BR 2.2

#32

4.0

RECON SYSTEMS, INC.

51 FIFTH STREET, P.O. BOX 842
Somerville, New Jersey 08876
201-685-0440

STACK SAMPLING REPORT

For

NICHOLS ENGINEERING & RESEARCH CORPORATION

Homestead & Willow Roads
Belle Mead, NJ 08502

Source Tested:

Municipal Sewage Sludge Incinerator #1
Scrubber Outlet (Stack)
Providence, R.I.

In Fulfillment of Purchase Order No. CE-1271-914

November 11, 1980

SYSTEMS
RESOURCE & ENVIRONMENT CONSERVATION

RECON SYSTEMS, INC.
51 Fifth Street, P.O. Box 842
Somerville, N. J. 08876
201-685-0440

STACK SAMPLING REPORT FOR

NICHOLS ENGINEERING & RESEARCH CORPORATION

On Incinerator #1
Providence, R.I.

INTRODUCTION

The above referenced stack was sampled for particulate emissions on September 30, 1980 to October 2, 1980. This report contains the following information.

SUMMARY

This testing appears to indicate the furnace tested is not in compliance with 1.3 lbs/dry ton emission standard:

Test No.	2	3	4
Grains/dscf	0.0231	0.0399	0.0295
Pounds/dry ton	2.43	4.12	3.04

Test No. 1 was abandoned because of excessive flaking of the stack wall material. An analysis of the relative catches in the test train lead us to believe this may have been a major factor even in tests 2-4:

% of particulate caught in nozzle and probe	43.0	53.6	49.5

Typically a sludge incinerator with scrubber (in this case 25"ΔP) would emit particulate of which only 10% would be caught in nozzle and probe.

Samples from this project will be retained for sixty days from the date of this report unless otherwise directed.

This report is submitted by

Richard F. Toro

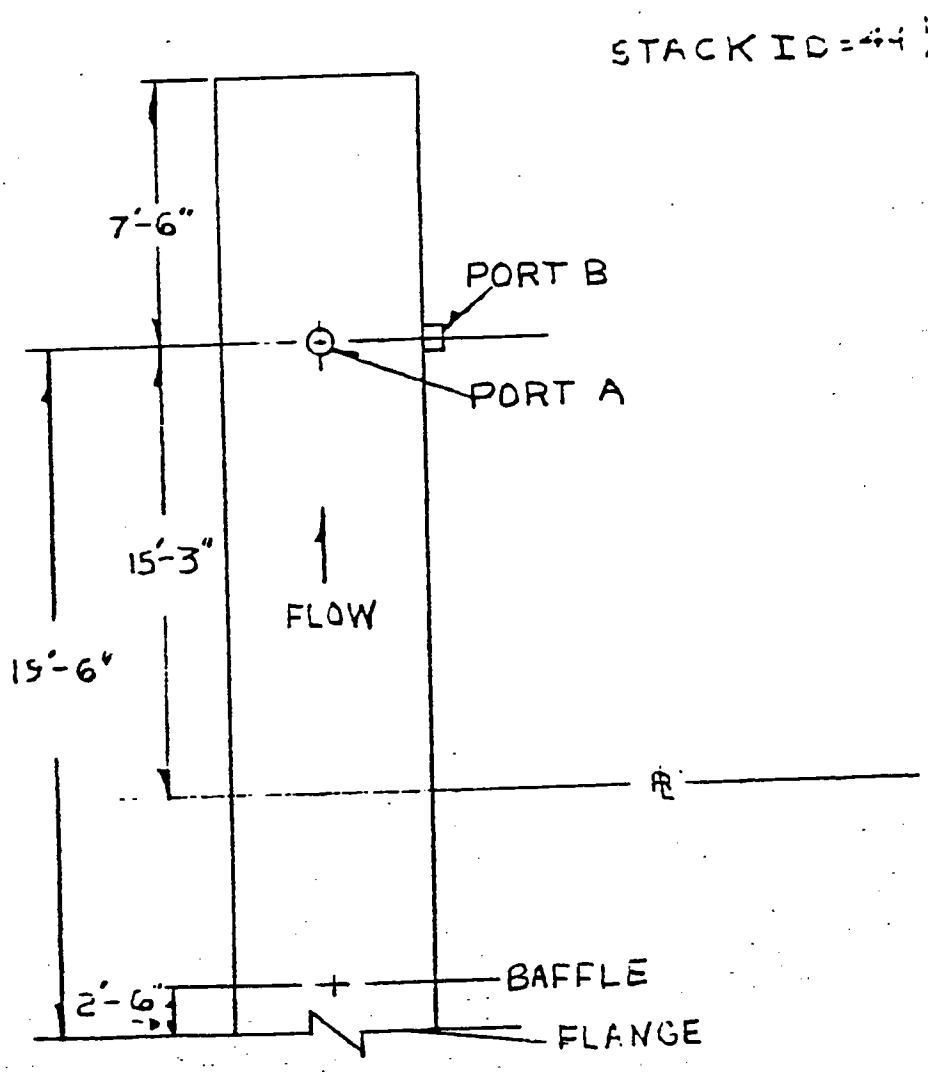
Richard F. Toro
Vice President

I am in responsible charge of RECON's stack test work, and have discussed and reviewed the procedures and results of this set of tests with the relevant field and laboratory personnel.

Norman J. Weinstein, P.E.
State of New Jersey
License No. 19536

SAMPLING LOCATION

INCINERATOR #1, SCRUBBER OUTLET



NO SCALE

RECON SYSTEM INC.
FWS 8-28-80

VELOCITY AND FLOW RATE DATA

Sample No.	1	2	3	4
Date	9/30/80	10/1/80	10/1/80	10/2/80
Time	1138-1336	0952-1140	1330-1528	1028-1249
Stack Diameter (in)	44.5			
Stack Cross Section (sq ft)	10.8			
Barometric ("Hg)	29.95	30.00	30.00	29.92
Average Stack Temperature (^{o}F)	--	108	113	107
Stack Pressure ("H_2O-gage)	--	-0.2	-0.2	-0.4
Moisture (% vol)	--	6.5	5.5	6.3
Average Velocity (ft/sec)	--	37.96	38.44	38.59
Average Velocity (ft/min)	--	2280	2310	2320
Actual Flow Rate (acfm)	--	24,600	24,900	25,000
Standard Flow Rate (scfm)	--	23,000	23,100	23,300
Dry Standard Flow Rate (dscfm)	--	21,500	21,800	21,900

Note - Run #1 Abandoned because of excessive flaking of stack material.

Standard Conditions are 70^{o}F, 29.92 "Hg.

STACK GAS COMPOSITION

Sample No.	1	2	3	4
Date	9/30/80	10/1/80	10/1/80	10/2/80
Time	1138-1336	0952-1140	1330-1528	1028-1249
% By Volume (Dry Basis)				
CO_2	4.5	5.5	6.7	6.0
CO	--	--	--	--
O_2	15.0	14.8	14.0	14.0
N_2 (by Difference)	80.5	79.7	79.3	80.0

PARTICULATE EMISSIONS

Sample No.	1	2	3	4
Date	9/30/80	10/1/80	10/1/80	10/2/80
Time	1138-1336	0952-1140	1330-1528	1028-1249
Sampling Data				
Nozzle Size (in)	1/4----------			
No. Of Sampling Points	44----------			
Sampling Time (min)	88----------			
Sample Volume (dscf)	--	50.0	57.8	57.0
% Isokinetic	--	84	95	94
Emissions Data				
Front Half Catch				
Grains/dscf	--	0.0231	0.399 (0.0399 per raw data in app)	0.0295
Pound/hour	--	4.26	7.45	5.53
Pounds/dry ton	--	2.43	4.12	3.04

Note - Run #1 Abandoned because of excessive flaking of stack material.

PROCESS INFORMATION

Feed Rates

Test No.	2	3	4
Date	10/1/80	10/1/80	10/2/80
Time	0952-1140	1330-1528	1028-1249
Average Sludge Feed Rate, wet tons per hour	7.43	7.44	7.91
% Sludge Solids	23.6	24.3	23.0
Sludge feed rate, dry tons per hour	1.75	1.81	1.82

Sludge Composition

% solids	23.6	24.3	23.0	spec says
% moisture	76.4 < 78	75.7 < 78	77.0 = 77% to 78%	(75% acc.)
	100.0	100.0	100.0	(150-2)
% ash (dry basis)	44.8	50.0	44.8	
% combustibles (dry basis)	55.2	50.0	55.2	
	100.0	100.0	100.0	
Heating value, btu/lb dry solids	6,200	5,730	6,050	
Heating value, btu/lb dry combustibles	11,200	11,500	11,000	— 11000 Btu (spec)
Hexane extractables, % of dry solids	Results to Follow			

PROCESS INFORMATION (con't)

An ultimate analysis showed:

% C	34.31
H	5.39
N	2.56
S	1.03
Cl	1.83

Ash Analysis

% moisture
% combustibles — Results to Follow
% ash

Nichols

Subsidiary of
Neptune International Corp.

To: Recon Systems.

Date: Oct. 6, 1980

From: Tom Delaney

Subject: Data for furnace emission tests.

Job: Providence, R. I. CE-1271

Enclosed you'll find data taken during the furnace emission tests on Oct. 1, 1980, and Oct. 2, 1980.

Respectfully,

Tom Delaney

WEIGHT SCALE READINGS FOR TEST #1 AND #2 ON 10/1/80

WEIGHT SCALE READINGS	DIFF	AVERAGE TONS PER HOUR	TIME	
000000			8:00 AM	
000162	1.62	6.48	8:15	
000276	1.14	4.56	8:30	
000495	2.19	8.76	8:45	
000685	1.90	7.60	9:00	
000871	1.86	7.44	9:15	
001098	2.27	9.08	9:30	
001265	1.67	6.68	9:45	
001438	1.73	6.92	10:00	
001623	1.85	7.40	10:15	
001816	1.93	7.72	10:30	
002004	1.88	7.52	10:45	9.43 T/H
002202	1.98	7.92	11:00	
002393	1.91	7.64	11:15	
002580	1.87	7.48	11:30	
002769	1.89	7.56	11:45	
002948	1.79	7.16	12:00 PM	
003138	1.90	7.60	12:15	
003340	2.02	8.08	12:30	
003498	1.58	6.32	12:45	
003665	1.67	6.68	1:00	
003849	1.79	7.16	1:15	
004027	1.83	7.32	1:30	
004205	1.78	7.12	1:45	
004348	1.43	5.72	2:00	
004563	2.15	8.60	2:15	
004763	2.00	8.00	2:30	7.44 T/H
004961	1.98	7.92	2:45	
005158	1.97	7.88	3:00	
005352	1.94	7.76	3:15	
005521	1.69	6.67	3:30	

WEIGHT SCALE READINGS FOR TEST #3 ON 10/2/80

WEIGHT SCALE READS	DIFF.	AVERAGE TONS PER HOUR	TIME
0 0 0 0 0 0			8 00 AM
0 0 0 1 1 0 2	1.02	4.08	8 15
0 0 0 2 2 6 6	1.64	6.56	8 30
0 0 0 4 6 2	1.96	7.84	8 45
0 0 0 6 4 7	1.85	7.40	9 00
0 0 0 9 1 2	2.65	10.60	9 15
0 0 1 1 1 3	2.01	8.04	9 30
0 0 1 3 0 9	1.96	7.84	9 45
0 0 1 5 0 7	1.98	7.92	10 00
0 0 1 7 2 0	2.13	8.52	10 15
0 0 1 9 2 6	2.06	8.24	10 30
0 0 2 1 3 1	2.05	8.20	10 45
0 0 2 3 5 3	2.22	8.88	11 00
0 0 2 5 9 1	1.88	7.52	11 15
0 0 2 7 2 5	1.84	7.36	11 30
0 0 2 9 3 1	2.06	8.24	11 45
0 0 3 1 1 2	1.81	7.24	12 00 PM
0 0 3 3 0 8	1.96	7.76	12 15
0 0 3 5 1 7	2.11	8.44	12 30
0 0 3 6 9 8	1.81	7.24	1 00

DATA SHEET FOR SCRUBBER FLOWS AND I.D. FAN AMPS. CE-121 PROVIDENCE R.I.

