible]	[illegible]
6	:40	[illegible]	.64	.800	0.7	5.0	3701.15	70°	230°	[illegible]	[illegible]
Start	[illegible]						3701.95				
[illegible] 1	12:00	375	[illegible]	[illegible]	.7	4.6	3705.62	70°	210°	161	72°
2	:05	[illegible]	.82	.906	.9	5.5	3709.19	70°	250°	170	70°
3	:10	400	.88	.938	.9	5.5	3712.71	70	250°	180	70
4	:15	400	.78	.883	.9	5.5	3717.56	70	250°	[illegible]	70
5	:20	400°	.94	.970	1.0	6.0	3722.[illegible]	75	260°	[illegible]	70
6	:25	400	.91	.957	1.1	6.0	3726.12	75	265°	[illegible]	70
Total	60	4742	[illegible]	[illegible]	[illegible]	64.6	47.92	830	2885	2115	830
Average	5	395	[illegible]	0.965	0.91	5.4	0.80	69	240	176	68

PARTICULATE TEST NO.

I. Total Water Collected

	Silica Gel	Impingers
Final	211.2	307.0
Initial	200.0	[illegible]
Net	11.2	107.0

Total = 1202 ml ✓

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = 23.90 + .91 /13.6
= 23.97 in Hg

Vv = 1.415 x ml/Pm = 1.415 x 1202/ 23.97
= 7.10 cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = 7.10 / 7.10 + 47.62
= 12.90%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O = 18 x .129 =
CO_2 = 44 x 05.5 x .471 =
O_2 = 32 x .15.0 x .471 =
N_2 = 28 x .79.5 x .471 =
28.00

Relative Flue Gas Density

Gd = 28.00 /28.95 = 0.967

PARTICULATE TEST NO. _____

V. Average Flue Gas Velocity

Ps = 23.90 (.60/13.6) = 23.94 in.Hg

$$Vs = 2.9 \times Fs \times \sqrt{\frac{29.92 \times Ts}{Ps \times Gd}} \times \sqrt{P \text{ avg.}}$$

$$= 2.9 \times 0.83 \times \sqrt{\frac{29.92 \times 855}{23.94 \times .917}} \times .905$$

= 72.71 ft/sec

VI. Actual Flue Gas Flowrate

V = Vs x Area x 60 = 72.41 x 70.86 Sq.ft. x 60

= 307,858 ACFM

VII. Wet Meter Volume Converted to Stack Conditions

MVm = Vv + Vm = 7.10 + 47.92 = 55.02 cu.ft.

$$MVs = MVm \times \frac{Pm}{Ps} \times \frac{Ts}{530} = 55.02 \times \frac{23.97}{23.94} \times \frac{855}{530}$$

= 88.97 cu. ft.

VIII. Dry Meter Volume Converted to Standard Conditions

MVstd = Vm x Pm/29.92 = 47.92 x 23.97/29.92

= 38.39 DSCF

IX. Weight of Particulate Collected

	Impinger II	Probe #1	
	104.33211	104.94337	0.80544
Gross			
Tare	104.88022 / .00189	104.94281 / .00071	0.79919 / .00925
Net			

D = TOTAL 1.0011 .00996 ✓ grams

Probe No 1 .00184

Total .01185 ✓

PARTICULATE TEST NO. _____

X. Dust Concentration

Grains/ACF = 15.43 x D/MVs = 15.43 x .0017lb/ 88.87

= .0017 grains/ACF

Grains/DSCF = 15.43 x D/MVstd = 15.43 x .0046 / 38.39

= .0046 grains/DSCF

XI. Emission Rate

Pounds/Hr = D x V x 60/(MVs x 454)

= .0017lb x 307.858 x 60/(88.87 x 454)

= 4.56 lb/hr

Pounds/Million Btu = lb/hr / x 10^6 Btu/hr

= _____ lb/million Btu

XII. Percent Isokinetic Sampling

% = 305.6 x MVs/(Vs x t x d^2)

= 305.6 x 88.87/(72.41 x 60 x $(.375)^2$)

= 100.00 %

Field Test Data

Plant
Location
Date 10-30-79
Run No. 3

Amb. Temp. 50
Bar. Pressure 23.40
Stack Pressure
Nozzle Size
Heater Box Setting
Probe Heater Setting

