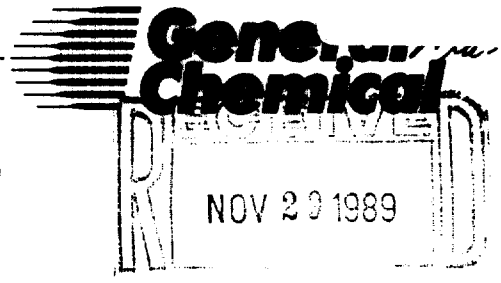
Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

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.

General Chemical Corporation
acting as agent for General Chemical (Soda Ash) Partners

Green River Soda Ash Operations
P. O. Box 551
Green River, Wyoming 82935-0551
(307)-875-3350



November 27, 1989

Mr. Charles A. Collins
Administrator
Department of Environmental Quality - Air Quality Division
Herschler Building
122 West 25th Street
Cheyenne, WY 82002

Dear Mr. Collins:

On September 7, 1989 the Wyoming Department of Environmental Quality advised General Chemical (Soda Ash) Partners of findings regarding the GR-3-D and GR-3-E calciner emissions sources. This letter had reference to an inspection performed by L. Gribovicz of the DEQ of these sources on June 28, 1989.

The letter written by the DEQ required that General Chemical (Soda Ash) Partners perform stack tests for particulate matter on these sources. In addition, the letter ordered that the opacity monitors on the stacks be certified in accordance with Performance Specification I of the WAQSR. The order further stated that results from the opacity monitors be reported quarterly in accordance with Section 23 of the WAQSR.

In order to comply with these requirements, the following schedule was utilized:

Event	Date Of Completion
Certification of Opacity Monitors	October 24-31, 1989
Testing of GR-3-D and GR-3-E Sources	November 3, 1989

Continuous monitoring of the two indicated sources commenced on November 1, 1989.

Enclosed are the results of the stack tests performed on the two units. The results indicate the following:

Source	Feed Rate	Allowable Emissions	Tested Emissions
GR-3-D	120 tph	37.2 lbs/hr	29.5 lbs/hr
GR-3-E	130 tph	37.7 lbs/hr	27.1 lbs/hr

Should any questions develop regarding this matter, please advise.

Very Truly Yours,

R. D. Casey
Plant Manager

cc: Lee Gribovicz - District Engineer
Department of Environmental Quality - Air Quality Division
210 Lincoln St.
Lander, Wyoming 82520

STACK EMISSIONS SURVEY
GENERAL CHEMICAL
SODA ASH PLANT
GREEN RIVER, WYOMING

NOVEMBER 1989
CALCINER #1

FILE NUMBER 8910-175

Prepared By:

Western Environmental Services and Testing, Inc.
6756 West Uranium Road
Casper, Wyoming 82604
(307) 234-5511

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STACK EMISSIONS SURVEY
GENERAL CHEMICAL
SODA ASH PLANT
GREEN RIVER, WYOMING

INTRODUCTION

Western Environmental Services and Testing, Inc. (WEST, Inc.) of Casper, Wyoming conducted a stack emissions survey at General Chemical's Soda Ash Plant located near Green River, Wyoming, on November 3, 1989. The purpose of this survey was to determine the emissions of particulate matter from the Exhaust Stack of the #1 Calciner.

The sampling followed the procedures set forth in the "Wyoming Air Quality Standards and Regulations", Wyoming Department of Environmental Quality, 1985; and the Code of Federal Regulations, Title 40, Chapter I, Part 60, revised July 1, 1989.

SUMMARY OF RESULTS

The principal conclusions are as follows:

#1 Calciner - Runs 1, 2, & 3

1. The emissions of particulate matter from the stack were 0.0507 grains per dry standard cubic foot (18.27 pounds per hour), based on averaging the three tests using the front-half collections of the EPA-type sampling train.

2. The emissions of particulate matter from the stack were 0.0818 grains per dry standard cubic foot (29.47 pounds per hour), based on averaging the three tests using the front-half and back-half collections of the EPA-type sampling train.

SUMMARY OF RESULTS

#1 Calciner

Run Number		1	2	3
Stack Flow Rate - ACFM		135226	137741	137944
Stack Flow Rate - DSCFM*		41414	42423	42340
% Water Vapor - % Volume		34.59	34.19	34.36
% CO2 - % Volume		13.6	14.0	12.8
% O2 - % Volume		9.0	8.8	9.4
% Excess Air At Sampling Point		78	75	84
Particulates				
Probe, Cyclone & Filter Catch grains/dscf*	(Can)	0.0491	0.0499	0.0530
grains/cf at Stack Conditions	(Cat)	0.0150	0.0153	0.0162
lbs/hr	(Caw)	17.419	18.146	19.231
Total Catch grains/dscf*	(Cao)	0.0785	0.0803	0.0865
grains/cf at Stack Conditions	(Cau)	0.0239	0.0246	0.0265
lbs/hr	(Cax)	27.847	29.182	31.382
Process Production Rate (as reported by plant personnel)	tons/hr	120	120	120

* 68 Deg. F., 29.92 "Hg (20 Deg. C., 760 mm Hg)

DISCUSSION OF RESULTS

#1 Calciner - Runs 1, 2, & 3

The three tests for particulates taken on the stack appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data are in close agreement. The moisture percentages were within 0.6 percent of the mean value. The measured flow rates (Qs) were within 1.5 percent of the mean value. The rates of sampling for the three tests were within the specified limits of the isokinetic rate, the greatest deviation being 8.8 percent.

The calculated front-half and back-half emissions (pounds per hour), of particulates from the three tests showed a range of +5.3 percent to -4.6 percent variation from the mean value.

DESCRIPTION OF PROCESS OPERATION

At General Chemical's Green River Soda Ash Operation, an electrostatic precipitator is used to limit point source emissions from the GR-3-D #1 Calciner.

Ore is fed into the calciner via a conveyor belt from storage silos. The ore is rotated through a kiln where heating, drying and chemical conversion takes place. Exhaust gases are drawn through the calciner, up through cyclones and through the precipitator. Following the precipitator, the exhaust is emitted to the atmosphere via a stack.

DESCRIPTION OF SAMPLING LOCATION

The sampling ports are located on both circular Dryer Exhaust Stacks approximately 100 feet above the ground. The sampling was performed from two ports on the circular stacks located 42 feet 6 inches (7.1 stack diameters) downstream of the stack inlet, and 12 feet (2.0 equivalent stack diameters) upstream of the stack outlet. The area of the stack is 4072 square inches. Port and wall thickness is 6-1/2 inches.

SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used followed the procedures outlined in the "Wyoming Air Quality Standards and Regulations", Wyoming Department of Environmental Quality, 1985; and the Code of Federal Regulations, Title 40, Chapter 1, Part 60, revised July 1, 1989.

A preliminary velocity traverse was performed at each of the two ports in order to determine the uniformity of flow in the stack. Particulate samples of five-minute duration at each of six traverse points were taken from the two ports using an EPA-type, heated, stainless steel-lined probe. A total of 12 points were sampled.

Before each test, the sampling train was leak-checked at 15 inches of mercury at the nozzle. After each test, the train was again leak-checked at the nozzle at the highest recorded vacuum reading during the test. Final leak-checking was performed in order to predetermine the possibility of a diluted sample.

Before and after each test period, the pitot lines were checked for leaks under both a vacuum and pressure. Also the lines were checked for clearance and the zero manometer reading verified, before and after each test.

The emissions were calculated from gravimetric analysis using the front-half and back-half collections of the EPA-type sampling train in accordance with the EPA "New Source Performance Standards".

Orsat analysis were provided for each test using a grab-type sample.

DESCRIPTION OF TESTS

Personnel from WEST, Inc. arrived at the plant at 0700 hours on Friday, November 3, 1989. After testing the #2 Calciner stack, the equipment was moved onto the #1 Calciner Stack and readied for testing by 1300 hours. Testing on the #1 Calciner began at 1315 hours and continued until the completion of the three test at 1720 hours.

The equipment was moved off the stack and loaded into the mobile laboratory. All of the samples, which had been recovered immediately after each test, were taken to WEST, Inc.'s laboratory in Casper for further analyses and evaluation.

Testing on the #1 Calciner at General Chemical's Soda Ash Plant located near Green River, Wyoming, was completed at 1830 hours on Friday, November 3, 1989.

James E. Meador, Jr.
Vice President

Alan D. Roylance
Manager of Operations

APPENDICES

A. Location of Sampling Points

B. Source Emission Calculations

C. Calibration of Equipment

D. Field Testing Data

E. Analytical Data

F. Plant Operational Data

G. Chain of Custody

H. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points

APPENDIX A

Location of Sampling Points

The sampling ports on the #1 Calciner are located approximately 100 feet above the ground. The sampling was performed from two ports on the circular stack located 42 feet 6 inches (7.1 stack diameters) downstream of the stack inlet, and 12 feet (2.0 equivalent stack diameters) upstream of the stack outlet. The area of the stack is 4072 square inches. The location of the sampling points were calculated as follows:

Inside Stack Diameter = 72 inches

Port and Wall Thickness = 6-1/2 inches

Point Number	Percent Diameter From Wall	Distance From Wall (inches)
1	4.4	3- 3/16
2	14.7	10- 9/16
3	29.5	21- 1/4
4	70.5	50- 3/4
5	85.3	61- 7/16
6	95.6	68-13/16

APPENDIX B

Source Emission Calculations

Nomenclature for Particulate Calculations

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_{an}	gr/dscf	g/dscm	Particulate - Probe, Cyclone and Filter
C_{ao}	gr/dscf	g/dscm	Particulate - Total
C_{at}	gr/CF @ Stack Conditions	g/m^3	Particulate - Probe, Cyclone and Filter
C_{au}	gr/CF @ Stack Conditions	g/m^3	Particulate - Total
C_{aw}	lbs/hr	kg/hr	Particulate - Probe, Cyclone and Filter
C_{ax}	lbs/hr	kg/hr	Particulate - Total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air At Sampling Point
g	32.2 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the Stack Gas by Volume

* 528° R, 29.92 "Hg (20°C, 760 mm Hg)

Symbol	English Units	Metric Units	Description
M_d			Mole Fraction of Dry Gas
mf	mg	mg	Particulate - Probe, Cyclone and Filter
M_{H_2O}	18 lb/lb-mole		Molecular Weight of Water
m_t	mg	mg	Particulate - Total
MW_{air}	lb/lb-mole	g/g-mole	Molecular Weight Of Stack Gas
MW	28.95 lb/ lb-mole		Molecular Weight Of Air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight Of Dry Stack Gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure Drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP_s	"H_2O	mm H_2O	Velocity Head of Stack Gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume At Actual Stack Conditions
Q_s	DSCFM	dscm/hr	Stack Gas Volume At 29.92 "Hg, 528°R, Dry
R	21.83 "Hg ft^3/lb-mole-°R		Universal Gas Constant

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

Symbol	English Units	Metric Units	Description
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net Time of Test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of Dry Gas Sampled @ Meter Conditions
$V_{m_{std}}$	dscf	dscm	Volume of Dry Gas Sampled @ Standard Conditions
V_s	fpm	m/sec	Stack Velocity @ Stack Conditions
V_w	ml	ml	Total water Collected in Impingers And Silica Gel
$V_{w_{gas}}$	scf	scm	Volume of Water Vapor Collected @ Standard Conditions
ρ_{air}	0.0748 lbs/ft^3		Density of Air
ρ_{H_2O}	1 g/ml		Density of Water
ρ_{man}	51.63 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Example Particulate Calculations