TIME	I.D. FAN AMP'S	VENTURI DIFF	SCRUBBER DIFF.	WEIR Flow G.P.M	WEIR+SPRAY Flow G.P.M	SCRUBBER Flow G.P.M
10 AM	70-72	26"	5-6"	270	480	1200
11 AM	70-72	26-27"	5-6"	270	480	1300
12 P.M.	72-74	26-27"	5-6"	270	470	1300
1:30 P.M	72-74	26-27"	5-6"	260	470	1300
2:30 P.M	72	26-27"	5-6"	250	470	1300
2:5 AM	74	26-27"	5-6"	260	460	1280
2:5 AM	72-74	25-26"	5-6"	260	470	1280
2:25 PM	72-74	25-26"	5-6"	250	465	1300

DATA SHEET FOR SCRUBBER
AND I.D. FAN AMPS.

DATE	TEST #	TIME	I.D. FAN AMP'S	VENTURI DIFF	SCRU DIF
10/1/80	1	10 AM	70-72	26"	5-
10/1/80	1	11 AM	70-72	26-27"	5-
10/1/80	2	1:30 P.M.	72-74	26-27"	5-6
10/1/80	2	2:30 P.M	72-74	26-27"	5-6
10/1/80	2	3:30 P.M	72	26-27"	5-6
10/2/80	3	10:25 AM	74	26-27"	5-6
10/2/80	3	11:25 AM	72-74	25-26"	5-6
10/2/80	3	12:25 PM	72-74	25-26"	5-6

R.I. CE-1271

R SDW. 137 SEWAGE DISPOSAL WORKS

P-10	P-11	P-12	DRAFT FD	GL	BP	FLU	BTM	OIL BURNERS VD	5	7	9	FUEL OIL IN	OUT	FLO	
			—	08	—	10	24	24	3	1	—	450	304	54	
			—	08	—	16	24	26	3	1	—	—	553	54	
			—	08	—	10	24	26	3	1	—	—	616	58	
			—	08	—	10	24	26	3	1	—	—	6745	6	
			—	08	—	10	24	26	3	1	—	—	728	56	
			—	08	—	10	24	26	3	1	—	—	786	58	
			—	08	—	16	24	26	3	1	—	—	843	56	
			—	08	—	16	24	26	3	1	—	—	893	56	
[illegible]	[illegible]	110	—	08	—	10	24	24	3	2	—	—	173	77	
[illegible]	[illegible]	110	—	10	—	18	24	27	4	3	3	—	2179	119	
[illegible]	[illegible]	110	—	10	—	18	24	25	2	2	3	—	270	181	
[illegible]	[illegible]	110	—	10	—	10	16	16	2	2	3	—	467	197	
[illegible]	[illegible]	110	—	44	—	20	20	16	2	2	3	—	663	195	
1160	200	110	—	46	—	24	22	10	2	2	3	—	843	180	
1130	200	110	—	46	—	22	24	10	2	2	3	—	034	192	
1160	210	110	—	46	—	24	24	0	2	2	3	—	[illegible]	166	
1170	210	110	—	46	—	24	23	26	2	2	3	—	378	178	
1170	220	120	—	46	—	22	21	26	2	2	3	—	538	160	

OPERATOR: [illegible] FOREMAN: [illegible]

OPERATOR: [illegible] FOREMAN: [illegible]

OPERATOR: [illegible] FOREMAN: [illegible]

TOTALIZER START: _____

TOTALIZER END: _____

SLUDGE INC. _____ LBS.

LIQUIDOMETER START: _____

LIQUIDOMETER END: _____

OIL USED: _____ GALS.

FEED TO FURNACE: ____ HRS.

REMARKS: _____

#2

#3

	OIL	TONS	STICK
11/7	442	0	56½"
7/3	1307	43	-13"
3/11			

PROVIDENCE R.I. CE-1271

DATE: 9/30 to 10/1 19 86 SLUDGE INCINERATOR SDW. 1ST SEWA

TIME	UNIT NO.	SLUDGE WGT. METER	TON	TEMPERATURES P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	DRAFT FD	G.L	BP	FLU	STK	OIL VO	OIL SU
11PM				START-UP AT 1300°												—	08	—	10	24	24	3
12				"							"					—	08	—	16	24	26	3
1				"							"					—	08	—	10	24	26	3
2				"							"					—	08	—	10	24	26	3
3				"							"					—	08	—	16	24	26	3
4				"							"					—	08	—	10	24	26	3
5				"							"					—	08	—	16	24	26	3
6				"							"					—	08	—	16	24	26	3
7AM	34			960	1060	1120	1180	1300	920	800	340	110	200	200	110	—	09	—	10	24	22	3
8				800	960	1100	1140	1280	880	720	350	160	1040	220	110	—	10	—	18	24	22	4
9		0700	7	760	720	820	940	1300	980	820	460	160	1060	200	110	—	20	—	18	24	24	2
10		1400	7	700	760	920	980	1360	1080	860	530	200	1100	210	110	—	38	—	10	18	18	2
11		2200	8	720	760	920	940	1120	1240	1000	500	200	1120	—	110	—	44	—	22	22	18	2
12		2900	7	720	780	820	960	1340	1560	760	740	210	1160	200	110	—	46	—	24	22	20	2
1		3600	7	720	780	920	980	1300	1500	820	820	210	1120	200	110	—	46	—	22	24	18	2
2		4300	7	720	760	910	980	1260	1600	840	640	240	1160	210	110	—	44	—	24	20	20	2
3PM		4900	7	750	770	940	960	1360	1520	870	680	220	1170	210	110	—	46	—	24	23	26	2
4		5800	9	750	770	920	950	1330	1520	830	580	230	1170	220	120	—	46	—	22	21	26	2
5																						
6																						
7																						
8																						
9																						
10																						

Heath #9

CE-1611.

R . . SDW. 157 SEWAGE DISPOSAL WORKS

P-10	P-11	P-12	DRAFT FD	DRAFT		DRAFT	DRAFT	OIL BURNERS				FUEL OIL IN	FUEL OIL OUT	FUEL OIL	
			-	06	-	16	24	26	3	1	-	815	857	42	
			-	06	-	16	24	26	3	1	-	-	893	36	
			-	06	-	16	22	25	3	1	-	-	936	43	
			-	06	-	16	24	18	3	1	-	-	980	44	
			-	06	-	10	22	17	3	1	-	-	1036	48	
			-	06	-	10	22	17	3	1	-	-	1078	42	
			-	06	-	10	22	17	3	1	-	-	1097	19	
			-	30	42	10	24	-	3	1	-	-	1176	41	
			-	30	44	10	24	-	3	1	-	-	1215	45	
130	220	110	-	20	98	12	24	24	3	2	3	-	1285	70	
140	220	120	-	40	98	24	26	26	3	2	3	-	1478	193	
140	200	110	-	40	98	16	24	25	3	2	3	-	1687	209	
140	200	120	-	38	98	10	26	26	-	2	3	-	1998	311	
120	200	120	-	36	98	10	06	25	-	2	3	-	2068	70	
60	210	120		20	98	20	22	25	-	2	3	-	2265	197	

OPERATOR: Jarvis FOREMAN: Cicero

OPERATOR: FOREMAN:

OPERATOR: FOREMAN:

TOTALIZER START: _____

TOTALIZER END: _____

SLUDGE INC. _____ LBS.

LIQUIDOMETER START: _____

LIQUIDOMETER END: _____

OIL USED: _____ GALS.

FEED TO FURNACE: ___ HRS.

REMARKS: _____

Shut down ID fan at 5:30 AM. Trouble with scrubber pump.

4 20

OIL TONS STICK

366 0 56"

106

DATE: [illegible] 19 [illegible] SLUDGE INCINERATOR SDW. 137 SEWAGE D

TIME	UNIT NO.	SLUDGE WGT. METER	SLUDGE WGT. TON	TEMPERATURES P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	DRAFT FD	I.D.	AP	FL	ISH	OIL BURNERS 4	5	7	1
11PM				5	[illegible]	[illegible]	[illegible]	[illegible]								-	06	-	16	24	26	3	1	
12				"				"								-	06	-	16	24	26	3	1	
1				"				"								-	06	-	16	22	26	3	1	
2				"				"								-	06	-	16	24	18	3	1	
3				"				"								-	06	-	10	22	17	3	1	
4				"				"								-	06	-	10	22	17	3	1	
5				"		"		"								-	06	-	10	22	17	3	1	
6				"				"								-	30	+2	10	24	-	3	1	
7A.M.																-	30	44	10	24	-	3	1	
8				530	1000	1100	1140	1390	920	[illegible]	360	140	980	220	110	-	20	98	12	24	24	3	2	
9		0600	6	620	740	835	1020	1220	1160	820	360	140	1140	220	120	-	40	98	32	26	26	3	2	
10		1500	9	670	730	880	960	1380	1580	840	780	360	1140	200	110	-	40	98	16	84	25	3	2	
11		0300	8	700	740	900	960	1440	1560	850	820	320	1140	200	120	-	38	98	10	06	26	-	2	
12		1800	8	760	770	942	760	1420	1600	860	780	340	1120	200	120	-	36	98	10	06	25	-	2	
1		2900	8	800	750	780	980	1540	1620	880	780	280	1160	210	120		20	98	20	[illegible]	[illegible]	-	2	
2																								
3PM																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								

high Temp

STACK TESTING PROCEDURES CHECKLIST

Particulate Emissions:
- ✓ US EPA 5
- ___ US EPA 17
- ___ N.J. Method ___
- ___ Plus impinger catch
- ___ Plus aqueous and organic impinger catch
- ___ Other: _____

Velocity:
- ___ Standard pitot tube and manometer
- ✓ "S" pitot tube and manometer
- ___ Other: _____

Temperature:
- ✓ thermocouple
- ___ temperature gage
- ___ process indicator

Gas Composition:
- ✓ onsite fyrite
- ___ grab sample and lab orsat
- ___ integrated sample and lab orsat
- ___ integrated and traversed sample and lab orsat
- ___ Other: _____

Particle Sizing:
- ___ instack cascade impactor
- ___ heated out of stack cascade impactor
- ___ plus impinger catch
- ___ plus aqueous and organic impinger catch

Sulfur Oxide Emissions:
- ___ US EPA 6
- ___ US EPA 8
- ___ Controlled condensation for SO_3
- ___ US EPA 6__ or 8__ combined with US EPA 5__ or 17___ or particle sizing ___

Nitrogen Oxide Emissions:
- ___ US EPA 7
- ___ Chemiluminescent monitor

Hydrocarbon Emissions:
- ___ N.J. Method ___
- ___ RECON Method 2
- ___ Integrated gas bag direct and lab GC
- ___ Grab sample gas bag direct and lab GC
- ___ Onsite GC direct

Metal Emissions:
- ___ AA determination on filter and probe wash
- ___ AA determination on impinger catch

Comments:

SELECTED NOMENCLATURE

Time = military time

min = minutes

^{o}F = degrees Fahrenheit

^{o}C = degrees Centigrade

"H_2O = inches water (pressure or vacuum)

"Hg = inches mercury (pressure or vacuum)

mm Hg = millimeters of mercury (pressure or vacuum)

psig = pounds of pressure per square inch-gage

sq ft = square feet

in = inches

micron = 10^{-6} meters

ft/sec = feet per second

ft/min = feet per minute

acfm = cubic feet per minute of total gas flow at flowing conditions

scfm = cubic feet per minute of total gas flow at $70^{o}F$, 29.92"Hg

dscfm = cubic feet per minute of dry gas (excluding water) flow at $70^{o}F$, 29.92"Hg

dscf = cubic feet of dry gas (excluding water) at $70^{o}F$, 29.92"Hg

lb/hr = pounds per hour

lb/hour = pounds per hour

BTU/hr = British thermal units per hour

% = volume per cent when referred to gases and water vapor

% vol = volume per cent

% wgt = weight percent

ppmv = volumes of gaseous contaminants per million volumes of total gas

grains = grams x 15.4

μg = micrograms = 10^{-6} grams

mg = milligrams = 10^{-3} grams

grains/dscf = grains of pollutants per cubic foot of dry stack gas at 70°F, 29.92"Hg

gr/dscf = grains/dscf

$\mu g/m^3$ = micrograms of pollutants per cubic meter of total stack gas at 25°C, 760 mm Hg

mg/l = milligrams/liter of liquid = ppm by weight if specific gravity of liquid = 1.0