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)		Pressure Differential Across Meter (ΔH) In. H_2O		Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
	13:05						3726.61				
SW 1	10	400	.70	.841	.80	4.0	3729.21	65	210°	170	65
2	15	400	.70	.841	.90	4.0	3733.57	60	200°	170	50
3	20	400	.64	.800	.70	4.0	3737.13	65	210°	175	50
4	25	410	.79	.874	1.0	5.5	3741.08	70	250°	190	50
5	30	400	.96	.979	1.1	7.0	3745.37	70	260°	220	50
6	35	400	.80	.894	0.9	5.0	3749.25	70	270°	230	50
Start							2719.25				
SE 1	13.55	400	.36	.527	0.40	5.0	3753.28	70	200	150	70
2	14:00	400	.48	.638	1.00	6.0	3757.56	70	200	180	70
3	05	410	.56	.707	1.00	5.8	3761.63	80	200	200	50
4	10	410	.60	.775	.65	4.0	3765.03	80	260	145	50
5	15	410	.60	.775	.70	4.0	3768.42	80	230	180	50
6	20	405	.60	.775	.95	4.5	3772.35	75	220	190	50
	14:25										
Total	1:20	4990		10.55	10.20	48.4	95.66	865	2895	2255	605
Average	20	415	.67	.869	0.85	4.9	0.76	72	241	188	50

PARTICULATE TEST NO. ____

I. Total Water Collected

	Silica Gel	Impingers
Final	211.8	316.0
Initial	200	200
Net	11.8	116.0

Total = 127.8 ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = 23.90 + .75 /13.6
= 23.96 in Hg

Vv = 1.415 x ml/Pm = 1.415 x 127.8/ 23.96
= 7.55 cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = 7.55/ 7.55 + 45.66
= 14.19%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = 5.0 % Vol, dry
O_2 = 16.5 % Vol, dry
N_2 = 78.5 % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O	=	18 x	14.19		=	
CO_2	=	44 x	5.0	x .8581	=	
O_2	=	32 x	16.5	x .4581	=	
N_2	=	28 x	78.5	x .4581	=	
						27.43

Relative Flue Gas Density

Gd = 27.43/28.95 = 0.961

PARTICULATE TEST NO. _____

V. Average Flue Gas Velocity

$Ps = 23.90 + (.60/13.6) = 23.94$ in.Hg

$$Vs = 2.9 \times Fs \times \sqrt{\frac{29.92 \times Ts}{Ps \times Cd}} \times \sqrt{P}\ avg.$$

$$= 2.9 \times 0.83 \times \sqrt{\frac{29.92 \times 862}{23.94 \times .961}} \times .860$$

$= 69.35$ ft/sec

VI. Actual Flue Gas Flowrate

$V = Vs \times Area \times 60 = 69.35 \times 70.86$ Sq.ft. $\times 60$

$= 294,848$ ACFM

VII. Net Meter Volume Converted to Stack Conditions

$MVm = Vv + Vm = 7.55 + 45.66 = 53.21$ cu. ft.

$$MVs = MVm \times \frac{Pm}{Ps} \times \frac{Ts}{530} = 53.21 \times \frac{23.96}{23.94} \times \frac{463}{530}$$

$= 46.71$ cu. ft.

VIII. Dry Meter Volume Converted to Standard Conditions

$MVstd = Vm \times Pm/29.92 = 45.66 \times 23.96/29.92$

$= 36.56$ DSCF

IX. Weight of Particulate Collected

	FRONT		
	103.99800	105.22771	0.79562
Gross	108.99638	105.23341 ✓	0.80317 ✓
Tare	.00162	.00027	.00755
Net			

FRONT + TOTAL = .00282 grams ✓

.00162

.00044 ✓

PARTICULATE TEST NO. _____

X. Dust Concentration

Grains/ACF = 15.43 x D/MVs = 15.43 x .00282/ 86.71

= .0005 grains/ACF

Grains/DSCF = 15.43 x D/MVstd = 15.43 x .00282/ 36.56

= .0012 grains/DSCF

XI. Emission Rate

Pounds/Hr = D x V x 60/(MVs x 454)

= .00282 x 244,618 x 60/(86.71 x 454)

= 1.27 lb/hr

Pounds/Million Btu = _____ lb/hr / _____ x 10^6 Btu/hr

= _____ lb/million Btu

XII. Percent Isokinetic Sampling

% = 305.6 x MVs/(Vs x t x d^2)

= 305.6 x 86.71/(61.35 x 60 x (.0625)^2)

= 101.89 %

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

PARTICULATE STACK SAMPLING REPORT

Company TEXASGULF, INC.