1. Volume of Dry Gas Sampled At Standard Conditions.*

$$V_{m_{std}} = V_m \left[\frac{T_{std}}{T_m + 460} \right] \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$V_{m_{std}} = 17.65\ V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of Water Vapor Collected At Standard Conditions.*

$$V_{w_{gas}} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S)\ \rho_{H_2O}\ R\ T_{std}}{P_{std}\ M_{H_2O}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{w_{gas}} = \text{scf} \times 0.028317 = \text{scm}$$

3. Percent Moisture in Stack Gas.

$$\%M = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \%$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

4. Mole Fraction of Dry Gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average Molecular Weight of Dry Stack Gas.

$$MW_d = \left(\%CO_2 \times \frac{44}{100}\right) + \left(\%O_2 \times \frac{32}{100}\right) + \left(\%N_2 \times \frac{28}{100}\right) + \left(\%CO \times \frac{28}{100}\right) = \text{lb/lb-mole}$$

$$= \text{g/g-mole}$$

6. Molecular Weight of Stack Gas.

$$MW = MW_d \times M_d + 18\ (1-M_d) = \frac{\text{lb}}{\text{lb-mole}} = \text{g/g-mole}$$

7. Percent Excess Air At Sampling Point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - (\%O_2) + 0.5\ (\%CO)}$$

8. Stack Pressure.

$$P_s = P_b + \frac{\text{stack pressure } "H_2O}{13.6} = "\text{Hg Absolute}$$

$$P_s = "\text{Hg Abs.} \times 25.4 = \text{mm Hg}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

9. Stack Velocity At Stack Conditions.

$$V_s = C_p\ 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P_s}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2}$$

$$V_s = 5123.8\ C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{\frac{1}{2}} \times \text{Average} \left[(\Delta P)^{\frac{1}{2}} \right] = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry Stack Gas Volume At Standard Conditions.*

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\ V_s \times A_s \times M_d \times P_s}{T_s + 460} = \text{DSCFM}$$

$$Q_s = \text{DSCFM} \times 1.6990 = \text{dscm/hr}$$

11. Actual Stack Gas Volume At Stack Conditions.

$$Q_a = \frac{V_s \times A_s}{144} = \text{ACFM}$$

$$Q_a = \text{ACFM} \times 1.6990 = \text{m}^3/\text{hr}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

12. Percent Isokinetic

$$\%I = \frac{V_{m_{std}} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \times \frac{\pi D_n^2}{4}}$$

$$\%I = \frac{1039\ V_{m_{std}} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s\ D_n^2}$$

13. Particulate - Probe, Cyclone, and Filter.

$$C_{an} = \frac{m_f}{V_{m_{std}}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154\ \frac{m_f}{V_{m_{std}}} = gr/dscf$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm$$

14. Particulate - Total.

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{m_{std}}} = gr/dscf$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

15. Particulate - Probe, Cyclone, and Filter At Stack Conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{at} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

16. Particulate - Total, At Stack Conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{au} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

17. Particulate - Probe, Cyclone, and Filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = \text{lbs/hr}$$

$$C_{aw} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

18. Particulate - Total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = \text{lbs/hr}$$

$$C_{ax} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

GENERAL CHEMICAL
SODA ASH PLANT
GREEN RIVER, WYOMING
STACK EMISSIONS SURVEY

NOVEMBER 1989

FILE NUMBEWR 8910-175

SOURCE EMISSION CALCULATIONS

Symbol	Description	Units	CAL. #1	CAL. #1	CAL. #1
Run No.			1	2	3
Date			11/03/89	11/03/89	11/03/89
Begin			1315 MST	1446 MST	1618 MST
End			1418 MST	1549 MST	1720 MST
Pb	barometric pressure	"Hg Abs. (mm Hg)	23.32 592.33	23.32 592.33	23.32 592.33
Pm	orifice pressure drop	"H2O (mm H2O)	1.09 27.73	1.04 26.52	1.01 25.61
Vm	volume dry gas sampled @ meter conditions	cu. ft. (cu. m.)	42.097 1.192	41.674 1.180	41.537 1.176
Tm	avg. gas meter temp	deg. F (deg. C)	97 36	99 37	100 38
Vmstd	volume dry gas sampled @ standard conditions*	dscf (dscm)	31.189 .883	30.793 .872	30.627 .867
Vw	total H2O collected, impingers & silica gel	ml	349.5	338.9	339.7
Vwgas	volume water vapor collected @ standard conditions*	scf (scm)	16.496 .467	15.996 .453	16.034 .454
%M	moisture in stack gas by volume	%	34.59	34.19	34.36

* 68 deg. F., 29.92 "Hg (20 deg. C., 760 mm Hg)

Source Emission Calculations

GENERAL CHEMICAL
FILE NUMBER 8910-175

Symbol	Description	Units	CAL. #1	CAL. #1	CAL. #1
Run No.			1	2	3
Md	mole fraction of dry gas	-------	.6541	.6581	.6564
CO2		%	13.6	14.0	12.8
O2		%	9.0	8.8	9.4
N2		%	77.4	77.2	77.8
%EA	excess air @ sampling point	%	78	75	84
MWd	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	30.54 30.54	30.59 30.59	30.42 30.42
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	26.20 26.20	26.29 26.29	26.15 26.15
dP's	velocity head of stack gas	"H2O (mm H2O)	.883 22.44	.920 23.37	.918 23.33
Ts	stack temperature	deg. F (deg. C)	421 216	422 216	422 217
Ps	stack pressure	"Hg Abs. (mm Hg)	23.29 591.58	23.29 591.58	23.29 591.58
Vs	stack velocity @ stack conditions	fpm (m/sec)	4782 24.29	4871 24.74	4878 24.78
As	stack area	sq. in. (sq. met.)	4072 2.63	4072 2.63	4072 2.63
Qs	dry stack volume @ standard conditions*	DSCFM (dscm/hr)	41414 70362.87	42423 72075.86	42340 71935.48
Qa	actual stack gas volume @ stack conditions	ACFM (cu.m./hr)	135226 229749.34	137741 234021.24	137944 234366.73

* 68 deg. F., 29.92 "Hg (20 deg. C., 760 mm Hg)

Source Emission Calculations

GENERAL CHEMICAL
FILE NUMBER 8910-175

Symbol	Description	Units	CAL. #1	CAL. #1	CAL. #1
Run No.			1	2	3
Tt	net time of test	min.	60	60	60
Dn	sampling nozzle diameter	in.	.245	.245	.245
		(m)	.006	.006	.006
%I	percent isokinetic	%	108.82	104.88	104.52
mf	particulate - probe, cyclone and filter	mg	99.4	99.8	105.4
mt	particulate - total	mg	158.9	160.5	172.0
Can	particulate - probe, cyclone and filter	gr/dscf*	.0491	.0499	.0530
		(g/dscm)	.1124	.1143	.1214
Cao	particulate - total	gr/dscf*	.0785	.0803	.0865
		(g/dscm)	.1797	.1838	.1981
Cat	particulate - probe, cyclone and filter @ stack conditions	gr/cf	.0150	.0153	.0162
		(g/cu.m.)	.0343	.0351	.0371
Cau	particulate - total @ stack conditions	gr/cf	.0239	.0246	.0265
		(g/cu.m.)	.0548	.0564	.0606
Caw	particulate - probe, cyclone and filter	lbs/hr	17.419	18.146	19.231
		(kg/hr)	7.901	8.231	8.723
Cax	particulate - total	lbs/hr	27.847	29.182	31.382
		(kg/hr)	12.631	13.237	14.235

* 68 deg. F., 29.92 "Hg (20 deg. C., 760 mm Hg)

APPENDIX C

Calibration of Equipment

APPENDIX C

Calibration Data

July 19, 1989

DRY GAS METERS

Unit Number	Calibration Factor
1	1.028
2	1.024
3	1.068
4	1.011

APPENDIX C

Calibration Data

July 18, 1989

NOZZLES

Set A

Nozzle No.	Diameter (inches)
1A	MIA
2A	0.227
3A	0.253
4A	0.321
5A	0.359
6A	0.378
7A	0.446
8A	0.500
9A	0.499
10A	0.576

Set B

Nozzle No.	Diameter (inches)
1B	0.130
2B	0.178
3B	0.239
4B	0.306
5B	0.358
6B	0.366
7B	0.501

Set I

Nozzle No.	Diameter (inches)
I-1	0.130
I-2	0.195
I-3	0.245
I-4	0.310
I-5	0.371
I-6	0.417
I-7	0.488
I-8	0.565
I-9	0.614

Set II

Nozzle No.	Diameter (inches)
II-1	0.123
II-2	0.192
II-3	0.253
II-4	0.312
II-5	0.376
II-6	0.435
II-7	0.496
II-8	0.561
II-9	0.609

Set III

Nozzle No.	Diameter (inches)
III-1	0.130
III-2	0.180
III-3	0.246
III-4	0.369
III-5	0.367
III-6	0.429
III-7	0.500
III-8	0.558
III-9	0.611

APPENDIX C

Calibration Data

July 19, 1989

PITOT TUBES

Pitot Length (effective length)	Calibration Factor	Pitot Length (effective length)	Calibration Factor
		122-1	High 0.823 Low 0.822
32-1	High 0.833 Low 0.831	128-1	High 0.823 Low 0.821
32-2	High 0.834 Low 0.831	132-1	High 0.822 Low 0.821
46-1	High 0.817 Low 0.818	132-2	High 0.820 Low 0.823
49-1	High 0.814 Low 0.812		
49-3	High 0.821 Low 0.821		
73-1	High 0.828 Low 0.824		
74-1	High 0.820 Low 0.822		
96-1	High 0.828 Low 0.822		

APPENDIX D

Field Testing Data

Job No. 175 Part FIELD DATA

Job Name Gen Chem

Run No. 1

Location Calciner #1

Date 11-3-89

Operator Rasmussen / Hettinger

Sample Box No. 6 Meter Box No. 4

ΔPs Pm Ts

Nomograph Setting ΔP — ΔH —

Ambient Temp. °F 98°

Assumed Moisture % 32

Read and Record at the Start of Each Test Point. A / B

Probe Length 7'

Pitot Tube Leak Check BEFORE OKAY / AFTER OKAY

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 8.0 "Hg = 0.000 cfm

Tm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
A-6	1315	466.396	0.83	1.0	1.0	2.5	415	265	232	68	95	95	1.3
5	1320	469.70	0.99	1.3	1.3	3.0	422	266	243	61	97	95	1.25
4	1325	473.53	0.94	1.2	1.2	3.0	421	262	253	60	98	97	
3	1330	477.22	1.05	1.3	1.3	3.0	421	260	258	62	98	97	1.2
2	1335	481.14	1.05	1.3	1.3	3.0	420	252	266	61	99	97	
1	1340	485.07	0.82	1.0	1.0	2.5	417	248	263	64	99	97	
END	1345	488.532	—	—	—	—	—	—	—	—	—	—	
B-6	1348	488.532	0.80	0.95	0.95	2.5	420	237	254	68	98	96	
5	1353	491.82	0.90	1.1	1.1	3.0	424	245	251	64	99	96	
4	1358	495.35	0.89	1.05	1.05	3.0	424	255	250	64	99	97	
3	1403	498.88	0.93	1.1	1.1	3.0	424	255	248	63	99	97	
2	1408	502.54	0.84	1.0	1.0	2.5	423	250	247	64	100	97	
1	1413	505.97	0.66	0.80	0.80	2.5	421	242	245	66	100	97	
END ALL	1418	508.035	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.828 Pitot Tube No. 96-1