C = elemental carbon

CO = carbon monoxide

CO_2 = carbon dioxide

H = elemental hydrogen

H_2 = molecular hydrogen

H_2O = water

N = elemental nitrogen

N_2 = molecular nitrogen

NO_x = NO + NO_2 = nitric oxide plus nitrogen dioxide reported as equivalent nitrogen dioxide

S = elemental sulfur

SO_2 = sulfur dioxide

SO_3 = sulfur trioxide

SO_4 = sulfate

H_2SO_4 = sulfuric acid

H_2S = hydrogen sulfide

Cl = elemental chlorine or chloride

HCl = hydrogen chloride

F = fluoride, reported as HF (hydrogen fluoride)

CH_4 = methane

O = elemental oxygen

O_2 = molecular oxygen

A = argon

$<$ = less than; represents the minimum detectability limits

$\leq$ = equal to or less than

ND = none detected--minimum detectable limit

Front half (dry catch) particulate = particulate matter collected in/on nozzle, probe, cyclone, flask, heated hose, and filter of EPA sampling train

Back half (wet catch) particulate = material collected in impingers after filter of EPA sampling train

Organic wet catch = residue after low temperature ($70^{\circ}F$) evaporation of ether/chloroform used to extract soluble materials from the wet catch

Aqueous wet catch = residue after high temperature ($220^{\circ}F$) evaporation of water left after ether/chloroform extraction

Combustibles = volatiles = loss on heating @ $550^{\circ}C$ after drying @ $110^{\circ}C$

Ash = residue after heating @ $550^{\circ}C$

COPIES OF ORIGINAL DATA AND CALCULATION SHEETS

RECON SYSTEMS, INC.
51 Fifth Street, P.O. Box 842
Somerville, N. J. 08876
201-685-0440
POLLUTION CONTROL SYSTEMS
PHYSICAL & ENGINEERING CONSULTING

PARTICULATE
STACK SAMPLING DATA BOOK

COMPANY Nichols

RECON JOB NO. 1363

JOBSITE ADDRESS Providence R.I.

SAMPLING DATE(S) 9/30/83 etc

CONTACT

SAMPLING TEAM

PHONE

STACK(S) SAMPLED Incin #1

OPERATING CONDITIONS normal

1629

same as previously listed

Traverse Points
For Circular Stacks

See EPA Method 1 for determining the number of points to be sampled on each traverse. Circle this number and the entire column below it.

Location of traverse points in circular stacks

100 K_1 = (Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.5	
6			95.6	89.6	65.8	35.5	26.9	22.0	18.8	16.5		
7				89.5	77.4	64.5	36.6	28.3				
8				96.7	85.4		63.4	37.5				
9					91.8		73.1	62.5				
10					97.5		79.9	71.7				
11												
12						97.9	90.1	83.1	78.4			
13							94.3				.5	40.2
14											3.9	62.7
15											8.2	82.5
16											82.0	77.0
17									95.6	90.3	85.1	80.6
18									98.6	93.3	88.4	83.5
19										96.1	91.3	86.8
20										98.7	94.5	89.5
21											96.5	92.1
22											98.9	94.5
23												96.5
24												98.9

Use this and the following page for each probe marking.

Nozzle Areas (ft^2) = A_n

1/8" = $0.851(10^{-4})$ 3/8" = $7.65(10^{-4})$

3/16" = $1.92(10^{-4})$ 1/2" = $13.6(10^{-4})$

1/4" = $3.41(10^{-4})$

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Probe Markings - Circular

Stack I.D. @ Port 44 1/2 inches Port Extension 2 1/4 inches

Right most column is the distance from probe tip to outside of port extension.

Traverse Point Number	Length Factor from Previous Page, K_L	Product of length factor times stack inside diameter (inches) K_L x (stack ID)	Sum of previous column and port extension (inches) K_L x (stack ID) + port extension	Convert previous column to inches and common fractions
		.49 = 1	3 1/4	3 1/4
1	.011	1.56	3.81	3 13/16
2	.035	2.67	4.92	4 15/16
3	.060	3.87	6.12	6 1/8
4	.087	5.16	7.41	7 7/16
5	.116	6.50	8.75	8 3/4
6	.146	8.01	10.26	10 1/4
7	.180	9.70	11.95	12
8	.218	11.66	13.91	13 15/16
9	.262	14.02	16.27	16 1/4
10	.315	17.49	19.74	19 3/4
11	.393	27.01	29.26	29 1/4
12	.607	30.48	32.73	32 3/4
13	.695	32.84	35.09	35 1/16
14	.738	34.71	36.96	37
15	.782	36.49	38.74	38 3/4
16	.820	38.00	40.25	40 1/4
17	.857	39.34	41.59	41 9/16
18	.884	40.63	42.88	42 7/8
19	.913	41.93	44.08	44 1/16
20	.940	42.94	45.19	45 3/16
21	.965	44.01 = 43.5	45.75	45 3/4
22	.989			
23				
24				

Stack cross sectional area = csa = $\frac{0.785}{144}(ID)^2 = \frac{ID^2}{183.4}$ = 10.797 ft^2

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Pos T, B

Pos A TEMP °C	α	ΔP in H_2O	Pos T, B TEMP °C	α
	+ 17	.10		
	+ 6	.11		+ 5
	+ 3	.11		+ 13
	+ 5	.12		+ 5
46	+ 9	.14		+ 7
	+ 9	.16		+ 16
	+ 8	.15		+ 0
46	+ 10	.19		+ 2
	+ 9	.17		+ 0
	+ 14	.18		+ 3
46	+ 9	.18	102	+ 7
	+ 7	.18		+ 2
	+ 8	.15		+ 2
46	+ 14	.15	80	+ 3
	+ 7	.14	102	+ 3
	+ 18	.16		+ 9
46	+ 12	.13		+ 9
	+ 10	.10		+ 2
	+ 3	.12		+ 2
	+ 3	.11		+ 2
	+ 2	.13		+ 0
46	+ 9	.18		+ 7
		.14		4.5
8.7		6.6		

ΔP .14

Temp 80°C = or 176°F

Preliminary Data

Cp = .84

$\Delta H_@$ = 1.86

% CO_2 = x 0.44 =

% O_2 = x 0.32 =

% N_2 = x 0.28 =

Dry MW = 29.80

% H_2O = 20

P_s = 29.92 "Hg (absolute)

P_s/P_m = 1.0

T_s = 110 ~~150~~ °F

T_m = 90 °F

ΔP (average) = .14 "H_2O

$MW = 0.18(\%H_2O) + \text{Dry MW}\left(\frac{100-\%H_2O}{100}\right)$ (25,33; 15; 29.80; 15)

MW = 28.03

Nomograph C = .89 D_p = .35 " choose D = 3/8 1/4 "

Final setting ΔP = .56 @ 1.85 ΔH

Stack Velocity $V_s = 85.48(C_p)\sqrt{\frac{(T_s + 460)(\Delta P)}{(MW)(P_s)}}$

$V_s = 85.48(.84)\sqrt{\frac{(570)(.14)}{(28.03)(29.92)}}$ = 22.15 ft/sec

Meter Flow = $A_n(V_s)(60)\left(\frac{100-\%H_2O}{100}\right)\left(\frac{T_m + 460}{T_s + 460}\right)\left(\frac{P_s}{P_m}\right)$

$= (3.4)(10^{-4})(.85)(60)\left(\frac{100-90}{100}\right)\left(\frac{90 + 460}{110 + 460}\right)(1.0)$ (22.15; .85; .965)

= .372 ft^3/min

Choose 2 minutes/point x 22 points/port x 2 ports = 88 minutes(θ)

Sample volume = θ(meter flow) = .372 x 88 = 32.71 dscf

Run #1
ABANDONED
Because
OF
STACK
FLAKING

Particulate Sampling Field Data

PITOBE NO. .84

Plant Nichols Providence R.I. | Date 9-30-90 | CONSOLE NO. 1.86

Stack Scrubber OUTLET | Sample No. 1 | Box No.

Nozzle Size 1/4" | Probe Heater @ 70 | Box Heater @ — °F

Time @ Each Point (θ) 2 Min | Hose Heater @ — | @ — °F

Ambient Temperature 65 °F | Ambient Pressure (P_{bar}) 29.95 "Hg

Stack Pressure (P) -.2 "H_2O (gage) ÷ 13.6 = "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = "Hg

Dry Bulb ___ °F

Wet Bulb ___ °F ___ %H_2O

Operating Condition or Remarks

Port/ Point	Military Clock Time	Meter Reading 68.889	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F
A 1	1135	68.889	.48	1.6	62	62	11	42	242
2	1140	70.4	.50	1.65	—	—	11	44	250/64
3	42	71.8	.52	1.70	75	68	11+	45	248
4	44	73.3	.55	1.80	—	—	12+	45	235
5	46	74.6	.55	1.8	80	71	12	45	245
6	48	76.2	.56	1.85	—	—	12+	44	255
7	50	77.4	.56	1.85	93	71	12+	44	250
8	52	79.2	.54	1.8	—	—	12+	44	240
9	54	80.4	.56	1.85	95	74	12+	44	240
10	56	82.0	.53	1.75	—	—	12+	44	250/65
11	58	83.3	.53	1.75	97	75	12+	44	255
12	12:00	85.0	.46	1.52	—	—	10+	43	245
13	02	86.2	.47	1.55	87	76	10+	43	240
14	04	87.5	.45	1.50	—	—	10+	44	245
15	06	88.8	.45	1.50	89	78	10+	43	255
16	08	90.1	.40	1.35	—	—	9+	43	250
17	10	91.6	.40	1.35	91	90	9+	43	240
18	12	93.2	.35	1.18	—	—	9+	43	240
19	14	93.9	.35	1.18	93	81	8+	43	240/64
20	16	95.3	.30	.99	—	—	7+	43	250
21	18	96.3	.30	.99	93	83	7+	44	245
22	20	97.41	.30	.99	—	—	7+	44	235
END	22	98.516							
*	θ=	V=29.627	-----	ΔH=	T_m=		---	--	T_s=

* Sum, Average, or Difference

(Convert to °F)

V_m = V (DGMCF) = ( )( ) = ___ ft^3

Other Data

Time	Sample or Measurement	Value
1150	O_2	16
	CO_2	3

Leak check OK @ .015 cfm

___ % x MW/100 =

Average CO_2 = ___ x 0.44 = ___

O_2 = ___ x 0.32 = ___

N_2 = ___ x 0.28 = ___

100.0 = dry MW

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Somerville, NJ

Particulate Sampling

PITOBE NO. 67

Plant Nichols Providence R.I. | Date 9-30-80 | CONSOLE NO. 1.46
Stack Scrubber OUTLET | Sample No. 1 | Box No.
Nozzle Size 1/4 " | Probe Heater @ 70 ° | Box Heater @ °F
Time @ Each Point (θ) 2 Min | Hose Heater @ — @ °F
Ambient Temperature 70 °F | Ambient Pressure (P_{bar}) 29.45"Hg

Stack Pressure (P) -.2 "H_2O (gage) ÷ 13.6 = "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = "Hg