Address: P.O. BOX 100, GRANGER, WY. 82934

Unit Tested: CALCINER #1 EMISSION POINT #4

Test Date: SEPT. 14, 15, 1978

TEXASGULF, INC., GRANGER, WY., CALCINER #1, EMISSION POINT #4, 1978

SUMMARY OF STACK SAMPLING CALCULATIONS	TEST 1	TEST 2	TEST 3
P_{bar} = Barometric pressure at site, in. Hg	23.88 ✓	23.88 ✓	23.47 (23.97)
P_s = Absolute stack gas pressure, in. Hg.	23.89 ✓	23.89 ✓	23.98
T_s = Absolute average stack gas temp., °R	900 ✓	907 ✓	908 ✓
T_m = Absolute average dry gas meter temp., °R	530 (1)	530 (1)	530 (1)
V_{lc} = Total volume of water collected, ml	121 ✓	121 ✓	142 ✓
V_m = Volume of gas through dry gas meter, ft^3	37.71 ✓	36.35 ✓	38.21 ✓
H = Average pressure drop across orifice, in. H_2O	0.53 ✓	0.52 ✓	0.56 ✓
C_p = Pitot tube coefficient	0.83 (2)	0.83 (2)	0.83 (2)
$(\sqrt{\Delta p})_{avg}$ = Average velocity head of stack gas, in. H_2O	0.749 ✓	0.720 ✓	0.758 ✓
A_s = Cross-sectional area of stack, ft^2	70.87 ✓	70.87 ✓	70.87 ✓
Front-half particulate collected, gm	0.02996 ✓	0.00556	0.00387
Back-half particulate collected, gm	0.00132 ✓	0.00312	0.00082
M_n = Total amount of particulate collected	0.02996 ✓	0.00868 ✓	0.00469 ✓
θ = Total sampling time, min.	60 ✓	60 ✓	60 ✓
A_n = Cross-sectional area of nozzle, ft^2	.000341 ✓	.000341 ✓	.000341 ✓
Percent Isokinetic	99.95	101.10	102.52
Emission Rate			
Pounds/hour	13.12	2.52	1.73
Pounds/million BTU	NA	NA	NA
Grains/DSCF	0.0146	0.0030	0.0019

EMISSION RATES DO NOT INCULDE BACK HALF

(1) The rough field data sheets do not indicate a temperature compensated dry gas meter.

(2) The field data sheets show the pitot tube coefficient to be 0.84

Company TEXASGULF, INC. Sampling location CALCINER #1 EMISSION POINT #4

Stack inside diameter, in. 114 Stack area, sq. ft. 70.87

Port extension, in. 15 Pitot tube correction factor 0.83

Stack Pressure 23.81 (0.16) Pitot tube traverse Prelim

Traverse Pt. No.	% of Diameter	Distance from inside Wall	Distance from outside of Port
SE 1	4.4	5.0	20.0
2	14.7	16.4	31.4
3	29.4	33.5	48.5
4	70.6	80.5	95.5
5	85.3	97.25	112.25
6	95.6	109.0	124.0
SW 1			
2			
3			
4			
5			
6			

Traverse Pt. No.	Velocity Head P	Velocity Head $\sqrt{P}$	Temperature
SE 1	.44	.663	
2	.46	.678	
3	.52	.721	
4	.52	.721	
5	.48	.693	
6	.50	.707	
SW 1	.52	.721	
2	.60	.775	
3	.64	.800	
4	.48	.693	
5	.46	.678	
6	.50	.707	
Average $\sqrt{P}$		0.714	
Average Temperature			885°F

. . . PRELIMINARY DATA

INC.

Sampling Location CALCINER #1 EMISSION POINT #4

meter, in. 114

Stack area, sq. ft. 70.87

in. 15

Pitot tube correction factor 0.83

23.81 (0.16)

Pitot tube traverse Prelim

Distance from inside Wall	Distance from outside of Port
5.0	20.0
16.4	31.4
33.5	48.5
80.5	95.5
97.25	112.25
109.0	124.0

Traverse Pt. No.	Velocity Head		Temperature
	P	$\sqrt{P}$	
SE 1	.44	.663	
2	.46	.678	
3	.52	.721	
4	.52	.721	
5	.48	.693	
6	.50	.707	
SW 1	.52	.721	
2	.60	.775	
3	.64	.800	
4	.48	.693	
5	.46	.678	
6	.50	.707	
Average $\sqrt{P}$		0.714	
Average Temperature			885° R.

