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Reference Number
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Emission Test Repor
Swift Chemical Company
Beaumont, Texas

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MEASUREMENT OF EMISSIONS FROM A MODERN AMMONIUM NITRATE MANUFACTURING PLANT, SWIFT CHEMICAL COMPANY, BEAUMONT, TEXAS

by

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VOLUME I

FINAL REPORT
July 23, 1980

EPA Contract No. 68-02-2814, Work Assignment No. 18
MRI Project No. 4468-L(18)

For

Environmental Protection Agency
Emission Measurement Branch
Emission Standards and Engineering Division
MD-13
Research Triangle Park, North Carolina 27711

Attn: Mr. J. E. McCarley

PREFACE

The work reported herein was conducted by personnel from Midwest Research Institute (MRI), the GCA/Technology Division (GCA), Swift Chemical Company, Beaumont, Texas, and the U.S. Environmental Protection Agency (EPA).

The scope of work issued under EPA Contract No. 68-02-2814, Work Assignment No. 18, was under the supervision of MRI Project Manager, Mr. Douglas E. Fiscus. Mr. Bruce C. DaRos of MRI served as Field Task Leader. Mr. Mark D. Hansen was responsible for summarizing the test and analytical data in this report. Sample analysis performed at the Swift Chemical Company, Beaumont, Texas, plant and at the MRI labs located in Kansas City, Missouri, was under the direction of Dr. George Scheil.

Mr. Stephen A. Capone and Mr. Timothy L. Curtin of GCA were responsible for monitoring the process operations during the testing program. GCA personnel were also responsible for writing the Process Description and Operation Section (Section 3) along with Appendix M of this report.

Members of the Swift Chemical Company, Beaumont, Texas, whose assistance and guidance contributed greatly to the success of the test program, include Mr. Ron E. Ashcroft, Plant Manager, Mr. Dwain Adcock, Production Supervisor, and Mr. Terry Sparkman, Chief Chemist.

Mr. Eric A. Noble, Office of Air Quality Planning and Standards, Industrial Studies Branch, EPA, served as Test Process Engineer and was responsible for coordinating the process operations monitoring.

Mr. Clyde E. Riley, Office of Air Quality Planning and Standards, Emission Measurement Branch, EPA, served as Technical Manager and was responsible for coordinating the emission test program.

Approved for:

MIDWEST RESEARCH INSTITUTE

M. P. Schrag, Director
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SECTION 1

INTRODUCTION

Section III of the Clean Air Act of 1970 charges the Administrator of the U.S. Environmental Protection Agency (EPA) with the responsibility of establishing Federal standards of performance for new stationary sources which may significantly contribute to air pollution. When promulgated, these standards of performance for new stationary sources (SPNSS) are to reflect the degree of emission limitation achievable through application of the best demonstrated emission control technology. To assembly this background information, EPA utilizes emission data obtained from controlled sources in the particular industry under consideration.

EPA's Office of Air Quality Planning and Standards (OAQPS) selected the Swift Chemical Company ammonium nitrate manufacturing plant at Beaumont, Texas, as a site for an emission test program. The test program was designed to provide a portion of the emission data base required for SPNSS for the process associated with the production of ammonium nitrate. The Swift Chemical Company ammonium nitrate manufacturing plant at Beaumont, Texas, produces granulated ammonium nitrate for fertilizer use. The ammonium nitrate is made by a C and I Girdler Rotary Drum Granulator which operates continuously, 24-hr a day and 7 days a week as production demands.

The plant represents the latest installation (1977) of a rotary drum granulator installed by C and I Girdler using a Joy "Type D" Turbulaire Scrubber in conjunction with a rotary drum cooler.

The rotary drum granulator exhaust is ducted through the scrubber, fan, and is discharged from a stack. Flow through the granulator to the constant flow scrubber is controlled with a dilution damper which varies the ratio of dilution air to exhaust gas.

Emissions sampling was conducted on the rotary drum granulator unit while its ammonium nitrate production rate was approximately 400 tons/day. Emission sampling was also conducted on the uncontrolled emissions venting from the cooler operation.

EPA engaged MRI to measure ammonium nitrate and ammonia concentrations and mass flow rates, particle size distributions, and plume opacities. Results of measurements contained in this report were performed during times of normal operation of the production process as described in Section 3, "Process Description and Operation."

During the testing program several of the test runs were discontinuous due to the excessive particulate loading at the rotary drum granulator scrubber inlet and the rotary drum cooler uncontrolled outlet sampling locations.