Operating Condition or Remarks
Ts/Tout

Dry Bulb ___ °F
Wet Bulb ___ °F ___ %H_2O

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F/°C
B 1	1201 52	98,801	.47	1.56	81	81	10+	240	38
2	54	100.2	.53	1.75	—	—	11+	255	38
3	56	101.7	.56	1.91	96	84	12+	240	42
4	58	103.3	.65	2.15	—	—	14+	240	43
5	1:00	104.5	.65	2.15	91	84	15	255	44
6	02	106.3	.72	2.35	—	—	16+	265	44
7	04	108.0	.75	2.45	93	84	17+	250	44
8	06	109.7	.70	2.30	—	—	17+	245	44
9	08	111.4	.65	2.15	95	85	16	245	44/65
10	10	112.8	.65	2.15	—	—	15+	250	44
11	12	114.6	.55	1.82	97	85	13+	245	45
12	14	116.1	.38	1.26	—	—	9+	235	45
13	16	117.1	.31	1.03	97	96	7+	240	50
14	18	118.2	.28	.93	—	—	7+	245	46/64
15	20	119.4	.30	1.0	94	88	7+	250	53
16	22	120.6	.27	.88	—	—	7	245	57
17	24	121.5	.27	.88	91	85	7+	245	61
18	26	122.7	.27	.88	—	—	7+	235	58
19	28	123.8	.30	1.0	90	88	8	245	56
20	30	124.7	.30	1.0	—	—	8+	255	55/69
21	32	125.9	.32	1.05	89	88	8+	255	55
22	34	127.0	.33	1.06	—	—	8+	240	55
END	36	128.111							
		29.310							
*	θ=	V=58.837	-----	ΔH=	T_m=		--	--	T_s=

(Convert to) °F

* Sum, Average, or Difference

V_m = V (DGMCF) = ( )( ) = ___ ft^3

Other Data

Time	Sample or Measurement	Value
Init	O_2	15
	CO_2	5.0
	EO_2	14
	CO_2	5.5

Average CO_2 = ___ % x MW/100 = ___ x 0.44 = ___

O_2 = ___ x 0.32 = ___

N_2 = ___ x 0.28 = ___

100.0 = dry MW

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PLANT Nichols - Providence RI
TEST FOR Part.
SAMPLE NO. 1 BOX NO. 1

STACK
DATE
OPERATING CONDITION

		Grams		Grams
Impinger 1	Final Weight	772.2	Impinger 1	89.6
	Initial Weight	682.6		
	Increase			
Impinger 2	Final Weight	674.7	Impinger 2	18.4
	Initial Weight	656.3		
	Increase			
Impinger 3	Final Weight	465.8	Impinger 3	5.7
	Initial Weight	463.1		
	Increase			
Silica Gel	Final Weight	829.2	Silica Gel	15.4
	Initial Weight	813.8		
	Increase			

Record Water Collected in cyclone, flash, if any:

Final Weight _____ gms

Initial Weight _____ gms

Increase _____ gms

147.5 grams

Total mass of water caught

Filter Diameter _____ inches

Filter Type _____

Filter	Final Weight	.6553
	Initial Weight	.5583
	Increase	

gram

Total mass of particulate caught on filter

Is ice present in the impinger bath at the end of this sample?

Yes ✓ No _____

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.6556
.5583
.0973

Nomograph Rest for 10% moist. + 1/4" Nozzel

Preliminary Data

C_p = _____

$\Delta H_@$ = _____

% H_2O = _____

P_s = _____ "Hg (absolute)

P_s/P_m = _____

T_s = _____ ^oF

T_m = _____ ^oF

% CO_2 = _____ x 0.44 = _____

% O_2 = _____ x 0.32 = _____

% N_2 = _____ x 0.28 = _____

Dry MW = _____

ΔP (average) = .95 "H_2O

$$MW = 0.18\ (\%H_2O) + \frac{\text{Dry MW}\ (100-\%H_2O)}{100}$$

MW = _____

Nomograph C = .94 D_p = ~~.25~~ .26", choose D = 1/4 ~~5/16~~ "

Final setting ΔP = ~~.85~~ .95 @ 1.85 ΔH

Stack Velocity $V_s = 85.48(C_p)\sqrt{\frac{(T_s + 460)(\Delta P)}{(MW)(P_s)}}$

$V_s = 85.48(\quad)\sqrt{\frac{(\quad)(\quad)}{(\quad)(\quad)}}$ = _____ ft/sec

Meter Flow = $A_n(V_s)(60)\left(\frac{100-\%H_2O}{100}\right)\left(\frac{T_m + 460}{T_s + 460}\right)\left(\frac{P_s}{P_m}\right)$

= (____)(10^{-4})(____)(60) $\left(\frac{100-}{100}\right)\left(\frac{\quad + 460}{\quad + 460}\right)\left(\quad\right)$

= ____ ft^3/min

Choose ____ minutes/point x ____ points/port x ____ ports = _____ minutes(θ)

Sample volume = θ(meter flow) = _____ x _____ = _____ dscf

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Particulate Sampling Field Data

Plant Nichols Providence R.I. | Date 10-1-90 | PITOBE NO. .83
Stack SCRUBBER OUTLET | Sample No. 2 | CONSOLE NO. 1.16
Nozzle Size 1/4 | Box No.
Time @ Each Point (θ) 2 Min | Probe Heater @ 300 | Box Heater @
Ambient Temperature 60 °F | Hose Heater @ | Ambient Pressure (P_{bar}) 29.65 "Hg

Stack Pressure (P) -.2 "H_2O (gage) ÷ 13.6 = "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = "Hg

Dry Bulb X °F
Wet Bulb X °F ~10 %H_2O estimate

Operating Condition or Remarks Readjust Nomograph T_m = 80 @ Port B C = .9 ΔP = .75

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F / °C
A 1	9:52	157.346	.46	.90	59	59	2.0	230	34 / 54
2	54	158.4	.49	.94	-	-	2	240	38
3	56	159.6	.52	1.0	60	59	2	235	41
4	58	160.6	.53	1.05	-	-	2	245	44
5	10:00	161.6	.54	1.06	62	60	2	250	44
6	02	162.7	.56	1.1	-	-	2+	250	44
7	04	163.8	.53	1.05	65	60	2	235	45
8	06	165.0	.50	.96	-	-	2	240	45
9	08	166.1	.46	.90	66	61	H	255	45
10	10	167.2	.48	.93	-	-	1+	255	46
11	12	168.1	.46	.90	70	62	H-	245	46
12	14	169.2	.38	.74	-	-	1+	240	43
13	16	170.1	.38	.74	72	64	1+	245	42 / 55
14	18	170.0	.35	.68	-	-	1+	260	42
15	20	171.9	.38	.74	74	65	1+	260	42
16	22	172.9	.35	.68	-	-	1+	250	42
17	24	173.9	.32	.63	75	63	1+	245	43
18	26	174.6	.32	.63	-	-	1+	255	43
19	28	175.6	.32	.67	75	68	1+	260	43
20	30	176.5	.29	.54	-	-	1+	255	44
21	32	177.3	.29	.56	76	69	1+	245	45
22	34	178.1	.27	.53	-	-	1+	240	45
END	10 36	178.919	—	—	—	—	—	—	—
		21.473	Port B CONTINUED NEXT PAGE						
*	θ=	V=	-----	ΔH=	T_m=		--	--	T_s=

* Sum, Average, or Difference (Convert to °F

V_m = V (DGMCF) = ( )( ) = _____ ft^3

Other Data

Time	Sample or Measurement	Value
	O_2	15.0
	CO_2	5.5

Leak Check = .018 CFM

Average CO_2 = ___ % x MW/100 = ___ x 0.44 = _____

O_2 = ___ x 0.32 = _____

N_2 = ___ x 0.28 = _____

100.0 = dry

RECON SYSTEMS, Somerville, N

Particulate Sampling Field Data

Plant Nichols R.T. | Date 10-1-90 | PITOBE NO. .83
Stack | Sample No. 2 | CONSOLE NO. 1.86
Nozzle Size "N" | Box No.
Time @ Each Point (θ) 2 Min | Probe Heater @ 80 % Box Heate
Ambient Temperature 60 °F | Hose Heater @ ——— @ ——— °F
Ambient Pressure (P_{bar}) 30.00 "Hg

Stack Pressure (P) −.2 "H_2O (gage) ÷ 13.6 = −.01 "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = 29.99 "Hg

Dry Bulb ___ °F
Wet Bulb ___ °F ___ %H_2O

Operating Condition or Remarks
C = .88 ΔP = .56

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F/°C
B 1	1056	179.098	.42	1.38	66	66	2+	250	37
2	58	180.5	.52	1.7	—	—	4+	260	35
3	11:00	181.7	.52	1.7	68	69	4+	255	41
4	02	183.4	.60	2.0	—	—	5	255	41
5	04	184.7	.58	1.95	74	68	5	245	42
6	06	186.3	.65	2.15	—	—	5	240	43
7	08	187.9	.67	2.2	69	78	5+	250	43
8	10	189.2	.67	2.2	—	—	5+	260	43
9	12	190.7	.65	2.15	80	69	5+	250	44
10	14	192.4	.60	2.0	—	—	4+	240	44
11	16	194.1	.58	1.95	81	70	4+	240	44
12	18	195.5	.35	1.15	—	—	3+	250	39
13	20	196.7	.28	.93	81	71	2+	260	41
14	22	197.7	.29	.97	—	—	2+	250	43
15	24	198.9	.25	.83	79	71	2	250	43
16	26	199.7	.27	.99	—	—	2+	240	42
17	28	200.6	.27	.99	78	71	2+	255	43
18	30	202.0	.26	.86	—	—	2+	250	43
19	32	203.0	.29	.96	76	72	2+	245	41
20	34	204.2	.29	.96	—	—	2+	240	42
21	36	205.2	.30	1.0	76	73	2+	250	43
22	38	206.1	.29	.96	—	—	2+	260	43
END	1140	207.308	—	—	—	—	—	—	—
		28.210							
		21.473							
*	θ=	V= 49.683	-----	ΔH= 1.13	T_m= 69		--	--	T_s= 100

(Convert to °F)

* Sum, Average, or Difference

V_m = V (DGMCF) = ( )(1,000) = 49.683 ft³

Other Data

Time	Sample or Measurement	Value
1110	CO_2	5.5
	O_2	14.5

Leak check Q .01

Average CO_2 = ___ % x MW/100 = ___ x 0.44 = ___
O_2 = ___ x 0.32 = ___
N_2 = ___ x 0.28 = ___
100.0 = dry MW

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PLANT _____ STACK _____
TEST FOR _____ DATE _____
SAMPLE NO. 2 BOX NO. 2 OPERATING CONDITION _____

		Grams		Grams
Impinger 1	Final Weight	812.5		
	Initial Weight	762.7		
	Increase		Impinger 1	49.8
Impinger 2	Final Weight	750.1		
	Initial Weight	739.9		
	Increase		Impinger 2	10.2
Impinger 3	Final Weight	495.3		
	Initial Weight	493.4		
	Increase		Impinger 3	1.9
Silica Gel	Final Weight	783.9		
	Initial Weight	772.2		
	Increase		Silica Gel	11.7

Record Water Collected in cyclone, flash, if any:

Final Weight _____ gms

Initial Weight _____ gms

Increase _____ gms

73.6 grams

Total mass of water caught

Filter Diameter 4 inches

Filter Type SH

Filter	Final Weight	.6040	
	Initial Weight	.5611	
	Increase		.0429 gram

Total mass of particulate caught on filter

Is ice present in the impinger bath at the end of this sample?
Yes ✓ No _____

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acetone at room temperature followed by 110°C for 1 hour
ether/chlorgform (E/C) @ room temperature
water @ 110°C
all cooled in desiccator

RECON Job No. 1363

Jobsite: Providence Client Order No.