SGULF INC Sampling Location CALCINER #1 EMISSION POINT #4

TEST 1

8 Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	% CO_2 A	% O_2 B-A	% CO C-B	% N_2 100-C
11:05				4.5	12.0		83.5

TEST 2

-78 Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	% CO_2 A	% O_2 B-A	% CO C-B	% N_2 100-C
14:20				4.5	12.5		83.0

TEST 3

9-15-78 of ple tion Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	% CO_2 A	% O_2 B-A	% CO C-B	% N_2 100-C
5 10:55				3.0	15.0		82.0

Company TEXASGULF, INC.

Plant Location GRANGER, WYO

Run No. 1

Sampling Location CALCINER #1, POINT #4

Date 9-14-78

Start Time 10:30

Finish Time 11:40

Filter No. 10

Assumed Moisture, % 17.0

Probe Tip Diameter, in. ¼

Probe Length, ft. 10

Ambient Temperature, °F

Bar. Pressure, in. Hg. 23.88

Initial Leak Check, CFS

CFM 0 at 15 in. Hg.

Final Leak Check, CFS

CFM 0 at 15 in. Hg.

Point No.	Time (min)	Dry Gas Meter FT^3	Pitot in. H_2O P	Pitot in. H_2O $\sqrt{P}$	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	Stack Temp. °F
START	10:30	3294.37											
SE - 1	35	3297.26	.48	.693		.48		70	3.2	200	70	23.89	410
2	40	3300.70	.72	.849		.70		70	3.9	250	140	23.89	430
3	45	3304.06	.60	.775		.50		70	3.5	260	155	23.89	440
4	50	3307.10	.54	.707		.48		70	3.5	250	150	23.89	445
5	55	3310.31	.50	.707		.48		70	3.5	250	160	23.89	450
6	11:00	3312.95	.50	.707		.48		70	3.5	250	170	23.89	440
START	11:10	3312.95											
SW -1	15	3316.34	.60	.775		.55		70	4.0	220	120	23.89	440
2	20	3319.75	.66	.812		.50		70	3.8	230	180	23.89	440
3	25	3322.99	.68	.825		.60		70	4.3	240	190	23.89	440
4	30	3326.42	.56	.748		.62		70	4.3	240	190	23.89	450
5	35	3329.41	.54	.735		.50		70	3.7	240	190	23.89	450
6	40	3332.08	.40	.632		.40		70	3.1	250	185	23.89	440
Total	60	37.71	6.78	8.992		6.31		840	44.3	2880	1900		5275
Average	5	0.63	0.57	0.749		0.53		70	3.7	240	158	23.89	440

Stack Gas [illegible] Field Data

INC.

R, WYO

CINER #1, POINT #4

Assumed Moisture, % 17.0

Probe Tip Diameter, in. ¼

Probe Length, ft. 10

Ambient Temperature, °F

Bar. Pressure, in. Hg. 23.88

Initial Leak Check, CFS
CFM 0 at 15 in. Hg.

No leak check performed

Final Leak Check, CFS
CFM 0 at 15 in. Hg.

Tot H_2O VP	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	Stack Temp. °F
.748		.55		70	3.3	235	115	23.89	450
.787		.58		70	3.8	250	165	23.89	445
.812		.68		70	4.0	250	190	23.89	450
.707		.45		70	3.0	255	190	23.89	450
.678		.50		70	3.2	250	190	23.89	450
.678		.50		70	3.2	240	190	23.89	450
.583		.30		70	2.5	220	110	23.89	440
.721		.50		70	3.2	230	160	23.89	440
.748		.60		70	3.6	230	160	23.89	450
.748		.60		70	3.6	230	170	23.89	450
.707		.48		70	3.1	230	180	23.89	440
.721		.52		70	3.3	230	180	23.89	450
8.638		6.26		840	36.2	2850	2000		S365
0.720		0.52		70	3.0	238	167	23.89	447

STACK SAMPLE FIELD DATA

Company TEXASGULF INC

Plant Location GRANGER WYO

Run No. 3

Sampling Location CALCINER #1, POINT #4

Date 9-15-78

Start Time 9:20

Finish Time 10:25

Filter No. 12

Assumed Moisture, % 17.0

Probe Tip Diameter, in. ¼

Probe Length, ft. 10

Ambient Temperature, °F

Bar. Pressure, in. Hg. 23.97

Initial Leak Check, CFS
CFM 0 at 15 in. Hg.