Volume Collected V_m 92.077 ft^3 %CO_2 13.6 %CO 0.0

Water Collected V_w 349.5 ml %O_2 9.0 %N_2 77.4

Time of Test T_t 60 min Area Stack A_2 4072 in^2

Baro. Press. P_b 23.32 "Hg Stack Press. -0.14 in. H_2O

Sample Purge: Initial — Final —

Probe Tip No. I-3 Probe Tip Dia. 0.245 in

V_m = Dry Gas Meter Calibration Factor 1.011 x 91.637

Dry Gas Meter Reading ____ ft^3 - (T_t ____ min x Leak Rate ____ cfm

M_F = 99.4 M_T = 158.9

IMPINGER CATCH

SAMPLE NO. 1

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)
1	D.I.	100	Modif.	Final 799.6 Initial 552.0 Wt. Gain 247.6
2	D.I.	100	G.Smith	Final 670.5 Initial 586.3 Wt. Gain 84.2
3	Dry	-	Modif.	Final 475.7 Initial 468.9 Wt. Gain 6.8
4	silicagel	-	Modif.	Final 749.3 Initial 738.4 Wt. Gain 10.9
5				Final Initial Wt. Gain
6				Final Initial Wt. Gain
Flask	0			Final Initial Wt. Gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 349.5

DATE: 11-3-89

SIGNATURE: Michael E. Reynolds

ORSAT ANALYSIS RESULTS
Gas Fractional Part

CO_2 13.6

O_2 9.0

CO 0.0

N_2 77.4

SIGNATURE: Michael E. Reynolds DATE: 11-3-89

TIME: 1415

Job No. 8410475 — Part — FIELD DATA — Nomograph Setting ΔP ____ ΔH ____

Job Name Gen Chemical — Ambient Temp. °F 93

Run No. 2 — Assumed Moisture % 32

Location Calciner #1 — Read and Record at the Start of Each Test Point. — Probe Length 7'

Date 11-3-89 — Pitot Tube Leak Check Before OKAY / After OKAY

Operator Rasmussen / Hettinger — A B — Initial Leak @ 15.0 "Hg = 0.000 cfm

Sample Box No. 4 — Meter Box No. 4 — Final Leak @ 8.0 "Hg = 0.000 cfm

ΔPs — Pm — Ts — Tm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
													1.2
B-6	1446	509.438	0.85	1.0	1.0	2.5	417	260	230	72	100	100	
5	1451	512.79	0.96	1.15	1.15	3.0	425	261	235	61	99	99	
4	1456	516.43	1.0	1.2	1.2	3.5	423	250	238	59	99	99	
3	1501	520.16	1.0	1.2	1.2	3.5	422	250	241	60	100	99	
2	1506	523.85	0.87	1.05	1.05	3.0	422	243	253	62	100	97	1.05
1	1511	527.05	0.63	0.65	0.65	2.0	419	239	257	65	100	97	
END	1516	529.837											1.1
A-6	1519	529.837	0.84	0.90	0.90	2.5	419	243	253	69	99	97	
5	1524	533.01	1.0	1.1	1.1	3.5	424	245	255	62	100	97	
4	1529	536.55	1.0	1.1	1.1	3.5	423	251	257	60	100	97	
3	1534	540.09	1.05	1.15	1.15	3.5	423	255	255	62	101	97	
2	1539	543.76	1.05	1.15	1.15	3.5	422	254	254	63	101	97	
1	1544	547.46	0.8	0.88	0.88	3.0	419	251	253	65	101	97	
END All	1549	550.659											

Pitot Tube Calibration Factor C_p 0.828 — Pitot Tube No. 96-1

Volume Collected V_m 41.671 ft³ — %CO_2 14.0 %CO 0.0

Water Collected V_w 338.9 ml — %O_2 8.8 %N_2 77.2

Time of Test T_t 60 min — Area Stack A_2 4072 in²

Baro. Press. P_b 23.32 "Hg — Stack Press. −0.4 in. H_2O

Sample Purge: Initial — Final —

Probe Tip No T-3 — Probe Tip Dia. 0.245 in

V_m = Dry Gas Meter Calibration Factor 1.011 × 41.221

Dry Gas Meter Reading ____ ft³ − (____ T_t min × Leak Rate ____ cfm)

M_F = 99.8 — M_T = 160.5

IMPINGER CATCH

SAMPLE NO. 2

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)
1	D.I.	100	Modif.	Final 876.5 Initial 615.8 Wt. Gain 260.7
2	D.I.	100	G.Smith	Final 604.2 Initial 545.9 Wt. Gain 58.3
3	Dry	-	Modif.	Final 513.8 Initial 506.2 Wt. Gain 2.6
4	Silica Gel	-	Modif.	Final 751.1 Initial 738.8 Wt. Gain 12.3
5				Final Initial Wt. Gain
6				Final Initial Wt. Gain
Flask	0			Final Initial Wt. Gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 238.9

DATE: 11-3-89

SIGNATURE: Michael E. Reynolds

ORSAT ANALYSIS RESULTS
Gas Fractional Part

CO_2 14.0

O_2 8.8

CO 0.0

N_2 77.2

SIGNATURE: Michael E. Reynolds DATE: 11-3-89

TIME: 1540

Job No. 8970-175 — Part — FIELD DATA

Job Name General Chemical

Run No. 3

Location Calciner #1

Date November 3 1989

Operator Rasmussen / Hettinger

Sample Box No. 5 Meter Box No. 4

Read and Record at the Start of Each Test Point.

Nomograph Setting ΔP — ΔH —

Ambient Temp. °F 92

Assumed Moisture % 32

Probe Length 7'

Pitot Tube Leak Check Before OKAY / After okay

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 8.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp °F (Ts)	Probe Temp °F (ΔPs)	Oven Temp °F (Pm)	Effluent Temp °F (Tm)	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
													1.1
A-6	1618	551.006	0.87	0.96	0.96	2.5	419	261	235	70	102	101	
5	1623	554.31	1.0	1.1	1.1	3.0	425	262	239	68	101	100	
4	1628	557.85	0.98	1.05	1.05	3.0	423	262	239	65	100	99	
3	1633	561.28	1.05	1.15	1.15	3.0	425	245	244	64	100	99	
2	1638	564.98	1.05	1.15	1.15	3.0	424	249	247	64	101	99	
1	1643	568.66	0.71	0.8	0.8	2.5	419	242	252	67	101	99	
END	1648	571.815											
B-6	1650	571.815	0.86	0.94	0.94	3.0	421	239	253	70	100	99	
5	1655	575.04	0.95	1.05	1.05	3.0	425	242	255	65	100	99	
4	1700	578.51	1.0	1.1	1.1	3.5	423	244	259	64	101	99	
3	1705	582.09	1.05	1.15	1.15	3.5	422	249	259	64	101	99	
2	1710	585.80	0.89	0.98	0.98	3.0	423	244	257	65	101	99	
1	1715	589.32	0.61	0.67	0.67	2.5	417	240	255	68	101	99	
END ALL	1720	592.091											

Pitot Tube Calibration Factor C_p 0.828 Pitot Tube No. 96-1

Volume Collected V_m 41.537 ft³ %CO_2 12.8 %CO 0.0

Water Collected V_w 337.7 ml %O_2 9.4 %N_2 77.8

Time of Test T_t 60 min Area Stack A_2 4072 in²

Baro. Press. P_b 23.32 "Hg Stack Press. −0.4 in. H_2O

Sample Purge: Initial — Final —

Probe Tip No. I-3 Probe Tip Dia. 0.245 in

V_m = Dry Gas Meter Calibration Factor 1.011 X 41.085

[Dry Gas Meter Reading ft³ − (T_t min x Leak Rate cfm)]

M_F = 105.4 M_T = 172.0

IMPINGER CATCH

SAMPLE NO. 3

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)
1	D.I.	100	Modif.	Final 862.2 Initial 602.6 Wt. Gain 259.6
2	D.I.	100	G.Smith	Final 627.3 Initial 562.0 Wt. Gain 65.3
3	Dry	-	modif.	Final 478.2 Initial 472.7 Wt. Gain 5.5
4	Silicagel	-	Modif.	Final 751.8 Initial 742.5 Wt. Gain 9.3
5				Final Initial Wt. Gain
6				Final Initial Wt. Gain
Flask	0			Final Initial Wt. Gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 339.7

DATE: 11-3-89

SIGNATURE: Michael E. Reynolds

ORSAT ANALYSIS RESULTS
Gas Fractional Part

CO_2 12.8

O_2 9.4

CO 0.0

N_2 77.8

SIGNATURE: Michael E. Reynolds DATE: 11-3-89

TIME: 1200

APPENDIX E

Analytical Data

WEST, Inc.

PARTICULATE ANALYSIS

Date 11-17-89

Job No. 8910-175

Name General Chemical

Location Calciner # 1

Run No. 1

Filter No. R-397 — Front Wash 475 ml

	Filter	Front Wash	~~Impinger 1~~ Back Water 650 ml	~~Impinger 2~~ Back wash 50 ml
Final	0.7401	109.6611	97.6336	101.7548
Initial	0.6799	109.6200	97.5933	101.7342
	0.0602 = 60.2	0.0411 = 41.1	0.0403 = 40.3	0.0206 = 20.6
		− 1.9 Blank	− 1.1 Blank	− 0.3 Blank
		39.2	39.2	20.3

MF 99.4 mg MT 158.9 mg

Run No. 2

Filter No. R-398 — Front Wash 400 ml

	Filter	Front Wash	~~Impinger 1~~ Back Water 650 ml	~~Impinger 2~~ Back Wash 75 ml
Final	0.7454	104.9091	110.1600	103.5050
Initial	0.6799	104.8732	110.1267	103.4761
	0.0655 = 65.5	0.0359 = 35.9	0.0333 = 33.3	0.0289 = 28.9
		− 1.6 Blank	− 1.1 Blank	− 0.4 Blank
		34.3	32.2	28.5

MF 99.8 mg MT 160.5 mg

Run No. 3

Filter No. R-399 — Front Wash 350 ml

	Filter	Front Wash	~~Impinger~~ 1 Back water 625 ml	~~Impinger 2~~ Back Wash 85 ml
Final	0.7479	109.6393	103.9290	101.4025
Initial	0.6830	109.5974	103.8912	101.3721
	0.0649 = 64.9	0.0419 = 41.9	0.0378 = 37.8	0.0304 = 30.4
		− 1.4 Blank	− 1.1 Blank	− 0.5 Blank
		40.5	36.7	29.9

MF 105.4 mg MT 172.0 mg

Acetone Blank:

Volume 200 ml — Final 106.0116 — Initial 106.0108 — 0.0008

Blank: 0.004 mg/ml Total Weight 0.8 mg

D.I. Water Blank

Volume 200 ml — Final 100.5279 — Initial 100.5268 — 0.0011

Blank: 0.0055 mg/ml Total Weight 1.1 mg

APPENDIX E

Plant Operational Data

Operations Summary - GR-3-D #1 Calciner
Emission Tests of 11/03/89

Process Data - Mean Values

	Stack Temp., deg. C	Ore Temp., deg. C	Feed Rate, tons/hr **	Gas Usage, MMBTU/HR
Test #1	226	181	120	115.3
Test #2	233	198	120	118.5
Test #3	234	189	120	111.0