These interruptions, which also delayed the concurrent rotary drum granulator outlet sampling (concurrent with scrubber inlet sampling only), occurred throughout the test program.

These test interruptions were the result of processing problems within the plant. Test Nos. 1 and 2 (simultaneous inlet and outlet sampling) at the rotary drum granulator scrubber on March 5 and 6, 1979, were most affected by plant processing problems. Test No. 1 on March 5, 1979, was not completed. Test No. 2 on March 6, 1979, was completed but due to plant processing problems was not considered representative. In concurrence with the EPA Technical Manager, Test Nos. 1 and 2 at the rotary drum granulator scrubber were not considered valid tests. Subsequent tests, Tests 3, 4, and 5 at the rotary drum granulator scrubber were representative tests at this location. No other tests during the testing program were invalidated due to plant processing problems.

Section 2 of this report presents the summary of test results for all tests; except for Test Nos. 1 and 2 at the rotary drum granulator scrubber which were considered not representative. All of the samples and data collected during Test Nos. 1 and 2 at the rotary drum granulator scrubber were analyzed in the same manner as other test samples and data. Since data from these tests were not considered representative due to plant processing problems, it was omitted from Section 2 "Summary of Test Results," of this report. However, all of the analytical analyses, field data sheets, computer data reduction, and summary information pertaining to these two tests are presented in their appropirate appendices of Section 6.

The measurement program was conducted during the week of March 5 through March 9, 1979, and consisted of the following:

Rotary Drum Granulator Scrubber Measurements

1. Ammonium Nitrate and Ammonia in Gas Stream

Three isokinetic test runs of concurrent inlet and outlet tests were performed. The tests were conducted in accordance with the prescribed EPA methods for ammonium nitrate and ammonia, and provided velocity, moisture, ammonia, and ammonium nitrate particulate mass flow rate data.

2. Particle Size Distributions in Gas Streams

Three test runs were conducted at the inlet to the rotary drum granulator scrubber. The tests were performed using the procedures provided by the cascade impactor manufacturer.

3. Visible Emissions from Granulator Scrubber Stack

Approximately 9.5 hr of visible emissions observations were recorded on the scrubber stack discharge. Observations were performed in accordance with EPA Method 9 guidelines.

4. Gas Pressure Drop Across Scrubber

Pressure drop measurements were recorded approximately every 15 min during the testing periods.

5. Ambient Air Temperature and Relative Humidity

Wet and dry bulb ambient air temperatures were recorded at frequent intervals during the test days.

6. Scrubber Liquid Sampling

Samples of inlet and outlet scrubber liquor were collected during the ammonium nitrate testing. The pH and temperature of each sample were recorded. The samples were composited into three inlet and three outlet samples which were analyzed for ammonium nitrate and ammonia.

7. Ammonium Nitrate and Ammonia Analyses of Product

A single grab sample of the ammonium nitrate melt was collected and analyzed for ammonium nitrate and ammonia. In addition, grab samples of the unscreened and screened granulator product had sieve, bulk density, and temperature determinations performed on them. These samples were then composited for ammonium nitrate and ammonia determination.

Rotary Drum Cooler Measurements

1. Ammonium Nitrate and Ammonia in the Gas Stream

Three isokinetic test runs were performed on the uncontrolled emissions according to procedures prescribed in EPA methods for velocity, ammonium nitrate and ammonia, moisture, and ammonium nitrate particulate mass flow rates.

2. Particle Size Distributions in Gas Streams

Three test runs were conducted on the uncontrolled emissions of the rotary drum cooler. The tests were performed using the procedures provided by the cascade impactor manufacturer.

MRI personnel were responsible for collecting and measuring the above emission parameters. Concurrently, GCA was responsible for monitoring and recording necessary process parameters. A copy of MRI's Work Assignment and Technical Directives is included in Appendix P.

The sequence of events performed during this sampling program is shown in Tables 1-1 through 1-5 (Summary Log for Sampling Matrix).

The following sections of this report cover the summary of results (Section 2), process description and operation (Section 3), location of sampling points (Section 4), and sampling and analytical procedures (Section 5). Appendices A-P (Section 6) are presented in Volume II of this report. The appendices present copies of all field and laboratory data sheets, computer reduction of test data, detailed sampling and laboratory analytical procedures, and results of laboratory analyses.