Final Leak Check, CFS
CFM 0 at 15 in. Hg.

Point No.	Time (min)	Dry Gas Meter FT^3	Pitot in. H_2O P	Pitot in. H_2O $\sqrt{P}$	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	Stack Temp °F
START	9:20	3368.56											
SE -1	25	3371.64	.48	.693		.52		70	3.7	200	100	23.98	450
2	30	3374.45	.54	.735		.53		70	3.9	210	140	23.98	440
3	35	3378.90	.70	.837		.65		70	4.2	220	160	23.98	440
4	40	3381.25	.60	.775		.58		70	3.8	230	170	23.98	450
5	45	3384.47	.56	.748		.50		70	3.6	240	180	23.98	450
6	9:50	3387.52	.62	.787		.64		70	4.2	260	190	23.98	450
START	10:05	3387.52											
SW -1	10	3390.63	.60	.775		.55		70	3.8	230	160	23.98	440
2	15	3384.20	.72	.849		.62		70	4.1	220	190	23.98	450
3	20	3397.72	.56	.748		.55		70	3.9	220	190	23.98	450
4	25	3401.71	.52	.721		.50		70	3.7	230	200	23.98	450
5	30	3403.80	.52	.721		.58		70	3.9	240	190	23.98	450
6	10:35	3406.77	.55	.707		.53		70	3.7	240	200	23.98	450
Total	60	38.21	6.92	9.096		6.75		840	46.5	2740	2070		5370
Average	5	0.64	0.58	0.758		0.56		70	3.9	228	173	23.98	448

LABORATORY DATA

Company TEXASGULF, INC. Run No. 1

Sampling Location CALCINER #1, POINT #4 Date 9/14/78

MOISTURE COLLECTED

		(GM/ML)	Water Weight/Volume Gain (GM/ML)
IMPINGER 1	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 2	Final Weight/Volume	308	
	Initial Weight/Volume	200	
	Increase		108
IMPINGER 3	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 4	Final Weight/Volume	213	
	Initial Weight/Volume	200	
	Increase		13
	TOTAL MOISTURE CATCH		121

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Filter and Hot Box Glassware)

(1)	Filter & Particulates	0.80459
(2)	Filter Tare Weight	0.80293
(3)	Net Dry Particulates (1-2)	0.00166 ✓
(4)	Particulates Caught in Nozzle, Probe & Glassware	0.02698
(5)	Total Front Catch (3 & 4)	0.02864 ✓

BACK-HALF ANALYSIS (Impingers, Connecting Glassware)

(1)	Particulate caught in impingers evaporated down at less than 120°F	0.00132

back-half → 4% Total

TOTAL PARTICULATE CATCH (Sum of Front and Back-Half Catches)

0.02996 ✓

LABORATORY DATA

Company TEXASGULF, INC. Run No. 2

Sampling Location CALCINER #1, POINT #4 Date 9-14-78

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 2	Final Weight/Volume	308	
	Initial Weight/Volume	200	
	Increase		108
IMPINGER 3	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 4	Final Weight/Volume	213	
	Initial Weight/Volume	200	
	Increase		13
	TOTAL MOISTURE CATCH		121

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Filter and Hot Box Glassware)

(1)	Filter & Particulates	0.79808
(2)	Filter Tare Weight	0.79776
(3)	Net Dry Particulates (1-2)	0.00032 ✓
(4)	Particulates Caught in Nozzle, Probe & Glassware	0.00524
(5)	Total Front Catch (3 & 4)	0.00556 ✓

BACK-HALF ANALYSIS (Impingers, Connecting Glassware)

(1)	Particulate caught in impingers evaporated down at less than 120°F	0.00312

Back half → 4% of total

TOTAL PARTICULATE CATCH (Sum of Front and Back-Half Catches)