Screen Fractions
Feed Ore

	+1/2	+3/8	+1/4	+1/8	-1/8
Test #1	9.5	27.9	27	17	18.6
Test #2	6.6	16.8	23.6	23.8	29.2
Test #3	8.5	18.1	25.5	22.8	25.1

Bicarbonate Analyses - Discharge Ore

	% NaHCO3	% NaOH
Test #1	0.34	0
Test #2	0.32	0
Test #3	0.56	0

** Rate represents average rate for unit, maximum rates are approximately 135 - 140 tph. Operating rates are variable depending on ore sizing, associated bicarbonate residuals, and ore availability

Precipitator Summary - GR-3-D #1 Calciner

Mean Values

		Volts, A.C.	Milliamps, D.C.	Amps, A.C.
Test #1				
	Inlet	332	245	51
	Center	315	1030	157
	Outlet	305	980	152
Test #2				
	Inlet	345	290	54
	Center	303	1025	157
	Outlet	303	980	151
Test #3				
	Inlet	310	250	63
	Center	304	1045	157
	Outlet	305	965	151

1 CALCINER
COMPLIANCE TEST NO. 1

DATE 891103
ART TIME 13:16
D TIME 14:15

% Opacity
12.1
14.9
12.2
18.1
14.5
15.0
14.3
13.2
12.5
13.2
12.1
12.2
11.0
12.8
14.1
13.3
16.6
13.6
12.4
13.7
12.4
13.4
12.3
13.3
13.7
14.9
14.2
13.8
12.6
13.0
12.0
13.4
12.0
15.7
11.7
16.5
17.8
13.5
12.6
13.2
11.3
12.3
11.4
13.7
12.3
15.2
15.5
14.4
12.6
14.2
12.5
13.4
12.5
13.9
12.6
13.4
15.5
16.5
12.2
13.3
11.8
13.4
12.2
17.2

NO. of SAMPLES	64
MEAN	14.0
STD. DEV.	1.6
COEFF. VAR.	11.3

1 CALCINER
COMPLIANCE TEST NO. 2

DATE 851103
START TIME 14:47
END TIME 15:50

% Opacity
12.8
11.7
15.0
11.5
12.6
12.4
17.0
17.1
13.4
11.5
12.0
11.8
12.9
11.6
12.7
11.8
13.1
16.8
13.7
12.4
13.1
11.9
13.3
12.6
13.6
11.7
13.4
17.2
15.3
11.8
13.8
12.1
15.7
12.0
13.3
13.6
12.9
13.6
17.1
11.5
11.4
11.1
12.0
11.0
12.5
11.6
12.7
16.0
13.3
13.8
12.5
11.7
12.4
12.3
12.7
11.1
12.1
11.6
14.3
13.1
12.7
11.5
14.7
11.6
NO. of SAMPLES 64
MEAN 13.0
STD. DEV. 1.6
COEFF. VAR. 12.4

1 CALCINER
COMPLIANCE TEST NO. 3

DATE 891103
START TIME 16:19
END TIME 17:21

% Opacity
15.8
12.4
13.6
13.9
13.5
12.6
17.2
12.9
11.8
14.7
13.2
12.5
13.4
12.7
14.1
13.1
14.4
18.0
13.2
14.0
13.8
11.9
13.4
12.1
13.2
12.0
13.5
14.8
12.7
11.6
19.2
11.7
12.5
12.1
11.7
11.9
12.4
14.3
12.4
11.3
15.2
13.6
13.1
12.3
13.9
12.2
13.5
14.2
13.5
12.4
13.3
14.7
13.0
11.9
13.0
12.0
12.6
12.9
16.5
11.8
14.9
13.0
13.1
NO. of SAMPLES 63
MEAN 13.0
STD. DEV. 1.5
COEFF. VAR. 11.7

APPENDIX G

Chain of Custody
and
Analyses Request

WESTERN ENVIRONMENTAL SERVICES AND TESTING, INC.

Chain of Custody and Analysis Request

Job Number 8910-175 Date(s) Sampled 11-3-89

Job Name General Chemical Number of Runs 3

Source Location Green River, WY

Unit Tested Calciner #1

Absorbing Solution/Analysis For

Run	Filter Number	Imp 1	Imp 2	Imp 3	Imp 4	Probe Wash
1	R-397	D.I. / moist.	D.I. / moist.	Dry / moist.	Silicabel / moist.	Acetone / Particulates
2	R-398	"	"	"	"	"
3	R-399	"	"	"	"	"
4						

No_x: _____

Other _____

Total Number of Sample Bottles: 9

Total Number of Filters: 3

Comments: _____

Person Responsible for Samples: Michael E. Reynolds

Sample No.	Recovered by	Date	Time	Location
1	Michael E. Reynolds	11-3-89	1430	On site
2	Michael E. Reynolds	11-3-89	1600	On site
3	Michael E. Reynolds	11-3-89	1730	On site
4				

Samples Received By Michael E. Reynolds for transport Date: 11-3-89 Time: 1830

Samples Received at Lab by Alan D. Roylance Date: 11-6-89 Time: 0800

Samples Analyzed by Alan D. Roylance Date: 11-17-89 Time: —

4/85

APPENDIX H

Resumes of Test Personnel

MICHAEL E. REYNOLDS

CURRENT: 04/03/89 to present	Senior Technician, Western Environmental Services and Testing, Inc., Casper, Wyoming, and Beaumont, Texas; an environmental monitoring and consulting firm.
PROFESSIONAL: 05/88 to 04/89	Downhole Surveyor, Scientific Drilling International, Casper, Wyoming
11/86 to04/88	Contract Sample Catcher, Exploration Logging, Houston, Texas
06/81 to 09/86 (summers)	Partner, Custom Contract Haying, Glenrock, Wyoming
05/80 to 01/81	Laborer, Lower and Company, Inc., Casper, Wyoming
05/79 to 09/79	Laborer, Lower and Company, Inc., Casper, Wyoming
06/78 to 09/78	Roustabout, Thatcher and Sons, Inc., Casper, Wyoming
EDUCATION:	South Dakota School of Mines and Technology, Mining Engineering, 09/78 to 5/80
	University of Wyoming, Laramie, Undergraduate business courses consistent with M.B.A. program
	B.S. Petroleum Engineering, 12/83

TECHNICAL EXPERIENCE:

NIELS L. RASMUSSEN

CURRENT: 07/17/89 to present	Senior Technician, Western Environmental Services and Testing, Inc., Casper, Wyoming, and Evanston, Wyoming; an environmental monitoring and consulting firm.
PROFESSIONAL: 06/80 to 07/89	Logging Geologist, Exlog Central Area, Houston, Texas
Summer 1979	Thatcher and Sons, Glenrock, Wyoming
Summer 1978	Blackhills Bentonite, Casper, Wyoming
EDUCATION:	Exlog Oil Field Familiarization School, Houston Texas
	Bachelor of Science in Geology, University of Wyoming, Laramie, Wyoming, May 1980
	Associate Arts in Liberal Arts, Eastern Wyoming College, Torrington, Wyoming, May 1977
TECHNICAL EXPERIENCE:	Assisted in over 50 source emissions surveys and the maintenance of various ambient air networks, run various methods for sample analyses in the laboratory

STACK EMISSIONS SURVEY
GENERAL CHEMICAL
SODA ASH PLANT
GREEN RIVER, WYOMING

NOVEMBER 1989
CALCINER #2

FILE NUMBER 8910-175

Prepared By:

Western Environmental Services and Testing, Inc.
6756 West Uranium Road
Casper, Wyoming 82604
(307) 234-5511

TABLE OF CONTENTS

STACK EMISSIONS SURVEY
GENERAL CHEMICAL
SODA ASH PLANT
GREEN RIVER, WYOMING

INTRODUCTION

Western Environmental Services and Testing, Inc. (WEST, Inc.) of Casper, Wyoming conducted a stack emissions survey at General Chemical's Soda Ash Plant located near Green River, Wyoming, on November 3, 1989. The purpose of this survey was to determine the emissions of particulate matter from the Exhaust Stack of the #2 Calciner.

The sampling followed the procedures set forth in the "Wyoming Air Quality Standards and Regulations", Wyoming Department of Environmental Quality, 1985; and the Code of Federal Regulations, Title 40, Chapter I, Part 60, revised July 1, 1989.

SUMMARY OF RESULTS

The principal conclusions are as follows:

#1 Calciner - Runs 3, 4, & 5

1. The emissions of particulate matter from the stack were 0.0463 grains per dry standard cubic foot (18.54 pounds per hour), based on averaging the three tests using the front-half collections of the EPA-type sampling train.

2. The emissions of particulate matter from the stack were 0.0677 grains per dry standard cubic foot (27.10 pounds per hour), based on averaging the three tests using the front-half and back-half collections of the EPA-type sampling train.

SUMMARY OF RESULTS

#2 Calciner

Run Number		3	4	5
Stack Flow Rate - ACFM		138128	144913	146793
Stack Flow Rate - DSCFM*		45093	47472	47299
% Water Vapor - % Volume		30.44	30.10	31.27
% CO2 - % Volume		13.0	13.2	11.0
% O2 - % Volume		10.0	9.0	11.4
% Excess Air At Sampling Point		96	77	124
Particulates				
Probe, Cyclone & Filter Catch grains/dscf*	(Can)	0.0390	0.0519	0.0480
grains/cf at Stack Conditions	(Cat)	0.0127	0.0169	0.0154
lbs/hr	(Caw)	15.069	21.105	19.443
Total Catch grains/dscf*	(Cao)	0.0580	0.0752	0.0698
grains/cf at Stack Conditions	(Cau)	0.0189	0.0246	0.0224
lbs/hr	(Cax)	22.397	30.614	28.280
Process Production Rate (as reported by plant personnel)	tons/hr	130	130	130

* 68 Deg. F., 29.92 "Hg (20 Deg. C., 760 mm Hg)

DISCUSSION OF RESULTS

#1 Calciner - Runs 3, 4, & 5

The three tests for particulates taken on the stack appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data are in close agreement. The moisture percentages were within 2.1 percent of the mean value. The measured flow rates (Qs) were within 3.2 percent of the mean value. The rates of sampling for the three tests were within the specified limits of the isokinetic rate, the greatest deviation being 6.4 percent.

The calculated front-half and back-half emissions (pounds per hour), of particulates from the three tests showed a range of +13.8 percent to -18.7 percent variation from the mean value.

DESCRIPTION OF PROCESS OPERATION

At General Chemical's Green River Soda Ash Operation, an electrostatic precipitator is used to limit point source emissions from the GR-3-D #1 Calciner.

Ore is fed into the calciner via a conveyor belt from storage silos. The ore is rotated through a kiln where heating, drying and chemical conversion takes place. Exhaust gases are drawn through the calciner, up through cyclones and through the precipitator. Following the precipitator, the exhaust is emitted to the atmosphere via a stack.

DESCRIPTION OF SAMPLING LOCATION

The sampling ports are located on both circular Dryer Exhaust Stacks approximately 100 feet above the ground. The sampling was performed from two ports on the circular stacks located 42 feet 6 inches (7.1 stack diameters) downstream of the stack inlet, and 12 feet (2.0 equivalent stack diameters) upstream of the stack outlet. The area of the stack is 4072 square inches. Port and wall thickness is 6-1/2 inches.

SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used followed the procedures outlined in the "Wyoming Air Quality Standards and Regulations", Wyoming Department of Environmental Quality, 1985; and the Code of Federal Regulations, Title 40, Chapter 1, Part 60, revised July 1, 1989.