Source Tested: Metal Analyzed For

Sample No./ID Run #2

Signature

Date

Notebook #(page #)

Acetone Washings

Gross 633.5 GMS

TOTAL SAMPLE Tare- 257.6 GMS

Net washings _____ GMS = A

AMOUNT OF SAMPLE EVAPORATED _____ GMS = B

Evap. Beaker No. ____

Gross residue 105.6972 GMS

Tare- 105.6649 GMS

Net residue .0323 GMS = C

Acetone Blank = 0.0000 GMS = D
103.4023
103.4029
~~100~~ 127.4 GMS

Corrected Net Residue

$E = (C)-(B-C)(\frac{D}{100})$

$E = \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

E = .0323 GMS

Scaled Up

$Net = (E)(\frac{A}{B})$

$= \_\_\_\_ \_\_\_\_$

= .0323 GMS

Wet Catch

Gross _____ GMS

TOTAL SAMPLE Tare- _____ GMS

Net _____ GMS = F

AMOUNT EXTRACTED _____ GMS = G

AMOUNT of E/C _____ GMS = H

Water Phase

Evap. Beaker No. ____

Gross _____ GMS

Tare- _____ GMS

Net residue _____ GMS = J

Water Blank = _____ GMS = L
100 GMS

Corrected Net Residue

$Net\ (N) = J-(G)(L)$

$N = J-(G-J)(\frac{L}{100})$

$= \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

N = _____ GMS

Scaled Up

$Net = N(\frac{F}{G})$

$= \_\_\_\_ \_\_\_\_$

= _____ GMS

E/C Phase

Evap. Beaker No. ____

Gross _____ GMS

Tare- _____ GMS

Net residue _____ GMS = K

E/C Blank = _____ GMS = M
100 GMS

Corrected Net Residue

$P = K-(H-K)(\frac{M}{100})$

$= \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

P = _____ GMS

Scaled Up

$Net = P(\frac{F}{G})$

$= \_\_\_\_ \_\_\_\_$

= _____ GMS

Form L-3

Average Velocity Pressure

PLANT _____ STACK _____ SAMPLE No. ____ FOR _____

SAMPLING DATE _____ OPERATING CONDITION _____

PORT	POINT NO.	ΔP ("H_2O)	$\sqrt{\Delta P}$

TOTAL _____ (1) _____ (2)

AVERAGE $\sqrt{\Delta P}$ = (2)/(1) = _____ = .659

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Somerville, NJ 08876

Calculations

PLANT Preliminary | STACK
TEST FOR | DATE
SAMPLE NO. 2 BOX NO. 2 | OPERATING CONDITION

$$V_{m\text{-std}} = 17.71\ (V_m)\left(\frac{P_{bar} + \Delta H/13.6}{T_m + 460}\right) = 17.71\ (49.683)\left(\frac{30.00 + \frac{1.13}{13.6}}{529}\right)$$

$= 17.71\ (\quad)(\quad) = 50.04\ ft^3$

$$V_{w\text{-std}}\ (H_2O) = \frac{\text{Grams collected}}{21.2\ \text{gram/ft}^3} = \frac{(73.6)}{(21.2)} = 3.47\ ft^3$$

$$\%\ H_2O = \frac{(V_{w\text{-std}})\ 100}{(V_{w\text{-std}}) + (V_{m\text{-std}})} = \frac{100\ (3.47)}{(3.47) + (50.04)} = \frac{(347)}{(53.51)} = 6.49\ \%$$

$$\text{Molecular Weight (MW)} = \frac{18\ (\%H_2O)}{100} + \frac{\text{Dry M.W.}\ (100 - \%\ H_2O)}{100} = .18\ (6.49) + \frac{(29.47)(93.51)}{100}$$

$= (\quad) + (\quad) = 28.73$

$$\text{Velocity (actual) in Stack} = 85.48(Cp)\sqrt{\frac{T_s + 460}{P_s(MW)}}\sqrt{\Delta P} = 85.48(.83)\sqrt{\frac{(568)}{(29.99)(28.73)}}\sqrt{\Delta P}$$

$Vs = (\quad)\sqrt{\quad}\sqrt{\Delta P} = (\quad)(\quad)\sqrt{\Delta P}$

$Vs = (\quad)\sqrt{\Delta P} = (57.61)(.659) = 37.96\ ft/sec$

$ACFM = (Vs)(60)(csa) = (37.96)(60)(10.8) = 24600$

$$\text{Velocity @ Stp}\quad Vs\text{-std} = Vs\ (17.71)\left(\frac{Ps}{Ts + 460}\right) = \frac{(37.96)(17.71)(29.99)}{(568)} = 35.50\ ft/sec$$

$SCFM = (Vs\text{-std})(csa)\ (60) = (35.50)(10.8)(60) = 23004$

$$SCFMD = \left(\frac{100 - \%H_2O}{100}\right)(SCFM) = (.9351)(23004) = 21508$$

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Somerville, NJ 08876

Calculations

PLANT _____ STACK _____
TEST FOR. _____ DATE _____
SAMPLE NO. _____ BOX NO. _____ OPERATING CONDITION _____

Nozzle Velocity

@ STD $V_n = \frac{(V_{m\text{-}std} + V_{w\text{-}std})}{60\ (\theta)\ A_n} = \frac{(53.51)}{60(\ 88\ )(3.41)(10^{-4})} = 29.72$ ft/sec

$I = \frac{100\ V_{n\text{-}STD}}{V_{s\text{-}STD}} = \frac{100\ (29.72)}{(35.50)} = 83.7$ % Isokinetic

Concentration

$C's = \frac{15.4\ (\text{grams Collected})}{V_{m\text{-}STD}} =$

For Nozzle, Probe, Acetone Washings: $\frac{15.4(.0373)}{(\ 58.04)} = 0.0099$ gr/dscf 43%

Filter: $\frac{15.4\ (.0429\ )}{(\ 58.04)} = 0.0132$ gr/dscf

Front Half Total = 0.0231 gr/dscf

For Aqueous or Total Wet Catch: $\frac{15.4\ (\quad)}{(\quad)} =$ _____ gr/dscf

For Organic Phase of Wet Catch: $\frac{15.4(\quad)}{(\quad)} =$ _____ gr/dscf.

Total Front & Wet Catches = _____ gr/dscf.

Emission Rates lb/hr = (gr/dscf)(DSCFM)(60)/7000 = 0.00857(gr/dscf)(DSCFM)

For front half total, lb/hr = 0.00857(.0231)(21508) = 4.258 lb/hr

For aqueous or total wet catch, lb/hr = 0.00857( )( ) = _____ lb/hr

For organic wet catch, lb/hr = 0.00857( )( ) = _____ lb/hr

For total front & wet catches, lb/hr = 0.00857( )( ) = _____ lb/hr

Particulate Sampling Field Data

Plant Nichols R.I
Stack
Nozzle Size 1/4 "
Time @ Each Point (θ) 2 Min
Ambient Temperature 65 °F

PITOBE NO. .83
Date 10-1-80 CONSOLE NO. 1.86
Sample No. 3 Box No.
Probe Heater @ 80 % Box Heater @ °F
Hose Heater @ — @ — °F
Ambient Pressure (P_{bar}) 30.1 "Hg

Stack Pressure (P) .2 "H_2O (gage) ÷ 13.6 = "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = "Hg

Operating Condition or Remarks

Dry Bulb X °F
Wet Bulb X °F 10 %H_2O estimate

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F/°C
A 1	1330	207.827	.52	1.7	64	64	8+	236	42
2	2	209.2	.50	1.65	—	—	8+	255	43
3	4	210.8	.58	1.9	72	69	9	240	45
4	6	211.9	.64	2.1	—	—	10+	235	45
5	8	213.6	.60	1.85	76	70	9+	240	45
6	40	215.2	.60	1.95	—	—	10	255	45
7	42	216.5	.59	1.93	77	70	10	260	46
8	44	218.1	.58	1.9	—	—	10	255	48
9	46	219.7	.53	1.75	80	71	9	245	46
10	48	221.0	.52	1.7	—	—	9	240	47
11	50	222.4	.48	1.6	90	72	9+	240	47
D	52	223.8	.40	1.3	—	—	8		44
13	54	225.3	.42	1.37	80	73	7	255	37
14	56	226.4	.40	1.3	—	—	6+	245	38
15	58	227.7	.38	1.25	90	73	6+	245	42
16	2 00	229.0	.36	1.18	—	—	6+	250	44
17	02	230.0	.34	1.12	80	74	6+	260	44
18	04	231.2	.32	1.05	—	—	6+	260	44
19	06	232.4	.30	.99	77	74	5+	250	43
20	08	233.5	.28	.92	—	—	5+	245	43
21	10	234.4	.30	.99	75	74	5+	255	45
22	12	235.4	.28	.92	—	—	5+	253	48
	14 14	236.679	—	—	—	—	—	—	—
		28.852	Run 3 continued next page						
*	θ=	V=	-----	ΔH=	T_m=		--	--	T_s=

(Convert to °F)

* Sum, Average, or Difference

V_m = V (DGMCF) = ( )( ) = _____ ft^3

Other Data

Time	Sample or Measurement	Value
1:25	CO_2	6.5
	O_2	14.6

Leak check = CFM

Average CO_2 = ___ % x MW/100 = ___ x 0.44 = _____

O_2 = ___ x 0.32 = _____

N_2 = ___ x 0.28 = _____

100.0 = dry MW

RECON SYSTEMS, INC.
Somerville, NJ

Particulate Sampling Field Data

Plant Nichols E.I.
Stack
Nozzle Size 1/4 "
Time @ Each Point (θ) 2 Min
Ambient Temperature 65 °F

PITOBE NO. .83
Date 10-1-80 CONSOLE NO. 1-86
Sample No. 3 Box No.
Probe Heater @ 50 % Box Heater
Hose Heater @ — @ — °F
Ambient Pressure (P_{bar}) — "Hg

Stack Pressure (P) -.2 "H_2O (gage) ÷ 13.6 = — "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = 29.99 "Hg

Dry Bulb — °F
Wet Bulb — °F

~~10~~ %H_2O estimate

Operating Condition or Remarks

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F / °C
B 1	1444	237.478	.54	1.8	70	70	9+	240	43
2	46	238.9	.60	1.92	—	—	10	250	43
3	48	240.0	.58	1.90	71	71	10	260	45
4	50	241.8	.64	2.1	—	—	10+	250	45
5	52	243.5	.62	2.05	76	71	10+	235	45
6	54	245.1	.67	2.2	—	—	11+	245	45
7	56	246.5	.70	2.3	79	71	11+	250	46
8	58	248.1	.67	2.2	—	—	11+	260	46
9	1500	249.9	.67	2.2	81	73	12	255	46
10	02	251.4	.65	2.15	—	—	11+	250	45
11	04	252.9	.52	1.7	45	74	9+	245	46
12	06	254.5	.34	1.12	—	—	6+	260	39
13	08	255.6	.34	1.13	86	76	6+	260	37
14	10	256.7	.27	.88	—	—	5+	255	32
15	12	257.8	.26	.92	82	78	5+	245	32
16	14	258.7	.27	.88	—	—	5+	235	37
17	16	259.9	.28	.92	80	76	5+	245	48
18	18	260.9	.28	.92	—	—	5+	260	49
19	20	262.1	.32	1.05	79	76	6+	260	58
20	22	263.4	.30	.99	—	—	6	245	55
21	24	264.3	.34	1.12	79	76	5+	245	59
22	26	265.4	.34	1.12	—	—	5+	250	64
END	28	266.570	—	—	—	—	—	—	—
		29.092	END Test						
*	θ=	V= ~~16.092~~ 57.944	-----	ΔH=1.51	T_m=	75	--	--	T_s=113

(Convert to °F)

* Sum, Average, or Difference

V_m = V (DGMCF) = ( ) (1.000) = 57.944 ft^3

Other Data

Time	Sample or Measurement	Value
	CO_2	7.0
	O_2	13.5

Leak check = .019 CFM

Average CO_2 = % / 6.75 x MW/100 = x 0.44 = 2.97

O_2 = 14.0 x 0.32 = 4.47

N_2 = 79.25 x 0.28 = 22.26

100.0 29.70 = dry MW

RECON SYSTEMS, INC.
Somerville, NJ

Water and Dry Particulate Collections

PLANT _____ STACK _____
TEST FOR _____ DATE _____
SAMPLE NO. 3 BOX NO. _____ OPERATING CONDITION _____

		Grams	Grams
Impinger 1	Final Weight	712.8	
	Initial Weight	673.2	
	Increase		Impinger 1 39.6
Impinger 2	Final Weight	658.8	
	Initial Weight	644.0	
	Increase		Impinger 2 14.8
Impinger 3	Final Weight	495.3	
	Initial Weight	493.4	
	Increase		Impinger 3 1.9
Silica Gel	Final Weight	815.4	
	Initial Weight	800.2	
	Increase		Silica Gel 15.2

Record Water Collected in cyclone, flash, if any:

Final Weight _____ gms

Initial Weight _____ gms

Increase _____ gms

71.5 grams

Total mass of water caught

Filter Diameter _____ inches

Filter Type _____

Filter	Final Weight	.7576
	Initial Weight	.6984
	Increase	

.0692 gram

Total mass of particulate caught on filter

Is ice present in the impinger bath at the end of this sample?
Yes _____ No _____