0.00868 ✓

LABORATORY DATA

Company TEXASGULF, INC. Run No. 5

Sampling Location CALCINER #1, POINT #4 Date 9-15-78

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 2	Final Weight/Volume	335	
	Initial Weight/Volume	200	
	Increase		135
IMPINGER 3	Final Weight/Volume		
	Initial Weight/Volume		
	Increase		
IMPINGER 4	Final Weight/Volume	207	
	Initial Weight/Volume	200	
	Increase		7
	TOTAL MOISTURE CATCH		142

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Filter and Hot Box Glassware)

(1)	Filter & Particulates	0.80070
(2)	Filter Tare Weight	0.80015
(3)	Net Dry Particulates (1-2)	0.00055 ✓
(4)	Particulates Caught in Nozzle, Probe & Glassware	0.00332
(5)	Total Front Catch (3 & 4)	0.00387 ✓

BACK-HALF ANALYSIS (Impingers, Connecting Glassware)

(1)	Particulate caught in impingers evaporated down at less than 120°F	0.00082

back-half → 17% of total

TOTAL PARTICULATE CATCH (Sum of Front and Back-Half Catches)

0.00469 ✓

CONTROL EQUIPMENT OPERATING DATA

TEXASGULF, INC., GRANGER, WY., CALCINER #1, EMISSION POINT #4, 1978

I. Electrostatic Precipitators

Design Efficiency	98.89
Total No. of Fields	4
No. of Fields in Operation	3
Voltages in Each Field	
Currents in Each Field	
Fan Motor Amperes	
Sparking Rate: sparks/min.	NA
Remarks:	

II. Fabric Filter Collector

Design Efficiency	
Pressure Drop Across Collector, in. H_2O	NONE
Type of Cleaning	
Fan Motor Amperes	
Number of Compartments	
Remarks:	

III. Scrubber

Scrubber Type: Venturi Plate
Stray Turbulent Bed Other NONE

Design Efficiency	
Pressure Drop Across Scrubber, in. H_2O	
Liquid Flowrate to Scrubber gal/min.	
Liquid/Gas Ratio	
Recirculation of Scrubber Liquid, %	
Flue Gas to Scrubber, %	
Fan Motor Amperes	
Remarks:	

IV. Mechanical Collectors:

Type Cyclone - Multicyclone - Other

Design Efficiency	70%
Pressure Drop Across Collector, in. H_2O	NA
Fan Motor Amperes	NA
Remarks:	

TEXASGULF, INC. — Emission location: EMISSION POINT #4

	DESIGN	NORMAL
Feed rate, tons/hr	130.0	114.8
Coal Rate Tons/hr	9.8	8.7
KW produced (power boilers)		
Million BTU/hr produced		

Remarks:

	ACTUAL		
	TEST 1	TEST 2	TEST 3
Feed rate, tons/hr	93.9	93.9	95.2
Steam rate, lbs/hr: Coal Rate Tons/hr	8.0 (6.3)	8.0 (6.4)	8.0 (6.4)
KW produced (power boilers)			
Million BTU/hr produced			

* Feed number - coal feed rates less water

NOTE: Fuel analysis must accompany all fossil-fuel fired boiler stack tests.

Remarks:
EMISSIONS = $17.31\ P^{0.16}$

The coal feed rate must exclude H_2O when determining allowables.

TEST 1
$E = 17.31\ (93.9 + 8.0)^{0.16} = 36.3$ lbs/hr $17.31\ (93.9+6.3)^{.16} = 36.18$

TEST 2
$E = 17.31\ (93.9 + 8.0)^{0.16} = 36.3$ lbs/hr $17.31\ (93.9+6.4)^{.16} = 36.18$

TEST 3
$E = 17.31\ (95.2 + 8.0)^{0.16} = 36.3$ lbs/hr $17.31\ (95.2+6.4)^{.16} = 36.26$

TEXASGULF, INC., GRANGER, WY., CALCINER #1, EMISSION POINT #4, 1978

COAL ANALYSIS

DATE	MOIST.	ASH	SULFUR	BTU
~~8-21-78~~	~~21.10~~	~~2.95~~	~~0.57~~	~~10,152~~
~~8-23-78~~	~~19.84~~	~~3.42~~	~~0.58~~	~~10,218~~
8-25-78	20.13	3.43	0.54	10,132

All results are on an as received basis.

Thank you,
The Kemmerer Coal Co. Lab,

Bob Sanders

Bob Sanders, Chemist.