A preliminary velocity traverse was performed at each of the two ports in order to determine the uniformity of flow in the stack. Particulate samples of five-minute duration at each of six traverse points were taken from the two ports using an EPA-type, heated, stainless steel-lined probe. A total of 12 points were sampled.

Before each test, the sampling train was leak-checked at 15 inches of mercury at the nozzle. After each test, the train was again leak-checked at the nozzle at the highest recorded vacuum reading during the test. Final leak-checking was performed in order to predetermine the possibility of a diluted sample.

Before and after each test period, the pitot lines were checked for leaks under both a vacuum and pressure. Also the lines were checked for clearance and the zero manometer reading verified, before and after each test.

The emissions were calculated from gravimetric analysis using the front-half and back-half collections of the EPA-type sampling train in accordance with the EPA "New Source Performance Standards".

Orsat analysis were provided for each test using a grab-type sample.

DESCRIPTION OF TESTS

Personnel from WEST, Inc. arrived at the plant at 1300 hours on Thursday, November 2, 1989. After meeting with plant personnel, the equipment was moved onto the #2 Calciner Stack and readied for testing by 1730 hours. Testing on the #2 Calciner began at 1745 hours and continued until the completion of the Run 2 at 2120 hours. These tests were voided due to sample equipment problems. The equipment was secured for the night at 2200 hours.

Personnel from WEST, Inc. arrived at the plant at 0700 hours. The equipment was readied for testing by 0800 hours and testing began at 0813 hours. Testing continued until the completion of run 5 at 1238 hours.

The equipment was moved off the #2 Calciner and onto the #1 Calciner Stack. All of the samples, which had been recovered immediately after each test, were taken to WEST, Inc.'s laboratory in Casper for further analyses and evaluation.

Testing on the #2 Calciner at General Chemical's Soda Ash Plant located near Green River, Wyoming, was completed at 1300 hours on Friday, November 3, 1989.

James E. Meador, Jr.
Vice President

Alan D. Roylance
Manager of Operations

APPENDICES

A. Location of Sampling Points

B. Source Emission Calculations

C. Calibration of Equipment

D. Field Testing Data

E. Analytical Data

F. Plant Operational Data

G. Chain of Custody

H. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points

APPENDIX A

Location of Sampling Points

The sampling ports on the #2 Calciner are located approximately 100 feet above the ground. The sampling was performed from two ports on the circular stack located 42 feet 6 inches (7.1 stack diameters) downstream of the stack inlet, and 12 feet (2.0 equivalent stack diameters) upstream of the stack outlet. The area of the stack is 4072 square inches. The location of the sampling points were calculated as follows:

Inside Stack Diameter = 72 inches

Port and Wall Thickness = 6-1/2 inches

Point Number	Percent Diameter From Wall	Distance From Wall (inches)
1	4.4	3- 3/16
2	14.7	10- 9/16
3	29.5	21- 1/4
4	70.5	50- 3/4
5	85.3	61- 7/16
6	95.6	68-13/16

APPENDIX B

Source Emission Calculations

Nomenclature for Particulate Calculations

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_{an}	gr/dscf	g/dscm	Particulate - Probe, Cyclone and Filter
C_{ao}	gr/dscf	g/dscm	Particulate - Total
C_{at}	gr/CF @ Stack Conditions	g/m^3	Particulate - Probe, Cyclone and Filter
C_{au}	gr/CF @ Stack Conditions	g/m^3	Particulate - Total
C_{aw}	lbs/hr	kg/hr	Particulate - Probe, Cyclone and Filter
C_{ax}	lbs/hr	kg/hr	Particulate - Total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air At Sampling Point
g	32.2 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the Stack Gas by Volume

* 528° R, 29.92 "Hg (20°C, 760 mm Hg)

Symbol	English Units	Metric Units	Description
M_d			Mole Fraction of Dry Gas
mf	mg	mg	Particulate - Probe, Cyclone and Filter
M_{H_2O}	18 lb/lb-mole		Molecular Weight of Water
m_t	mg	mg	Particulate - Total
MW_{air}	lb/lb-mole	g/g-mole	Molecular Weight Of Stack Gas
MW	28.95 lb/ lb-mole		Molecular Weight Of Air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight Of Dry Stack Gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure Drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP_s	"H_2O	mm H_2O	Velocity Head of Stack Gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume At Actual Stack Conditions
Q_s	DSCFM	dscm/hr	Stack Gas Volume At 29.92 "Hg, 528°R, Dry
R	21.83 "Hg ft^3/lb-mole-°R		Universal Gas Constant

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

Symbol	English Units	Metric Units	Description
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net Time of Test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of Dry Gas Sampled @ Meter Conditions
$V_{m_{std}}$	dscf	dscm	Volume of Dry Gas Sampled @ Standard Conditions
V_s	fpm	m/sec	Stack Velocity @ Stack Conditions
V_w	ml	ml	Total water Collected in Impingers And Silica Gel
$V_{w_{gas}}$	scf	scm	Volume of Water Vapor Collected @ Standard Conditions
ρ_{air}	0.0748 lbs/ft^3		Density of Air
ρ_{H_2O}	1 g/ml		Density of Water
ρ_{man}	51.63 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Example Particulate Calculations

1. Volume of Dry Gas Sampled At Standard Conditions.*

$$V_{m_{std}} = V_m \left[\frac{T_{std}}{T_m + 460} \right] \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$V_{m_{std}} = 17.65\ V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of Water Vapor Collected At Standard Conditions.*

$$V_{w_{gas}} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S)\ \rho_{H_2O}\ R\ T_{std}}{P_{std}\ M_{H_2O}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{w_{gas}} = \text{scf} \times 0.028317 = \text{scm}$$

3. Percent Moisture in Stack Gas.

$$\%M = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \%$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

4. Mole Fraction of Dry Gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average Molecular Weight of Dry Stack Gas.

$$MW_d = \left(\%CO_2 \times \frac{44}{100}\right) + \left(\%O_2 \times \frac{32}{100}\right) + \left(\%N_2 \times \frac{28}{100}\right) + \left(\%CO \times \frac{28}{100}\right) = \text{lb/lb-mole}$$

$$= \text{g/g-mole}$$

6. Molecular Weight of Stack Gas.

$$MW = MW_d \times M_d + 18\ (1-M_d) = \frac{\text{lb}}{\text{lb-mole}} = \text{g/g-mole}$$

7. Percent Excess Air At Sampling Point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - (\%O_2) + 0.5\ (\%CO)}$$

8. Stack Pressure.

$$P_s = P_b + \frac{\text{stack pressure } "H_2O}{13.6} = "\text{Hg Absolute}$$

$$P_s = "\text{Hg Abs.} \times 25.4 = \text{mm Hg}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

9. Stack Velocity At Stack Conditions.

$$V_s = C_p\ 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P_s}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right] 1/2$$

$$V_s = 5123.8\ C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{\frac{1}{2}} \times \text{Average} \left[(\Delta P)^{\frac{1}{2}} \right] = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry Stack Gas Volume At Standard Conditions.*

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$= Q_s = \frac{0.123\ V_s \times A_s \times M_d \times P_s}{T_s + 460} = \text{DSCFM}$$

$$Q_s = \text{DSCFM} \times 1.6990 = \text{dscm/hr}$$

11. Actual Stack Gas Volume At Stack Conditions.

$$Q_a = \frac{V_s \times A_s}{144} = \text{ACFM}$$

$$Q_a = \text{ACFM} \times 1.6990 = m^3/hr$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

12. Percent Isokinetic

$$\%I = \frac{V_{m_{std}} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \times \frac{\pi D_n^2}{4}}$$

$$\%I = \frac{1039\ V_{m_{std}} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s\ D_n^2}$$

13. Particulate - Probe, Cyclone, and Filter.

$$C_{an} = \frac{m_f}{V_{m_{std}}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154\ \frac{m_f}{V_{m_{std}}} = gr/dscf$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm$$

14. Particulate - Total.

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{m_{std}}} = gr/dscf$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

15. Particulate - Probe, Cyclone, and Filter At Stack Conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{at} = gr/CF \times 2.290 = g/m^3$$

16. Particulate - Total, At Stack Conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{au} = gr/CF \times 2.290 = g/m^3$$

17. Particulate - Probe, Cyclone, and Filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = lbs/hr$$

$$C_{aw} = lbs/hr \times 0.4536 = kg/hr$$

18. Particulate - Total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = lbs/hr$$

$$C_{ax} = lbs/hr \times 0.4536 = kg/hr$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

GENERAL CHEMICAL
SODA ASH PLANT
GREEN RIVER, WYOMING
STACK EMISSIONS SURVEY

NOVEMBER 1989

FILE NUMBEWR 8910-175

SOURCE EMISSION CALCULATIONS

Symbol	Description	Units	CAL. #2	CAL. #2	CAL. #2
Run No.			3	4	5
Date			11/03/89	11/03/89	11/03/89
Begin			0813 MST	1006 MST	1136 MST
End			0917 MST	1108 MST	1238 MST
Pb	barometric pressure	"Hg Abs. (mm Hg)	23.32 592.33	23.32 592.33	23.32 592.33
Pm	orifice pressure drop	"H20 (mm H20)	1.23 31.22	1.32 33.55	1.33 33.76
Vm	volume dry gas sampled @ meter conditions	cu. ft. (cu. m.)	44.554 1.262	46.993 1.331	46.803 1.325
Tm	avg. gas meter temp	deg. F (deg. C)	94 35	97 36	99 37
Vmstd	volume dry gas sampled @ standard conditions*	dscf (dscm)	33.215 .941	34.852 .987	34.611 .980
Vw	total H20 collected, impingers & silica gel	ml	308.0	318.0	333.7
Vwgas	volume water vapor collected @ standard conditions*	scf (scm)	14.538 .412	15.010 .425	15.751 .446
%M	moisture in stack gas by volume	%	30.44	30.10	31.27

* 68 deg. F., 29.92 "Hg (20 deg. C., 760 mm Hg)

Source Emission Calculations

GENERAL CHEMICAL
FILE NUMBER 8910-175

Symbol	Description	Units	CAL. #2	CAL. #2	CAL. #2
Run No.			3	4	5
Md	mole fraction of dry gas	-------	.6956	.6990	.6873
CO2		%	13.0	13.2	11.0
O2		%	10.0	9.0	11.4
N2		%	77.0	77.8	77.6
%EA	excess air @ sampling point	%	96	77	124
MWd	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	30.48 30.48	30.47 30.47	30.22 30.22
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	26.68 26.68	26.72 26.72	26.40 26.40
dP's	velocity head of stack gas	"H2O (mm H2O)	.939 23.85	1.034 26.27	1.049 26.65
Ts	stack temperature	deg. F (deg. C)	417 214	418 215	418 214
Ps	stack pressure	"Hg Abs. (mm Hg)	23.24 590.27	23.24 590.27	23.24 590.27
Vs	stack velocity @ stack conditions	fpm (m/sec)	4885 24.81	5125 26.03	5191 26.37
As	stack area	sq. in. (sq. met.)	4072 2.63	4072 2.63	4072 2.63
Qs	dry stack volume @ standard conditions*	DSCFM (dscm/hr)	45093 76612.21	47472 80655.25	47299 80361.75
Qa	actual stack gas volume @ stack conditions	ACFM (cu.m./hr)	138128 234678.79	144913 246207.30	146793 249401.95

* 68 deg. F., 29.92 "Hg (20 deg. C., 760 mm Hg)