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1 hour [illegible] followed by 110°C for
ether/chloroform (E/C) @ room temperature
water @ 110°C
all cooled in desiccator

Jobsite: Providence Client Order No. [illegible]

Source Tested: _____ Metal Analyzed For _____

Sample No./ID Run #3

Signature _____

Date _____

Notebook #(page #) _____

Acetone Washings

Gross 596.3 GMS

TOTAL SAMPLE Tare- 257.0 GMS

Net washings _____ GMS = A

AMOUNT OF SAMPLE EVAPORATED _____ GMS = B

Evap. Beaker No. ____

Gross residue 104.5910 GMS

Tare- 104.5106 GMS

Net residue 0.0804 GMS = C

Acetone Blank = 0.0000 GMS / 100 GMS = D

Corrected Net Residue

$E = (C)-(B-C)(\frac{D}{100})$

$E = \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

E = _____ GMS

Scaled Up

$Net = (E)(\frac{A}{B})$

= _____ _____

= 0.0804 GMS

Wet Catch

Gross _____ GMS

TOTAL SAMPLE Tare- _____ GMS

Net _____ GMS = F

AMOUNT EXTRACTED _____ GMS = G

Water Phase

Evap. Beaker No. ____

Gross _____ GMS

Tare- _____ GMS

Net residue _____ GMS = J

Water Blank = _____ GMS / 100 GMS = L

Corrected Net Residue

$Net\ (N) = J-(G)(\frac{L}{100})$

$N = J-(G-J)(\frac{L}{100})$

$= \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

N = _____ GMS

Scaled Up

$Net = N(\frac{F}{G})$

= _____ _____

= _____ GMS

AMOUNT of E/C _____ GMS = H

E/C Phase

Evap. Beaker No. ____

Gross _____ GMS

Tare- _____ GMS

Net residue _____ GMS = K

E/C Blank = _____ GMS / 100 GMS = M

Corrected Net Residue

$P = K-(H-K)(\frac{M}{100})$

$= \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

P = _____ GMS

Scaled Up

$Net = P(\frac{F}{G})$

= _____ _____

= _____ GMS

Form L-3

Average Velocity Pressure

PLANT _____ STACK _____ SAMPLE No. ____ FOR _____

SAMPLING DATE _____ OPERATING CONDITION _____

PORT	POINT NO.	ΔP ("H_2O)	$\sqrt{\Delta P}$

TOTAL _____ (1) _____ (2)

AVERAGE $\sqrt{\Delta P}$ = (2)/(1) = _____ = .668

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Somerville, NJ 08876

Calculations

PLANT _____ STACK _____

TEST FOR _____ DATE _____

SAMPLE NO. _____ BOX NO. _____ OPERATING CONDITION _____

$$V_{m\text{-std}} = 17.71\ (V_m)\left(\frac{P_{bar} + \Delta H/13.6}{T_m + 460}\right) = 17.71\ (57.944)\left(\frac{30.00 + \frac{1.51}{13.6}}{535}\right)$$

$$= 17.71\ (\quad)(\quad) = \underline{57.76}\ ft^3$$

$$V_{w\text{-std}}\ (H_2O) = \frac{\text{Grams collected}}{21.2\ \text{gram/ft}^3} = \frac{(71.5)}{(21.2)} = \underline{3.37}\ ft^3$$

$$\%\ H_2O = \frac{(V_{w\text{-std}})\ 100}{(V_{w\text{-std}}) + (V_{m\text{-std}})} = \frac{100\ (\quad)}{(\quad)+(\quad)} = \frac{(337)}{(61.13)} = \underline{5.52}\ \%$$

$$\text{Molecular Weight (MW)} = \frac{18\ (\%H_2O)}{100} + \frac{\text{Dry M.W.}\ (100 - \%\ H_2O)}{100} = .18\ (\quad) + \frac{(\quad)(\quad)}{100}$$

$$= (\quad) + (\quad) = \underline{29.05}$$

$$\text{Velocity (actual) in Stack} = 85.48(Cp)\sqrt{\frac{T_s + 460}{P_s(MW)}}\sqrt{\Delta P} = 85.48(.83)\sqrt{\frac{(573)}{(29.94)(29.05)}}\sqrt{\Delta P}$$

$$Vs = (\quad)\sqrt{\quad}\sqrt{\Delta P} = (\quad)(\quad)\sqrt{\Delta P}$$

$$Vs = (\quad)\sqrt{\Delta P} = (57.54)(.668) = \underline{38.44}\ ft/sec$$

$$ACFM = (Vs)(60)(\text{csa}) = (38.44)(60)(10.8) = \underline{24906}$$

$$\text{Velocity @ Stp}\quad V_{s\text{-std}} = Vs\ (17.71)\left(\frac{Ps}{Ts + 460}\right) = \frac{(38.44)(17.71)(29.94)}{(573)} = \underline{35.63}\ ft/sec$$

$$SCFM = (V_{s\text{-std}})(\text{csa})\ (60) = (10.8)(35.63)(60) = \underline{23089}$$

$$SCFMD = \left(\frac{100 - \%H_2O}{100}\right)(SCFM) = (\quad)(\quad) = \underline{21814}$$

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Calculations

PLANT _____ STACK _____
TEST FOR _____ DATE _____
SAMPLE NO. _____ BOX NO. _____ OPERATING CONDITION _____

Nozzle Velocity

@ STD $V_n = \frac{(V_{m\text{-}std} + V_{w\text{-}std})}{60\ (\theta)\ A_n} = \frac{(61.13)}{60(\ 88\ )(3.41)(10^{-4})} =$ 33.95 ft/sec

$I = \frac{100\ V_{n\text{-}STD}}{V_{s\text{-}STD}} = \frac{100\ (33.95)}{(35.63)} =$ 95.3 % Isokinetic

Concentration

$C's = \frac{15.4\ (\text{grams Collected})}{V_{m\text{-}STD}} =$

For Nozzle, Probe, Acetone Washings: $\frac{15.4\ (.0804)}{(57.76)} =$ .0214 gr/dscf

Filter: $\frac{15.4\ (.0692)}{(57.76)} =$ .0185 gr/dscf

Front Half Total = 0.0399 gr/dscf

For Aqueous or Total Wet Catch: $\frac{15.4\ (\quad)}{(\quad)} =$ _____ gr/dscf

For Organic Phase of Wet Catch: $\frac{15.4(\quad)}{(\quad)} =$ _____ gr/dscf.

Total Front & Wet Catches = _____ gr/dscf.

Emission Rates lb/hr = (gr/dscf)(DSCFM)(60)/7000 = 0.00857(gr/dscf)(DSCFM)

For front half total, lb/hr = 0.00857(21814)(.0399) = 7.45 lb/hr

For aqueous or total wet catch, lb/hr = 0.00857( )( ) = _____ lb/hr

For organic wet catch, lb/hr = 0.00857( )( ) = _____ lb/hr

For total front & wet catches, lb/hr = 0.00857( )( ) = _____ lb/hr

4.45 lb/hr

Particulate Sampling Field Data

PITOBE NO. 85
CONSOLE NO 1.86

Plant Nichols Prov. R.I.
Stack Scrubbed outlet
Nozzle Size 1/4 "
Time @ Each Point (θ) 2 Min
Ambient Temperature 65 °F

Date 10-2-80
Sample No. 4 Box No.
Probe Heater @ 80 ° Box Heater @ — °F
Hose Heater @ — °F
Ambient Pressure (P_{bar}) 29.92 "Hg

Stack Pressure (P) -.24 "H_2O (gage) ÷ 13.6 = -.03 "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = 29.89 "Hg

Dry Bulb ___ °F
Wet Bulb ___ °F ___ %H_2O

Operating Condition or Remarks.

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F/°C
A 1	10:28	268.642	.38	1.24	64	64	6+	260	49
2	30	269.9	.46	1.53	—	—	6+	240	49
3	32	271.3	.5	1.65	71	67	7+	245	51
4	34	272.6	.53	1.75	—	—	7+	255	51
5	36	273.9	.52	1.75	77	68	7+	255	51
6	38	275.6	.50	1.66	—	—	7	245	52
7	40	276.8	.50	1.65	81	70	6+	245	52
8	42	278.3	.51	1.70	—	—	7+	250	50
9	44	279.8	.44	1.45	84	71	6+	260	49
10 1	46	280.9	.44	1.45	—	—	6+	260	49
11	48	282.4	.45	1.5	88	74	6+	250	47
12	50	283.6	.46	1.52	—	—	6+	245	44
13	52	284.9	.46	1.56	46	76	6+	240	41
14	54	286.4	.40	1.30	—	—	6+	265	35
15	56	287.6	.38	1.25	87	76	6+	260	37
16	58	288.8	.38	1.25	—	—	6+	255	37
17	11:00	290.2	.35	1.17	89	78	5	245	36
18	02	291.2	.32	1.05	—	—	5	250	38
19	04	292.4	.30	.99	87	79	4+	260	34
20	06	293.4	.30	.99	—	—	4+	255	33
21	08	294.7	.25	.83	94	79	4	260	32
22	10	295.7	.26	.90	—	—	4+	260	33
END	12	296.704	—	—	—	—	—	—	—
			Run # 4 continued next page						
*	θ= 44	V=28.062	-----	ΔH= 1.37	T_m=	77.3	--	--	T_s=43.4

(Convert to) °F

* Sum, Average, or Difference

V_m = V (DGMCF) = ( )( ) = ___ ft^3

Other Data

Time	Sample or Measurement	Value
	CO_2	6.5
	O_2	14.5

Average CO_2 = ___ % x MW/100 = ___ x 0.44 = ___

O_2 = ___ x 0.32 = ___

N_2 = ___ x 0.28 = ___

100.0 = dry MW

RECON SYSTEMS, INC.
Somerville, NJ

Particulate Sampling Field Data

Plant: Nichols Providence R.I.
Stack: Scrubber OUTLET
Nozzle Size: 1/4"
Time @ Each Point (θ): 2 Min
Ambient Temperature: 75 °F

PITOBE NO. 83
Date 10-2-80 CONSOLE NO. 1.82
Sample No. 4 Box No.
Probe Heater @ 808 Box Heater @ → °F
Ambient Pressure (P_{bar}) 29.44 "Hg

Stack Pressure (P) −.4 "H_2O (gage) ÷ 13.6 = −.03 "Hg (gage)

Stack Pressure (P_s) = P_{bar} + P = "Hg

Dry Bulb X °F
Wet Bulb X °F 10 %H_2O estimate

Operating Condition or Remarks

Port/ Point	Military Clock Time	Meter Reading	Pitot ΔP	Orifice ΔH	Meter (°F) Temperature IN	Meter (°F) Temperature OUT	Line Vacuum "Hg	Box Temp °F	Stack Temp °F/°C
B 1	1205	298.967	.56	1.85	76	76	7+	235	41/58
2	07	300.5	.65	2.1	—	—	8+	255	44
3	09	302.2	.75	2.45	85	90	9	250	45
4	11	303.8	.75	2.45	—	—	9	245	45
5	13	305.3	.73	2.47	81	81	9	250	46
6	15	306.9	.70	2.3	—	—	8+	250	46
7	17	308.6	.75	2.45	95	93	9	260	45
8	19	310.2	.70	2.3	—	—	9	260	45
9	21	311.8	.70	2.3	97	96	9	245	45/57
10	23	313.5	.68	2.2	—	—	9+	240	44
11	25	315.2	.58	1.9	99	96	9	245	44
12	27	316.8	.38	1.25	—	—	6	265	37
13	29	317.9	.35	1.17	98	99	5+	260	37
14	31	319.1	.29	.92	—	—	5	250	38
15	33	320.3	.30	.99	97	90	5	240	38
16	35	321.3	.27	.95	—	—	4	250	35
17	37	322.5	.27	.99	97	90	4	260	35
18	39	323.5	.28	.92	—	—	4	255	31
19	41	324.6	.30	99	96	91	5	240	35/60
20	43	325.8	.32	1.05	—	—	5+	240	40
21	45	326.8	.32	1.05	96	91	5+	255	32
22	47	327.9	.32	1.05	—	—	5+	260	32
END	1249	329.091	—	—	—	—	—	—	—
			TEST	#4 END					
*	θ= 44	V=30.124	-----	ΔH= 1.63	T_m= 89.5		--	--	T_s=40.2
		58.186		1.50	93.4				(Convert to) 41.8 °F (107.2)

* Sum, Average, or Difference

V_m = V (DGMCF) = ( )( ) = ft³

Other Data

Time	Sample or Measurement	Value
	CO_2	5.5
	O_2	13.5

wet check CEM
D.D =

Average CO_2 = % x MW/100 = 8.0 x 0.44 = 2.64
O_2 = 14.9 x 0.32 = 4.48
N_2 = 80 x 0.28 = 22.4
100.0 29.52 = dry MW

RECON SYSTEMS, INC.
Somerville, NJ

Water and Dry Particulate Collections

PLANT Providence
TEST FOR
SAMPLE NO. 4 BOX NO.