TABLE 1-1. SUMMARY LOG FOR SAMPLING OF THE ROTARY DRUM GRANULATOR SCRUBBER INLET AND OUTLET, MARCH 5, 1979 (DAY 1)

Time	Production rate (tons/hr)	Scrubber inlet Method 5	Scrubber outlet Method 5	Visible emissions Method 9	Inlet scrubber liquor pH	Inlet scrubber liquor Temp. (°F)	Outlet scrubber liquor pH	Outlet scrubber liquor Temp. (°F)	Bulk density and sieve analysis
1529	NA[a]			Start					
1530				Stop	7.15	135	5.20	99	
1534									
1535		Begin test 1-IS	Begin test 1-OS						
1536									
1544									
1600					7.20	139	5.21	99	
1607									
1609									
1630					7.26	139	5.28	99	Grab sample-unscreened granulator product[c]
1635			Stop test 1-OS[b]						
1636									
1643				Start					
1647				Stop					
1654		Stop test 1-IS[b]							

a Data not available.

b Only one-half of Test No. 1 completed due to process problems within plant. Test No. 1 and sample were voided.

c Sample lost.

TABLE 1-2. SUMMARY LOG FOR SAMPLING OF THE ROTARY DRUM GRANULATOR SCRUBBER INLET AND OUTLET, MARCH 6, 1979 (DAY 2)

Time	Production rate (tons/hr)	Scrubber inlet Method 5	Scrubber outlet Method 5	Visible emissions Method 9	Meteorological data: Ambient temp. (°F)	Meteorological data: Relative humidity (%)	Inlet scrubber liquor: pH	Inlet scrubber liquor: Temp. (°F)	Outlet scrubber liquor: pH	Outlet scrubber liquor: Temp. (°F)	Scrubber pressure drop (in. H_2O)	Process sample
0900	NA[a]				54.2	NA[a]	6.60	129			7.1	
0904				Start								
0912				Stop								
0915					55.6	55					7.3	
0916				Start								
0930					56.2	55			5.20	100	7.2	
0940		Begin test 2-IS										
0944			Begin test 2-OS									
0945					57.2	55					7.3	
1000					57.9	51	6.50	130	5.23	100	7.2	
1004				Stop								
1009				Start								
1015					59.0	52					7.1	
1028		Stop, change ports										
1030					59.6	48	6.65	136	5.55	100	8.4	
1044			Stop, change ports									
1045					60.7	44					8.6	
1100					61.2	44					9.0	
1102				Stop								
1104		Resume test 2-IS	Resume test 2-OS									
1106				Start								
1115					62.2	41	6.85	130	5.55	100	9.1	
1130					63.0	42					8.9	Grab sample - AN melt to granulator
1145					64.0	38					8.8	
1200					64.2	38	7.05	134	5.50	100	8.8	
1204			Test 2-OS completed[b]									
1209		Test 2-IS completed[b]										
1215					64.6	35					8.8	
1219				Stop								

a Data not available.

b Test No. 2 is not considered representative because of plant process problems.

TABLE 1-3. SUMMARY LOG FOR SAMPLING OF THE ROTARY DRUM GRANULATOR SCRUBBER INLET AND OUTLET, MARCH 7, 1979 (DAY 3)

Time	Production rate (tons/hr)	Scrubber inlet Method 5	Scrubber outlet Method 5	Visible emissions Method 9	Brink particle size distribution granulator scrubber inlet	Meteorological data: Ambient temp. (°F)	Meteorological data: Relative humidity (%)	Inlet scrubber liquor: pH	Inlet scrubber liquor: Temp. (°F)	Outlet scrubber liquor: pH	Outlet scrubber liquor: Temp. (°F)	Scrubber pressure drop (in. H_2O)	Bulk density and sieve analysis
0915	14.49												
1000						59.0	57					10.7	
1015						62.6	46						
1030			Begin test 3-OS			63.8	43						
1031		Begin test 3-IS				64.3	43	6.65	136			10.3	
1045													
1100						64.1	44			5.99	92	10.1	
1115						65.8	40					9.9	
1119		Stop, change ports				66.4	40	6.70	120	5.80	94	9.9	
1130			Stop, change ports			66.7	37					10.2	
1138			Resume test 3-OS										
1139		Resume test 3-IS											
1145													
1153						67.9	34	6.60	121	6.18	94	9.4	
1200													Grab sample - unscreened granulator product
1215						68.1	34					9.4	
1230						68.2	38			5.74	94	9.5	
1234		Test 3-IS completed				70.0	33	6.52	123			9.2	
1238			Test 3-OS completed										
1245													
1300	14.49					71.5	31			6.55	94	8.8	
1330	16.22							6.51	122			8.6	
1340	16.22				Begin test 1-IS								
1345					Test 1-IS completed							9.2	
1445						77.4	26					9.7	