Source Emission Calculations

GENERAL CHEMICAL
FILE NUMBER 8910-175

Symbol	Description	Units	CAL. #2	CAL. #2	CAL. #2
Run No.			3	4	5
Tt	net time of test	min.	60	60	60
Dn	sampling nozzle diameter	in. (m)	.245 .006	.245 .006	.245 .006
%I	percent isokinetic	%	106.43	106.08	105.73
mf	particulate - probe, cyclone and filter	mg	84.1	117.4	107.8
mt	particulate - total	mg	125.0	170.3	156.8
Can	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	.0390 .0893	.0519 .1188	.0480 .1098
Cao	particulate - total	gr/dscf* (g/dscm)	.0580 .1327	.0752 .1723	.0698 .1598
Cat	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/cu.m.)	.0127 .0290	.0169 .0388	.0154 .0353
Cau	particulate - total @ stack conditions	gr/cf (g/cu.m.)	.0189 .0432	.0246 .0563	.0224 .0513
Caw	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	15.069 6.835	21.105 9.573	19.443 8.819
Cax	particulate - total	lbs/hr (kg/hr)	22.397 10.159	30.614 13.887	28.280 12.828

* 68 deg. F., 29.92 "Hg (20 deg. C., 760 mm Hg)

APPENDIX C

Calibration of Equipment

APPENDIX C

Calibration Data

July 19, 1989

DRY GAS METERS

Unit Number	Calibration Factor
1	1.028
2	1.024
3	1.068
4	1.011

APPENDIX C

Calibration Data

July 18, 1989

NOZZLES

Set A

Nozzle No.	Diameter (inches)
1A	MIA
2A	0.227
3A	0.253
4A	0.321
5A	0.359
6A	0.378
7A	0.446
8A	0.500
9A	0.499
10A	0.576

Set B

Nozzle No.	Diameter (inches)
1B	0.130
2B	0.178
3B	0.239
4B	0.306
5B	0.358
6B	0.366
7B	0.501

Set I

Nozzle No.	Diameter (inches)
I-1	0.130
I-2	0.195
I-3	0.245
I-4	0.310
I-5	0.371
I-6	0.417
I-7	0.488
I-8	0.565
I-9	0.614

Set II

Nozzle No.	Diameter (inches)
II-1	0.123
II-2	0.192
II-3	0.253
II-4	0.312
II-5	0.376
II-6	0.435
II-7	0.496
II-8	0.561
II-9	0.609

Set III

Nozzle No.	Diameter (inches)
III-1	0.130
III-2	0.180
III-3	0.246
III-4	0.369
III-5	0.367
III-6	0.429
III-7	0.500
III-8	0.558
III-9	0.611

APPENDIX C

Calibration Data

July 19, 1989

PITOT TUBES

Pitot Length (effective length)	Calibration Factor	Pitot Length (effective length)	Calibration Factor
		122-1	High 0.823 Low 0.822
32-1	High 0.833 Low 0.831	128-1	High 0.823 Low 0.821
32-2	High 0.834 Low 0.831	132-1	High 0.822 Low 0.821
46-1	High 0.817 Low 0.818	132-2	High 0.820 Low 0.823
49-1	High 0.814 Low 0.812		
49-3	High 0.821 Low 0.821		
73-1	High 0.828 Low 0.824		
74-1	High 0.820 Low 0.822		
96-1	High 0.828 Low 0.822		

APPENDIX D

Field Testing Data

Job No. [illegible] Part. FIELD DATA

Job Name General Chemical

Run No. 3

Location Calciner #2

Date 11-3-89

Operator Rasmussen / Hettinger

Sample Box No. 6 Meter Box No. 4

Read and Record at the Start of Each Test Point. A B C

Nomograph Setting ΔP — ΔH —

Ambient Temp. °F 87°

Assumed Moisture % 30

Probe Length 7'

Pitot Tube Leak Check Before: OKAY / After: OKAY

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 15.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
		ΔPs		Pm			Ts						1.35
A-6	0813	327.995	0.85	1.15	1.15	2.5	414	247	251	65	92	92	
5	0818	331.36	1.0	1.35	1.35	3.0	414	254	257	56	93	92	
4	0823	335.19	1.1	1.5	1.5	3.5	415	257	259	62	94	92	
3	0828	339.17	0.99	1.3	1.3	3.0	416	258	257	65	95	93	1.3
2	0833	343.01	1.0	1.30	1.3	3.0	418	253	254	66	96	93	
1	0838	346.78	0.93	1.2	1.2	3.0	417	249	251	68	97	93	
END 1	0843	350.486	—	—	—	—	—	—	—	—	—	—	
B-6	0847	350.486	0.84	1.1	1.1	2.5	417	240	246	68	96	93	
5	0852	353.56	1.05	1.35	1.35	3.0	417	250	245	67	96	93	1.33
4	0857	357.49	0.95	1.2	1.2	3.0	419	251	246	67	97	93	
3	0902	361.28	0.84	1.1	1.1	2.5	420	258	246	64	98	93	1.32
2	0907	364.96	0.85	1.1	1.1	2.5	420	258	246	63	98	93	
1	0912	368.54	0.87	1.1	1.1	2.5	417	249	245	64	98	93	1.3
END All	0917	372.064	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.828 Pitot Tube No. 96-1

Volume Collected V_m 44.554 ft^3 %CO_2 13.0 %CO 0.0

Water Collected V_w 207.0 ml %O_2 10.0 %N_2 77.0

Time of Test T_t 60 min Area Stack A_2 4072 in^2

Baro. Press. P_b 23.32 "Hg Stack Press. -1.10 in. H_2O

Sample Purge: Initial — Final —

Probe Tip No. I-3 Probe Tip Dia. 0.245 in

V_m = Dry Gas Meter Calibration Factor 1.011 X 44.06

Dry Gas Meter Reading ____ ft^3 - (T_t ____ min x Leak Rate ____ cfm

M_F = 84.1 M_T = 125.0

IMPINGER CATCH

SAMPLE NO. 3

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)
1	D.I.	100	m-d.f.	Final 720.6 Initial 568.1 Wt. Gain 202.5
2	D.I.	100	G.Smith	Final 656.5 Initial 580.0 Wt. Gain 76.5
3	Dry	-	modif.	Final 478.3 Initial 468.1 Wt. Gain 10.2
4	silica gel	-	modif.	Final 763.7 Initial 744.9 Wt. Gain 18.8
5				Final Initial Wt. Gain
6				Final Initial Wt. Gain
Flask	0			Final Initial Wt. Gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 308.0

DATE: 11-3-89

SIGNATURE: Michael E. Reynolds

ORSAT ANALYSIS RESULTS
Gas Fractional Part

CO_2 13.0

O_2 10.0

CO 0.0

N_2 77.0

SIGNATURE: Michael E. Reynolds DATE: 11-3-89

TIME: 0900

Job No. 175 Part FIELD DATA

Job Name General Chemical

Run No. 4

Location Caleiner #2

Date 11-3-84

Operator Rasmussen / Hettinger

Sample Box No. 4 Meter Box No. 4

Read and Record at the Start of Each Test Point.

Nomograph Setting ΔP — ΔH —

Ambient Temp. °F 92°

Assumed Moisture % 30

Probe Length 7'

Pitot Tube Leak Check Before: OKAY / After: OKAY

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 15.0 "Hg = 0.000 cfm

ΔPs Pm Ts Tm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
													1.3
B-6	1005	372.843	0.96	1.25	1.25	3.5	415	238	260	68	97	97	
-5	1011	376.54	1.1	1.40	1.40	4.0	417	245	259	61	97	96	
4	1016	380.55	1.2	1.55	1.55	4.5	417	255	240	59	97	96	
3	1021	384.72	1.1	1.4	1.4	4.0	418	254	241	62	98	95	
2	1026	388.81	1.1	1.4	1.4	4.0	419	252	246	66	99	95	1.25
1	1031	392.89	1.05	1.3	1.3	4.0	418	246	252	68	100	95	
END	1036	396.82	—	—	—	—	—	—	—	—	—	—	
A-6	1038	396.82	0.80	1.03	1.03	2.5	418	244	250	68	99	95	
5	1043	399.79	1.05	1.3	1.3	3.5	417	247	260	65	99	95	1.3
4	1048	403.55	1.1	1.4	1.4	4.0	417	255	263	63	100	95	
3	1053	407.61	1.05	1.35	1.35	4.0	420	255	264	63	101	95	
2	1058	411.59	1.0	1.3	1.3	4.0	422	246	261	64	101	95	
1	1103	415.52	0.90	1.2	1.2	4.0	421	248	256	65	102	96	
END all	1108	419.325	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.828 Pitot Tube No. 96-1

Volume Collected V_m 46.993 ft^3 %CO_2 13.2 %CO 0.0

Water Collected V_w 518.0 ml %O_2 9.0 %N_2 77.8

Time of Test T_t 60 min Area Stack A_2 4072 in^2

Baro. Press. P_b 23.32 "Hg Stack Press. -1.10 in. H_2O

Sample Purge: Initial — Final —

Probe Tip No. I-3 Probe Tip Dia. 0.245 in

V_m = Dry Gas Meter Calibration Factor 1.011 X 46.483

Dry Gas Meter Reading ____ ft^3 - (T_t ____ min x Leak Rate ____ cfm)

M_F = 117.4 M_I = 170.3

IMPINGER CATCH

SAMPLE NO. 4

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)
1	D.I.	100	M-d.f.	Final 933.6 Initial 598.7 Wt. Gain 234.3
2	D.I.	100	G.Smith	Final 612.7 Initial 547.6 Wt. Gain 65.1
3	Dry	-	modif.	Final 512.2 Initial 505.9 Wt. Gain 6.3
4	silica gel	-	modif.	Final 804.2 Initial 791.9 Wt. Gain 12.3
5				Final Initial Wt. Gain
6				Final Initial Wt. Gain
Flask	0			Final Initial Wt. Gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 318.0

DATE: 11-3-89

SIGNATURE: Michael C. Reynolds

ORSAT ANALYSIS RESULTS
Gas Fractional Part

CO_2 13.2

O_2 9.0

CO 0.0

N_2 77.8

SIGNATURE: Michael C. Reynolds DATE: 11-3-89

TIME: 1050

Job No. 175 Part FIELD DATA

Job Name Gen Chem

Run No. 5

Location Calciner #2

Date 11-3-89

Operator Rasmussen / Hoffinger

Sample Box No. 5 Meter Box No. 4

Read and Record at the Start of Each Test Point. A/B

Nomograph Setting ΔP ___ ΔH ___

Ambient Temp. °F 100

Assumed Moisture % 30

Probe Length 7'

Pitot Tube Leak Check Before Okay / After Okay

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 8.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔPs	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge Pm	Stack Temp °F Ts	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
A-6	1136	419.631	0.95	1.2	1.2	3.0	417	238	240	68	100	100	1.3
5	1141	422.96	1.1	1.4	1.4	3.5	419	245	238	64	99	98	
4	1146	426.87	1.2	1.55	1.55	4.0	420	269	245	60	99	97	
3	1151	431.09	1.15	1.5	1.5	4.0	419	255	243	62	100	97	
2	1156	435.28	1.05	1.35	1.35	4.0	417	246	245	67	101	97	
1	1201	439.29	1.05	1.35	1.35	4.0	415	250	246	68	101	97	
GNV	1206	443.291	—	—	—	—	—	—	—	—	—	—	1.25
B-6	1208	443.291	0.81	1.0	1.0	3.0	417	238	249	68	100	96	
5	1213	446.47	1.1	1.4	1.4	4.0	415	260	253	65	101	97	
4	1218	450.41	1.15	1.4	1.4	4.0	417	264	256	65	101	97	
3	1223	454.43	1.1	1.4	1.4	4.0	419	267	259	65	101	97	
2	1228	458.47	1.05	1.3	1.3	4.0	420	254	257	66	102	97	
1	1233	462.32	0.88	1.1	1.1	3.5	420	246	253	68	102	97	
END GN	1238	465.925	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.828 Pitot Tube No. 96-1