STACK
DATE
OPERATING CONDITION

		Grams		Grams
Impinger 1	Final Weight	631.6		
	Initial Weight	579.5		
	Increase		Impinger 1	52.1
Impinger 2	Final Weight	623.5		
	Initial Weight	611.3		
	Increase		Impinger 2	12.2
Impinger 3	Final Weight	494.9		
	Initial Weight	492.7		
	Increase		Impinger 3	2.2
Silica Gel	Final Weight	811.4		
	Initial Weight	796.1		
	Increase		Silica Gel	15.3

Record Water Collected in cyclone, flash, if any:

Final Weight _____ gms

Initial Weight _____ gms

Increase _____ gms

81.8 grams

Total mass of water caught

Filter Diameter _____ inches

Filter Type _____

Filter	Final Weight	.7455	
	Initial Weight	.6903	
	Increase		.0552 gram

Total mass of particulate caught on filter

Is ice present in the impinger bath at the end of this sample?
Yes _____ No _____

RECON SYSTEMS, INC.
Somerville, NJ 08876

temperature followed by 110°C for 1 hour
ether/chloroform (E/C) @ room temperature
water @ 110°C
all cooled in desiccator

Jobsite: Providence Client Order No. ____

Source Tested: ____ Metal Analyzed For ____

Sample No./ID Run #4

Signature ____

Date ____

Notebook #(page #) ____

Acetone Washings

Gross 650.9 GMS

TOTAL SAMPLE Tare- 257.6 GMS

Net washings ____ GMS = A

AMOUNT OF SAMPLE EVAPORATED ____ GMS = B

Evap. Beaker No. ____

Gross residue 111.90416 GMS

Tare- 111.85016 GMS

Net residue .0540 GMS = C

Acetone Blank = .0010 GMS / 100 GMS = D

Corrected Net Residue

$E = (C)-(B-C)(\frac{D}{100})$

$E = \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

E = ____ GMS

Scaled Up

$Net = (E)(\frac{A}{B})$

= ____ ____

= .0540 GMS

Wet Catch

Gross ____ GMS

TOTAL SAMPLE Tare- ____ GMS

Net ____ GMS = F

AMOUNT EXTRACTED ____ GMS = G

AMOUNT of E/C ____ GMS = H

Water Phase

Evap. Beaker No. ____

Gross ____ GMS

Tare- ____ GMS

Net residue ____ GMS = J

Water Blank = ____ GMS / 100 GMS = L

Corrected Net Residue

$Net\ (N) = J-(G)(\frac{L}{100})$

$N = J-(G-J)(\frac{L}{100})$

$= \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

N = ____ GMS

Scaled Up

$Net = N(\frac{F}{G})$

= ____ ____

= ____ GMS

E/C Phase

Evap. Beaker No. ____

Gross ____ GMS

Tare- ____ GMS

Net residue ____ GMS = K

E/C Blank = ____ GMS / 100 GMS = M

Corrected Net Residue

$P = K-(H-K)(\frac{M}{100})$

$= \_\_\_\_ - \_\_\_\_(\frac{\_\_\_\_}{100})$

P = ____ GMS

Scaled Up

$Net = P(\frac{F}{G})$

= ____ ____

= ____ GMS

Form I-3

Average Velocity Pressure

PLANT _____ STACK _____ SAMPLE No. ____ FOR _____

SAMPLING DATE _____ OPERATING CONDITION _____

PORT	POINT NO.	ΔP ("H_2O) A	ΔP ("H_2O) B	$\sqrt{\Delta P}$ A	$\sqrt{\Delta P}$ B
	A 1	.38	.56	.62	.75
	2	.46	.65	.68	.82
	3	.50	.75	.71	.87
	4	.53	.75	.73	.87
	5	.53	.73	.73	.85
	6	.50	.70	.71	.84
	7	.50	.75	.71	.87
	8	.51	.70	.71	.84
	9	.44	.70	.66	.84
	10	.44	.68	.66	.82
	11	.45	.58	.67	.76
	12	.46	.38	.68	.62
	13	.46	.36	.68	.60
	14	.40	.28	.63	.53
	15	.38	.30	.62	.50
	16	.38	.27	.62	.52
	17	.35	.27	.59	.52
	18	.32	.28	.57	.53
	19	.30	.30	.55	.55
	20	.30	.32	.55	.57
	21	.25	.32	.50	.57
	22	.26	.32	.51	.57
				AVG. .64	.70

TOTAL 44 ① ____ ②

AVERAGE $\sqrt{\Delta P} = \frac{②}{①} = \frac{\quad}{\quad} = .67$

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Somerville, NJ 08876

Calculations

PLANT _____ STACK _____

TEST FOR _____ DATE _____

SAMPLE NO. _____ BOX NO. _____ OPERATING CONDITION _____

$$V_{m\text{-std}} = 17.71\ (V_m)\left(\frac{P_{bar} + \Delta H/13.6}{T_m + 460}\right) = 17.71\ (58.180)\left(\frac{29.92 + \frac{1.50}{13.6}}{543.}\right)$$

$$= 17.71\ (\quad)(\quad) = \underline{56.99}\ ft^3$$

$$V_{w\text{-std}}\ (H_2O) = \frac{\text{Grams collected}}{21.2\ \text{gram/ft}^3} = \frac{(81.8)}{(21.2)} = \underline{3.86}\ ft^3$$

$$\%\ H_2O = \frac{(V_{w\text{-std}})\ 100}{(V_{w\text{-std}}) + (V_{m\text{-std}})} = \frac{100\ (\quad)}{(\quad)+(\quad)} = \frac{(386)}{(60.85)} = \underline{6.34}\ \%$$

$$\text{Molecular Weight (MW)} = \frac{18\ (\%H_2O)}{100} + \frac{\text{Dry M.W.}\ (100 - \%\ H_2O)}{100} = .18\ (6.34) + \frac{(29.52)(93.66)}{100}$$

$$= (\quad) + (\quad) = \underline{28.79}$$

$$\text{Velocity (actual) in Stack} = 85.48(Cp)\sqrt{\frac{T_s + 460}{P_s(MW)}}\sqrt{\Delta P} = 85.48(.83)\sqrt{\frac{(567)}{(29.54)(28.79)}}\sqrt{\Delta P}$$

$$Vs = (\quad)\sqrt{\quad}\sqrt{\Delta P} = (\quad)(\quad)\sqrt{\Delta P}$$

$$Vs = (\quad)\sqrt{\Delta P} = (57.54)(.67) = \underline{38.54}\ ft/sec$$

$$ACFM = (Vs)(60)(\text{csa}) = (38.54)(60)(10.8) = \underline{25003}$$

$$\text{Velocity @ Stp}\quad V_{s\text{-std}} = Vs\ (17.71)\left(\frac{Ps}{Ts + 460}\right) = \frac{(38.54)(17.71)(29.54)}{(567)} = \underline{36.03}\ ft/sec$$

$$SCFM = (V_{s\text{-std}})(\text{csa})\ (60) = (\quad)(\quad)(60) = \underline{23346}$$

$$SCFMD = \left(\frac{100 - \%H_2O}{100}\right)(SCFM) = (\quad)(\quad) = \underline{21866}$$

RECON SYSTEMS, INC.
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PLANT _____ STACK _____

TEST FOR _____ DATE _____

SAMPLE NO. _____ BOX NO. _____ OPERATING CONDITION _____

Nozzle Velocity

$$@ \text{ STD } V_n = \frac{\left(V_{m\text{-std}} + V_{w\text{-std}}\right)}{60\ (\theta)\ A_n} = \frac{(60.85)}{60(\ 88\ )(\ 3.41\ )(10^{-4})} = \underline{33.80} \text{ ft/sec}$$

$$I = \frac{100\ V_{n\text{-STD}}}{V_{s\text{-STD}}} = \frac{100\ (\ 33.80\ )}{(\ 36.03\ )} = \underline{93.8}\ \%\ \text{Isokinetic}$$

Concentration

$$C's = \frac{15.4\ (\text{grams Collected})}{V_{m\text{-STD}}} =$$

For Nozzle, Probe, Acetone Washings: $\frac{15.4(.0540)}{(56.99)} = \underline{0.0146}$ gr/dscf 19.5

Filter: $\frac{15.4\ (.0552)}{(56.99)} = \underline{0.0149}$ gr/dscf

Front Half Total = 0.0295 gr/dscf

For Aqueous or Total Wet Catch: $\frac{15.4\ (\quad)}{(\quad)} =$ _____ gr/dscf

For Organic Phase of Wet Catch: $\frac{15.4(\quad)}{(\quad)} =$ _____ gr/dscf.

Total Front & Wet Catches = _____ gr/dscf.

Emission Rates lb/hr = (gr/dscf)(DSCFM)(60)/7000 = 0.00857(gr/dscf)(DSCFM)

For front half total, lb/hr = 0.00857(.0295)(21866) = 5.53 lb/hr

For aqueous or total wet catch, lb/hr = 0.00857( )( ) = _____ lb/hr

For organic wet catch, lb/hr = 0.00857( )( ) = _____ lb/hr

For total front & wet catches, lb/hr = 0.00857( )( ) = _____ lb/hr

7.97

1.46

RECON SYSTEMS, INC.
Somerville, NJ

RECON SYSTEMS, INC.

51 Fifth Street, P.O. Box 842
Somerville, N. J. 08876
201-685-0440

SLUDGE - Moisture, Ash Lab Data Sheet

Client Nichols Client Order No. _____

Jobsite Providence RECON Job No. 1363

Source Tested _____ Sample No./ID Run #2

Moisture + Solids

Wet sludge weight + drying dish 52.6100

Drying dish # ___ tare weight - 1.8702

Wet sludge weight 50.7398 (A)

Dry sludge (overnight 105°C) + drying dish 13.8220

Drying dish # ___ tare - 1.8702

Dry sludge weight 11.9518 (B)

% solids = $\frac{100\ B}{A}$ = 23.6 % (D)

% moisture = 100 - D = 76.4 %

Ash + Combustibles

Dry sludge weight + ashing dish 84.7925

Ashing dish # 7 tare weight - 77.2392

Dry sludge weight 7.5513 (E)

Ashed sludge (550°C 1 hr.) + ashing dish 80.6242

Ashing dish # 7 tare - 77.2392

Ash sludge 3.3850 (F)

% ash = $\frac{100\ F}{E}$ = 44.8 % (G)

% combustibles = 100 - G = 55.2 %

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201-685-0440

SLUDGE - Moisture, Ash Lab Data Sheet

Client Nichols Client Order No. _____

Jobsite Providence RECON Job No. 1363

Source Tested _____ Sample No./ID Run #3

Moisture + Solids

Wet sludge weight + drying dish 50.7250

Drying dish # ____ tare weight - 1.8764

Wet sludge weight 48.8486 (A)

Dry sludge (overnight 105°C) + drying dish 13.7235

Drying dish # ____ tare - 1.8764

Dry sludge weight 11.8471 (B)

% solids = $\frac{100\ B}{A}$ = 24.25 % (D)

% moisture = 100 - D = 75.75 %

Ash + Combustibles

Dry sludge weight + ashing dish 78.4140

Ashing dish # 1 tare weight - 69.4978

Dry sludge weight 8.9162 (E)

Ashed sludge (550°C 1 hr.) + ashing dish 73.9585

Ashing dish # ____ tare - 69.4978

Ash sludge 4.4607 (F)

% ash = $\frac{100\ F}{E}$ = 50.0 % (G)

% combustibles = 100 - G = 50.0 %

RECON SYSTEMS, INC.