Volume Collected V_m 46.803 ft^3 %CO_2 11.0 %CO 0.0

Water Collected V_w 333.7 ml %O_2 11.4 %N_2 77.6

Time of Test T_t 60 min Area Stack A_2 4072 in^2

Baro. Press. P_b 23.32 "Hg Stack Press. -1.1 in. H_2O

Sample Purge: Initial ___ Final ___

Probe Tip No. I-3 Probe Tip Dia. 0.245 in

V_m = Dry Gas Meter Calibration Factor 1.011 X 46.294

Dry Gas Meter Reading ___ ft^3 - (T_t ___ min x Leak Rate ___ cfm

M_F = 107.8 M_T = 156.8

IMPINGER CATCH

SAMPLE NO. 5

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)
1	D.I.	100	Modif.	Final 838.7 Initial 594.8 Wt. Gain 243.9
2	D.I.	100	G.Smith	Final 648.0 Initial 577.0 Wt. Gain 71.0
3	Dry	-	modif.	Final 479.6 Initial 472.6 Wt. Gain 7.0
4	silicagel	-	modif.	Final 799.1 Initial 787.3 Wt. Gain 11.8
5				Final Initial Wt. Gain
6				Final Initial Wt. Gain
Flask	0			Final Initial Wt. Gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 333.7

DATE: 11-3-89

SIGNATURE: Michael E. Reynolds

ORSAT ANALYSIS RESULTS
Gas Fractional Part

CO_2 11.0

O_2 11.4

CO 0.0

N_2 77.6

SIGNATURE: Michael E. Reynolds DATE: 11-3-89

TIME: 1220

APPENDIX E

Analytical Data

WEST, Inc.

PARTICULATE ANALYSIS

Date 11-17-89

Job No. 8910-175

Name General Chemical

Location Calciner # 2

Run No. 3

Filter No. R-394 | Front Wash 375 ml | ~~Impinger 1~~ Back Water 650 ml | ~~Impinger 2~~ Back Wash 50 ml

	Filter	Front Wash	Impinger 1	Impinger 2
Final	0.7352	101.9506	95.0399	109.7411
Initial	0.6828	101.9174	95.0102	109.7285
	0.0524 = 52.4	0.0332 = 33.2	0.0297 = 29.7	0.0126 = 12.6
		− 1.5 Blank	− 1.1 Blank	− 0.3 Blank
		31.7	28.6	12.3

MF 84.1 mg MT 125.0 mg

Run No. 4

Filter No. R-395 | Front Wash 425 ml | ~~Impinger 1~~ Back Water 600 ml | ~~Impinger 2~~ Back Wash 75 ml

	Filter	Front Wash	Impinger 1	Impinger 2
Final	0.7398	101.8431	96.6490	107.0794
Initial	0.6730	101.7908	96.6194	107.0546
	0.0668 = 66.8	0.0523 = 52.3	0.0296 = 29.6	0.0248 = 24.8
		− 1.7 Blank	− 1.1 Blank	− 0.4 Blank
		50.6	28.5	24.4

MF 117.4 mg MT 170.3 mg

Run No. 5

Filter No. R-396 | Front Wash 525 ml | ~~Impinger 1~~ Back Water 625 ml | ~~Impinger 2~~ Back Wash 50 ml

	Filter	Front Wash	Impinger 1	Impinger 2
Final	0.7381	99.2212	98.6146	114.2090
Initial	0.6700	97.1794	98.5841	114.1890
	0.0681 = 68.1	0.0418 = 41.8	0.0305 = 30.5	0.0200 = 20.0
		− 2.1 Blank	− 1.1 Blank	− 0.4 Blank
		39.7	29.4	19.6

MF 107.8 mg MT 156.8 mg

Acetone Blank:

Volume 200 ml | Final 106.0116 | Initial 106.0108 | 0.0008

Blank: 0.004 mg/ml Total Weight 0.8 mg

D.I. Water Blank

Volume 200 ml | Final 100.5279 | Initial 100.5268 | 0.0011

Blank: 0.0055 mg/ml Total Weight 1.1 mg

APPENDIX E

Plant Operational Data

Operations Summary - GR-3-E #2 Calciner
Emission Tests of 11/03/89

Process Data - Mean Values

	Stack Temp., deg. C	Ore Temp., deg. C	Feed Rate, tons/hr **	Gas Usage, MMBTU/HR
Test #3	227	157	130	142.1
Test #4	225	175	130	144.9
Test #5	229	194	130	149.9

Screen Fractions
Feed Ore

	+1/2	+3/8	+1/4	+8M	-8M
Test #3	9.0	26.2	34.3	15.0	15.5
Test #4	8.8	24.5	27.1	17.1	22.5
Test #5	5.8	19.8	30.0	22.7	21.7

Bicarbonate Analyses - Discharge Ore

	% NaHCO3	% NaOH
Test #3	0	0.04
Test #4	0	0.43
Test #5	0	0.30

** Rate represents average rate for unit, maximum rates are approximately 135 - 140 tph. Operating rates are variable depending on ore sizing, associated bicarbonate residuals, and ore availability

Precipitator Summary - GR-3-E #2 Calciner

Mean Values

		Volts, A.C.	Milliamps, D.C.	Amps, A.C.
Test #3				
	Inlet	248	85	21
	Center	309	875	141
	Outlet	260	970	147
Test #4				
	Inlet	248	75	19
	Center	332	870	142
	Outlet	263	970	147
Test #5				
	Inlet	240	85	14
	Center	323	875	142
	Outlet	260	970	147

2 CALCINER
COMPLIANCE TEST NO. 1

DATE 891103
RT TIME 08:14
D TIME 09:18

	% Opacity
	9.4
	10.2
	9.6
	18.3
	21.7
	12.6
	11.3
	11.8
	10.2
	10.7
	10.4
	12.1
	9.5
	11.2
	18.5
	11.1
	10.3
	10.2
	11.1
	15.7
	9.5
	10.1
	9.4
	10.8
	14.2
	16.5
	11.4
	9.2
	8.4
	9.5
	8.4
	10.0
	9.0
	10.4
	9.2
	17.0
	9.6
	10.2
	8.9
	9.6
	8.9
	9.9
	8.2
	9.8
	8.7
	16.3
	13.1
	10.5
	9.1
	14.0
	8.7
	9.1
	8.8
	10.7
	8.7
	9.7
	15.4
	8.6
	8.0
	9.2
	8.1
	8.2
	8.1
NO. of SAMPLES	63
MEAN	11.0
STD. DEV.	2.9
COEFF. VAR.	26.5

2 CALCINER
COMPLIANCE TEST NO. 2

DATE 891103
START TIME 10:07
END TIME 11:09

% Opacity
8.8
10.8
9.6
11.6
9.6
8.7
9.7
15.8
9.3
9.4
8.4
9.8
8.5
9.5
9.1
9.7
8.9
21.5
11.1
11.4
8.8
9.3
8.8
9.9
8.1
10.1
8.7
16.8
13.4
9.2
8.7
9.9
8.4
9.2
8.9
7.9
7.6
8.5
18.2
12.3
9.1
10.2
8.8
10.2
8.9
9.5
8.7
8.9
10.3
12.7
8.2
8.3
7.9
9.5
7.8
8.5
8.1
13.6
7.8
20.1
9.1
10.9
8.5
NO. of SAMPLES 63
MEAN 10.0
STD. DEV. 2.8
COEFF. VAR. 28.5

2 CALCINER
COMPLIANCE TEST NO. 3

DATE 891103
START TIME 11:37
END TIME 12:39

	% Opacity
	13.1
	13.1
	9.4
	11.2
	10.2
	8.2
	8.0
	9.3
	8.0
	9.7
	8.7
	23.5
	11.2
	10.1
	9.9
	9.3
	9.0
	9.5
	8.3
	9.9
	8.0
	15.2
	11.2
	11.7
	9.5
	9.7
	8.9
	15.3
	9.3
	10.5
	9.5
	11.9
	23.6
	12.3
	12.0
	9.3
	8.7
	10.4
	9.2
	9.3
	9.6
	10.4
	15.0
	11.8
	9.6
	10.2
	10.3
	10.1
	9.6
	10.6
	8.4
	10.3
	8.7
	20.8
	9.6
	10.2
	8.9
	14.4
	8.1
	8.5
	8.2
	9.8
	8.3
NO. of SAMPLES	63
MEAN	11.0
STD. DEV.	3.2
COEFF. VAR.	29.2

APPENDIX G

Chain of Custody
and
Analyses Request

WESTERN ENVIRONMENTAL SERVICES AND TESTING, INC.

Chain of Custody and Analysis Request

Job Number 8910-105 Date(s) Sampled 11-3-89

Job Name General Chemical Number of Runs 3

Source Location Green River, WY

Unit Tested Calciner #2

Absorbing Solution/Analysis For

Run	Filter Number	Imp 1	Imp 2	Imp 3	Imp 4	Probe Wash
#3	R-394	D.I. / moist.	D.I. / moist.	Dry / moist.	Silicagel / moist.	Acetone / Particulates
#4	R-395	"	"	"	"	"
#5	R-396	"	"	"	"	"
4						

No_x: _____

Other _____

Total Number of Sample Bottles: 11

Total Number of Filters: 3

Comments: _____

Person Responsible for Samples: Michael C. Reynolds

Sample No.	Recovered by	Date	Time	Location
#3	Michael C. Reynolds	11-3-89	0930	On site
#4	Michael C. Reynolds	11-3-89	1115	On site
#5	Michael C. Reynolds	11-3-89	1250	On site
4				

Samples Received By Michael C. Reynolds for transport Date: 11-3-89 Time: 1830

Samples Received at Lab by Alan O. Roylance Date: 11-6-89 Time: 0800

Samples Analyzed by Alan O. Roylance Date: 11-17-89 Time: —

4/85

APPENDIX H

Resumes of Test Personnel

MICHAEL E. REYNOLDS

CURRENT: 04/03/89 to present	Senior Technician, Western Environmental Services and Testing, Inc., Casper, Wyoming, and Beaumont, Texas; an environmental monitoring and consulting firm.
PROFESSIONAL: 05/88 to 04/89	Downhole Surveyor, Scientific Drilling International, Casper, Wyoming
11/86 to04/88	Contract Sample Catcher, Exploration Logging, Houston, Texas
06/81 to 09/86 (summers)	Partner, Custom Contract Haying, Glenrock, Wyoming
05/80 to 01/81	Laborer, Lower and Company, Inc., Casper, Wyoming
05/79 to 09/79	Laborer, Lower and Company, Inc., Casper, Wyoming
06/78 to 09/78	Roustabout, Thatcher and Sons, Inc., Casper, Wyoming
EDUCATION:	South Dakota School of Mines and Technology, Mining Engineering, 09/78 to 5/80
	University of Wyoming, Laramie, Undergraduate business courses consistent with M.B.A. program
	B.S. Petroleum Engineering, 12/83

TECHNICAL EXPERIENCE:

NIELS L. RASMUSSEN

CURRENT: 07/17/89 to present	Senior Technician, Western Environmental Services and Testing, Inc., Casper, Wyoming, and Evanston, Wyoming; an environmental monitoring and consulting firm.
PROFESSIONAL: 06/80 to 07/89	Logging Geologist, Exlog Central Area, Houston, Texas
Summer 1979	Thatcher and Sons, Glenrock, Wyoming
Summer 1978	Blackhills Bentonite, Casper, Wyoming
EDUCATION:	Exlog Oil Field Familiarization School, Houston Texas
	Bachelor of Science in Geology, University of Wyoming, Laramie, Wyoming, May 1980
	Associate Arts in Liberal Arts, Eastern Wyoming College, Torrington, Wyoming, May 1977
TECHNICAL EXPERIENCE:	Assisted in over 50 source emissions surveys and the maintenance of various ambient air networks, run various methods for sample analyses in the laboratory

MEMORANDUM

To: General Chemical Compliance File

Through: C.A. Collins, Administrator CAC
Bernie Dailey, Engineering Supervisor

From: D.J. Olson, Compliance Officer

Date: 12/06/89

Subject: Stack Test Analysis for Calciners
GR-3-D and GR-3-E.