51 Fifth Street, P.O. Box 842
Somerville, N. J. 08876
201-685-0440

SLUDGE - Moisture, Ash Lab Data Sheet

Client Nichols Client Order No. _____

Jobsite Providence RECON Job No. 1363

Source Tested _____ Sample No./ID Run #4

Moisture + Solids

Wet sludge weight + drying dish 45.0380

Drying dish # ___ tare weight - 1.8607

Wet sludge weight 43.1773 (A)

Dry sludge (overnight 105°C) + drying dish 11.8030

Drying dish # ___ tare - 1.8607

Dry sludge weight 9.9323 (B)

$$\% \text{ solids} = \frac{100\ B}{A} = 23.0\ \% \text{ (D)}$$

% moisture = 100 - D = 77.0 %

Ash + Combustibles

Dry sludge weight + ashing dish 78.1200

Ashing dish # 3 tare weight - 70.3133

Dry sludge weight 7.8067 (E)

Ashed sludge (550°C 1 hr.) + ashing dish 73.8129

Ashing dish # ___ tare - 70.3133

Ash sludge 3.4996 (F)

$$\% \text{ ash} = \frac{100\ F}{E} = 44.8\ \% \text{ (G)}$$

% combustibles = 100 - G = 55.2 %

RECON SYSTEMS, INC.
51 Fifth Street, P.O. Box 842
Somerville, N. J. 08876
201-685-0440

RECON Job No. 1363

ject: Providence

ple No./ID Run #2 Sludge

CALORIMETRY DATA SHEET

ple + crucible 13.4460 g

crucible 12.6089 g(G)

sample .8371 g(M)

bustion aid Hg_1 _____ cal/g(D)

e wire used initially 10 cm(Q)

bomb charge 38.5 atm.

If Combustion Aid (CA) Used

CA + sample + crucible _____ g

sample + crucible _____ g

combustion aid(CA) _____ g(I)

H_2O initial temp. 20.359 °C

Temperature Rise

e(min. elapsed)	Temp.(°C)	Time(min. elapsed)	Temp.(°C)
0	20.359	9	21.542
1	20.360	10	21.560
2	20.361	11	21.570
3	20.362	12 TC	21.572
4	20.362	13	21.574
5 fire	20.363	14	21.575
5.5	20.560	15	21.575
6	21.010	16	21.575
6.5	21.245 21.069	17	21.575
7	21.375	18	
8	21.500	19	

wire remaining after ignition 2.2 cm(R)

le + crucible (fuse wire removed) after ignition _____ g(H)

filter (dried) + bomb residue _____ g

541 filter tare - _____ g

Bomb residue _____ g(F)

CRIMETRY DATA SHEET - Cont.

HNO_3/S/Cl Determinations

l bomb washings _____ ml(K)

b wash splitting:

titn. aliquot analyzed _____ ml(L) of total _____ ml(N)

fur determination aliquot analyzed _____ ml(P) of total _____ ml(S)

orine determination aliquot analyzed _____ ml(U) of total _____ ml(X)

unt 0.0725 N Na_2CO_3 titrant used for HNO_3 .19 ml(C_1)

fur crucible + $BaSO_4$ ppt (after ignition) _____ g

Sulfur crucible tare _____ g

$BaSO_4$ recovered _____ g(Y)

orine crucible/filter + AgCl ppt. _____ g

Chlorine crucible/filter tare _____ g

AgCl recovered _____ g(Z)

assembly (Parr manual)

5.0 min. elapsed t_c = 21.591 °C

6.2 min. elapsed r_1 = .001 °C/min.

12 min. elapsed r_2 = .0006 °C/min.

20.382 °C W = 2424 cal./°C(≈2424)

Calculations

rrected C_1) = $\frac{C_1(N)}{L}$ = _____ ml Y_1(corrected Y) = $\frac{Y(S)}{P}$ = _____ g

rrected Z) = $\frac{Z(X)}{U}$ = _____ g

p. rise) = $t_c - t_a - r_1(b-a) - r_2(c-b)$ = 1.204 °C

21.591 − 20.382 − .001(1.2) − .0006(5.8)

$\frac{(Y_1)(13.734)}{M}$ = _____ wt.% sulfur $C_3 = (Q-R)$ = _____ cm

$(C_2)(M)$ = _____ cal $e_3 = 2.3(C_3)$ = _____ cal

oss heat of combustion) = $\left(\frac{t(w) - C_4 - e_2 - e_3}{M}\right)(1.8)$ = 6198 BTU/lb = 6200

$\frac{Z_1(24.74)}{M}$ = _____ wt.% chlorine

n combusted = $1 - \left(\frac{(H-G) + F}{M}\right)$ = _____ (J)

rected for combustion aid) = $\left(\frac{Hg(M)}{1.8} - [(I)(D)]\right)(1.8)$ = _____ BTU/lb

rected to entire sample combustion) = $\frac{Hg_2}{J}$ = _____ BTU/lb

4, p.2

st Providence

le No./ID Run #3 Sludge

RECON Systems, Inc.
51 Fifth Street, P.O. Box 842
Somerville, N. J. 08876
201-685-0440

RECON Job No. 156

CALORIMETRY DATA SHEET

le + crucible 12.6949 g

crucible 11.5759 g(C)

sample 1.1190 g(M)

ustion aid Hg_1 _____ cal/g(D)

wire used initially 10 cm(Q)

omb charge 38.5 atm.

If Combustion Aid (CA) Used

CA + sample + crucible _____ g

sample + crucible _____ g

combustion aid(CA) _____ g(I)

H_2O initial temp. 21.638 °C

Temperature Rise

(min. elapsed)	Temp.(°C)	Time(min. elapsed)	Temp.(°C)
0	21.1638	9	23.101
1	21.639	10	23.131
2	21.640	11	23.130
3	21.641	12	23.135
4	21.642	13	23.136
5 fire	21.643	14	23.137
5.5	21.920	15	23.137
6.	22.445	16	23.137
6.5	22.745	17	23.137
7	22.890	18	
8	23.052	19	

+ 0.537

ire remaining after ignition 4.5 cm(R)

+ crucible (fuse wire removed) after ignition _____ g(H)

ilter (dried) + bomb residue _____ g

541 filter tare _____ g

Bomb residue _____ g(F)

24, p. 1

DRIMETRY DATA SHEET - Cont.

HNO_3/S/Cl Determinations

l bomb washings _____ ml(K)

wash splitting:

titn. aliquot analyzed _____ ml(L) of total _____ ml(N)

ur determination aliquot analyzed _____ ml(P) of total _____ ml(S)

rine determination aliquot analyzed _____ ml(U) of total _____ ml(X)

nt 0.0725 N Na_2CO_3 titrant used for HNO_3 19.5 ml(C_1)

ur crucible + $BaSO_4$ ppt (after ignition) _____ g

Sulfur crucible tare _____ g

$BaSO_4$ recovered _____ g(Y)

rine crucible/filter + AgCl ppt. _____ g

Chlorine crucible/filter tare _____ g

AgCl recovered _____ g(Z)

assembly (Parr manual)

5.0 min. elapsed t_c = 23.146 °C

6.2 min. elapsed r_1 = .001 °C/min.

12 min. elapsed r_2 = .0004 °C/min.

21.661 °C w = _____ cal./°C(~2424)

Calculations

orrected C_1) = $\frac{C_1(N)}{L}$ = _____ ml Y_1(corrected Y) = $\frac{Y(S)}{P}$ = _____ g

orrected Z) = $\frac{Z(X)}{U}$ = _____ g

p. rise) = $t_c - t_a - r_1(b-a) - r_2(c-b)$ = 1.491 °C

23.146 − 21.661 − .001(1.8) − .0004(58)

$\frac{(Y_1)(13.734)}{M}$ = _____ wt.% sulfur $C_3 = (Q-R)$ = _____ cm

14$(C_2)(M)$ = _____ cal $e_3 = 2.3(C_3)$ = 10.35 cal

ross heat of combustion) = $\left(\frac{t(w) - C_4 - e_2 - e_3}{M}\right)(1.8)$ = 5726 BTU/lb = 5730

$\frac{Z_1(24.74)}{M}$ = _____ wt.% chlorine

ion combusted = $1 - \left(\frac{(H-G) + F}{M}\right)$ = _____ (J)

rrected for combustion aid) = $\left(\frac{Hg(M)}{1.8} - [(I)(D)]\right)(1.8)$ = _____ BTU/lb

rrected to entire sample combustion) = $\frac{Hg_2}{J}$ = _____ BTU/lb

24, p.2

e No./ID Run #4 Sludge — Somerville, N. J. 08876

201-685-0440

CALORIMETRY DATA SHEET

le + crucible 13.0763 g

crucible 12.3005 g(G)

sample .7758 g(M)

ustion aid Hg_1 _____ cal/g(D)

wire used initially 10 cm(Q)

omb charge 38.5 atm.

If Combustion Aid (CA) Used

CA + sample + crucible _____ g

sample + crucible _____ g

combustion aid(CA) _____ g(I)

H_2O initial temp. 23.208 °C

Temperature Rise

Time (min. elapsed)	Temp. (°C)	Time (min. elapsed)		Temp. (°C)
0	23.208	9		24.295
1	23.212	10		24.312
2	23.214	11		24.321
3	23.217	12	+c	24.324
4	23.219	13		24.327
5 fire	23.220	14		24.329
5.5	23.400	15		24.330
6.	23.780	16		24.336
6.5	24.030 23.882	17		24.332
7	24.137	18		
8	24.254	19		

wire remaining after ignition 6.2 cm(R)

e + crucible (fuse wire removed) after ignition _____ g(H)

ilter (dried) + bomb residue _____ g

541 filter tare - _____ g

Bomb residue _____ g(F)

HNO_3/S/Cl Determinations

al bomb washings _____ ml(K)

b wash splitting:

3 titn. aliquot analyzed _____ ml(L) of total _____ ml(N)

fur determination aliquot analyzed _____ ml(P) of total _____ ml(S)

orine determination aliquot analyzed _____ ml(U) of total _____ ml(X

unt 0.0725 N Na_2CO_3 titrant used for HNO_3 15 ml(C_1)

fur crucible + $BaSO_4$ ppt (after ignition) _____ g

Sulfur crucible tare _____ g

$BaSO_4$ recovered _____ g(Y)

orine crucible/filter + AgCl ppt. _____ g

Chlorine crucible/filter tare _____ g

AgCl recovered _____ g(Z)

a assembly (Parr manual)

5.0 min. elapsed	t_c = 24.335 °C
6.2 min. elapsed	r_1 = .0024 °C/min.
12 min. elapsed	r_2 = .0016 °C/min.
23.236 °C	w = 2424 cal./°C (~2424)

Calculations

orrected C_1) = $\frac{C_1(N)}{L}$ = _____ ml Y_1(corrected Y) = $\frac{Y(S)}{P}$ = _____ g

orrected Z) = $\frac{Z(X)}{U}$ = _____ g

mp. rise) = $t_c - t_a - r_1(b-a) - r_2(c-b)$ = 1.087 °C

24.335 - 23.236 - .0024(1.2) - .0016(5.8)

$\frac{(Y_1)(13.734)}{M}$ = _____ wt.% sulfur $C_3 = (Q-R)$ = _____ cm

14(C_2)(M) = _____ cal $e_3 = 2.3(C_3)$ = _____ cal

ross heat of combustion) = $\left(\frac{t(w) - C_4 - e_2 - e_3}{M}\right)(1.8)$ = 6057 BTU/lb = 6050

$\frac{Z_1(24.74)}{M}$ = _____ wt.% chlorine

tion combusted = $1 - \left(\frac{(H-G) + F}{M}\right)$ = _____ (J)

orrected for combustion aid) = $\left(\frac{Hg(M)}{1.8} - [(I)(D)]\right)(1.8)$ = _____ BTU/lb

rrected to entire sample combustion) = $\frac{Hg_2}{J}$ = _____ BTU/lb