On November 3, 1989, General Chemical performed compliance tests on the GR-3-D and GR-3-E Calciner stacks to test for particulate emission levels in response to an order from the Administrator on September 7, 1989. The report transmitting the results of these tests was received by the Division on November 29, 1989.

Lee Gribovicz was on site to observe the testing effort, but equipment problems delayed the test until the following day and he was unable to observe the actual tests. He did however review the test procedures and specify some required data to be taken.

The tests were conducted in accordance with Reference Methods 1-5 for particulate. The sampling location was 7.1 stack diameters downstream of the stack inlet and 2 stack diameters upstream of the stack outlet, about 100 feet above ground. Particulate samples of 5 minute duration were taken at a total of 12 points. The process rate during the tests was 92-99% of design.

The raw test data included with the report was reviewed and independently analyzed for comparision with the results obtained by WEST, Inc., the testing firm. Some typographical errors and minor variations in calculations were noted which did not significantly affect the calculations. The results are summarized below and included as attachments to this memorandum.

EMISSIONS (lb/hr)

Source	WEST, Inc	AQD	Allowable
GR-3-D	29.47	29.52	37.9
GR-3-E	29.10	27.06	37.9

The Administrator's September 7, 1989, order also required General Chemical to certify the opacity monitors which were in existence on the stacks and to begin submitting quarterly CEM reports in accordance with Section 23 of the WAQSR. Certification for these monitors was accomplished on October 24-31, 1989. During these compliance tests the monitors recorded an average opacity of 13.3% for GR-3-D and 10.7% for GR-3-E.

The results of this testing effort indicate that the Calciners were operating in compliance with all applicable standards and regulation at the time of the test. These tests should be taken as proof of compliance for these sources.

cc: Lee Gribovicz

CAC/DO:mw

STACK TEST CALCULATIONS

SOURCE: GENERAL CHEMICAL COMPANY, CALCINER #1 (GR-3-D)

TESTED BY: REYNOLDS AND RASMUSSEN
WESTERN ENVIRONMENTAL SERVICES AND TESTING

DATE TESTED: 11/03/89

OBSERVED BY: LEE GRIBOVICZ

EVALUATED BY: DAN OLSON

	TEST #1	TEST #2	TEST #3
AMBIENT PRESSURE (in Hg)	2.332E+01	2.332E+01	2.332E+01
ABS. STACK GAS PRESSURE (in Hg)	2.329E+01	2.329E+01	2.329E+01
ABS. AVE. STACK GAS TEMP (*R)	8.810E+02	8.815E+02	8.822E+02
ABS. AVE. DGM TEMP (*R)	5.575E+02	5.589E+02	5.600E+02
TOT. VOL. H2O COLLECTED (ml)	3.495E+02	3.389E+02	3.397E+02
VOL. THRU DGM (ft3)	4.210E+01	4.167E+01	4.154E+01
AVE. DEL P ACROSS ORIFICE (in H2O)	1.090E+00	1.044E+00	1.008E+00
PITOT TUBE COEFFICIENT	8.280E-01	8.280E-01	8.280E-01
AVE. VEL. HEAD OF STACK GAS (in H2O)	9.430E-01	9.570E-01	9.550E-01
STD VOL. SAMPLED (scf)	3.117E+01	3.077E+01	3.061E+01
H2O VAPOR IN GAS @STP (ft3)	1.645E+01	1.595E+01	1.599E+01
MOL. WT. WET (lb/lb mole)	2.621E+01	2.629E+01	2.616E+01
MOL. WT. DRY (lb/lb mole)	3.054E+01	3.059E+01	3.042E+01
VEL. STACK GAS (fps)	8.019E+01	8.127E+01	8.133E+01
FLOW RATE, DRY @ STP (scfm)	4.155E+04	4.234E+04	4.223E+04
CONCENTRATION (gr/scf)	7.861E-02	8.043E-02	8.665E-02
CONCENTRATION (lb/scf)	1.123E-05	1.149E-05	1.238E-05
EMISSION RATE (lb/hr)	2.800E+01	2.919E+01	3.137E+01
% ISOKINETIC	1.082E+02	1.048E+02	1.046E+02

acfm = Velocity (fps) × 60 × Stack diameter (ft^2)

80.19 × 60 × 28.28 = 136,066
81.27 × 60 × 28.28 = 138,663
81.33 × 60 × 28.28 = 138,001

412,730 / 3 = 137,577 avg acfm

Average Emission Rate - 29.52 lb/hr.

Opacity During Tests - 13.3%

Process Rate - 120 TPH

General Chemical Co.
Calciner # 1 GR-3-D
11/3/89
West, INC

DAO 12/5/8

Data Sheet

P_{std} = 29.92 in Hg

T_{std} = 530° R

			Test 1	Test 2	Test 3
P_{bar}	=	barometric pressure at site (in Hg)	23.32	23.32	23.32
P_s	=	absolute stack gas pressure (in Hg)	23.29	23.29	23.29
T_s	=	absolute average stack gas temp. (°R)	881	881.5	882.2
T_m	=	absolute average dry gas meter temp. (°R)	557.5	558.9	560.0
V_{ic}	=	total volume of water collected (ml)	349.5	338.9	339.7
V_m	=	volume of gas through dry gas meter (ft^3)	42.10	41.674	41.537
ΔH	=	average pressure drop across orifice (in H_2O)	1.09	1.044	1.008
C_p	=	pitot tube coefficient	0.828	0.828	0.828
$(\sqrt{\Delta p})_{ave}$	=	average velocity head of stack gas (in H_2O)	0.943	0.957	0.955
A_s	=	cross-sectional area of stack (ft^2)	28.28	28.28	28.28
M_n	=	total amount of particulate collected (g)	.1589	.1605	.1720
θ	=	total sampling time (min.)	60	60	60
A_n	=	cross-sectional area of nozzle (ft^2)	3.27×10^{-4} →		

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	13.6	14.0	12.8
% O_2	9.0	8.8	9.4
% CO	0.0	0.0	0.0
% N_2	77.4	77.2	77.8

STACK TEST CALCULATIONS

SOURCE: GENERAL CHEMICAL COMPANY, CALCINER #2 (GR-3-E)

TESTED BY: REYNOLDS AND RASMUSSEN
WESTERN ENVIRONMENTAL SERVICES AND TESTING

DATE TESTED: 11/03/89

OBSERVED BY: LEE GRIBOVICZ

EVALUATED BY: DAN OLSON

	TEST #1	TEST #2	TEST #3
AMBIENT PRESSURE (in Hg)	2.332E+01	2.332E+01	2.332E+01
ABS. STACK GAS PRESSURE (in Hg)	2.324E+01	2.324E+01	2.324E+01
ABS. AVE. STACK GAS TEMP (*R)	8.770E+02	8.783E+02	8.779E+02
ABS. AVE. DGM TEMP (*R)	5.543E+02	5.573E+02	5.589E+02
TOT. VOL. H2O COLLECTED (ml)	3.080E+02	3.180E+02	3.337E+02
VOL. THRU DGM (ft3)	4.455E+01	4.699E+01	4.680E+01
AVE. DEL P ACROSS ORIFICE (in H2O)	1.229E+00	1.321E+00	1.329E+00
PITOT TUBE COEFFICIENT	8.280E-01	8.280E-01	8.280E-01
AVE. VEL. HEAD OF STACK GAS (in H2O)	9.620E-01	1.016E+00	1.023E+00
STD VOL. SAMPLED (scf)	3.319E+01	3.483E+01	3.459E+01
H2O VAPOR IN GAS @STP (ft3)	1.450E+01	1.497E+01	1.571E+01
MOL. WT. WET (lb/lb mole)	2.669E+01	2.672E+01	2.640E+01
MOL. WT. DRY (lb/lb mole)	3.048E+01	3.047E+01	3.022E+01
VEL. STACK GAS (fps)	8.097E+01	8.552E+01	8.661E+01
FLOW RATE, DRY @ STP (scfm)	4.472E+04	4.739E+04	4.721E+04
CONCENTRATION (gr/scf)	5.807E-02	7.540E-02	6.990E-02
CONCENTRATION (lb/scf)	8.296E-06	1.077E-05	9.986E-06
EMISSION RATE (lb/hr)	2.226E+01	3.063E+01	2.829E+01
% ISOKINETIC	1.071E+02	1.060E+02	1.057E+02

acfm = vel stack gas (ft/s) × 60 × Stack diameter (ft²)

80.97 × 60 × 28.28 = 137,310
85.52 × 60 × 28.28 = 145,110
86.61 × 60 × 28.28 = 146,960

429,460 / 3 = 143,153
avg acfm

Average Emission Rate - 27.06 lb/hr

Opacity During Tests - 10.7%

Process Rate - 130 TPH

DAO 12/5/89

General Chemical Co.
Calciner #2 GR-3-E
11/3/89
West, Inc

Data Sheet

P_{std} = 29.92 in Hg

T_{std} = 530° R

			Test 1	Test 2	Test 3
P_{bar}	=	barometric pressure at site (in Hg)	23.32	23.32	23.32
P_s	=	absolute stack gas pressure (in Hg)	23.24	23.24	23.24
T_s	=	absolute average stack gas temp. (°R)	877	878.3	877.9
T_m	=	absolute average dry gas meter temp. (°R)	554.3	557.3	558.9
V_{ic}	=	total volume of water collected (ml)	308.0	318.0	333.7
V_m	=	volume of gas through dry gas meter (ft^3)	44.534	46.993	46.803
ΔH	=	average pressure drop across orifice (in H_2O)	1.229	1.321	1.329
C_p	=	pitot tube coefficient	0.828	0.828	0.828
$(\sqrt{\Delta p})_{ave}$	=	average velocity head of stack gas (in H_2O)	0.962	1.016	1.023
A_s	=	cross-sectional area of stack (ft^2)	28.28	28.28	28.28
M_n	=	total amount of particulate collected (g)	.1250	.1703	.1568
θ	=	total sampling time (min.)	60	60	60
A_n	=	cross-sectional area of nozzle (ft^2)	3.27×10^{-4}	→	→

Orsat Analysis

	Test 1	Test 2	Test 3
% CO_2	13.0	13.2	11.0
% O_2	16.0	9.0	11.4
% CO	0.0	0.0	0.0
% N_2	71.0	77.8	77.6