(continued)

TABLE 1-3. (concluded)

Time	Production rate (tons/hr)	Scrubber inlet Method 5	Scrubber outlet Method 5	Visible emissions Method 9	Brink particle size distribution granulator scrubber inlet	Meteorological data: Ambient temp. (°F)	Meteorological data: Relative humidity (%)	Inlet scrubber liquor: pH	Inlet scrubber liquor: Temp. (°F)	Outlet scrubber liquor: pH	Outlet scrubber liquor: Temp. (°F)	Scrubber pressure drop (in. H_2O)	Bulk density and sieve analysis
1500	17.45	Begin test 4-IS				77.4	26	6.59	121	5.23	98	10.4	
1501			Begin test 4-OS										
1515						77.2	23					9.9	
1530						76.8	23	6.55	124			10.5	
1545						76.8	23			5.00	98	10.5	
1548		Stop, change ports											
1600						77.0	26	6.57	127			10.4	Grab sample - unscreened granulator product
1601			Stop, change ports										
1605			Resume test 4-OS										
1610		Resume test 4-IS											
1615						76.7	23			5.11	99	10.2	
1630						75.8	25					10.4	
1640				Start									
1643				Stop									
1644				Start									
1645						75.4	27	6.55	128	5.30	99	10.4	
1700						75.0	27					10.0	
1705			Test 4-OS completed										
1707		Test 4-IS completed											
1715										5.29	99		
1733	17.45			Stop									
1745								6.60	125				
1755					Begin test 2-IS								
1807					Test 2-IS completed								

TABLE 1-4. SUMMARY LOG FOR SAMPLING OF THE ROTARY DRUM GRANULATOR SCRUBBER INLET AND OUTLET; AND THE ROTARY DRUM COOLER OUTLET, MARCH 8, 1979 (DAY 4)

Time	Production rate (ton/hr)	Rotary drum granulator Scrubber inlet Method 5	Rotary drum granulator Scrubber outlet Method 5	Rotary drum cooler outlet Method 5	Visible emissions Method 9	Brink particle size distribution	Meteorological data Ambient temp. (°F)	Meteorological data Relative humidity (%)	Inlet Scrubber liquor pH	Inlet Scrubber liquor Temp. (°F)	Outlet Scrubber liquor pH	Outlet Scrubber liquor Temp. (°F)	Scrubber pressure drop (in. H_2O)	Bulk density and sieve analysis
0900														
0911	20.54		Begin test 5-OSS		start		55.9	55						
0914					stop									
0915					start									
0919		Begin test 5-IS					56.3	55	7.35	140	6.00	99	13.3	
0920					stop									
0930					start									
0943							59.0	47					13.7	
0945					stop									
0949					start		59.9	39	7.30	143	5.95	100	13.2	
0952					stop									
1000					start									
1007		Stop, change ports					61.0	40					12.5	
1011			Stop, change ports											
1015														
1023			Resume test 5-OS				61.8	36	7.10	140			12.5	
1028		Resume test 5-IS												
1030														
1031							62.5	37			5.80	100	12.3	
					stop									Grab sample-unscreened granulator product
1033														
1045					start									
1100							62.8	37					12.6	
1103							62.8	37	6.99	144	5.76	100	12.9	
1108					stop									
1115					start									
1116		Test 5-IS completed					63.6	34	7.10	150			12.6	
1123	20.54		Test 5-OS completed											
1124					stop									
1125					start									
1126					stop									
1130					start									
1149					stop		64.3	34			5.71	100		
1150					start								12.6	
1306					stop									
1335					start									
1400	20.5													
					stop	Begin scrubber inlet test 3-IS	74.0	29						
1403	20.5													
1405	20.85			Begin test 1-ORDC	start								11.8	
1410	↓			↓	↓	Test 3-IS at scrubber inlet completed								

continued

TABLE 1-4. (concluded)

Time	Production rate (ton/hr)	Rotary drum granulator: Scrubber inlet Method 5	Rotary drum granulator: Scrubber outlet Method 5	Rotary drum cooler outlet Method 5	Visible emissions Method 9	Brink particle size distribution	Meteorological data: Ambient temp. (°F)	Meteorological data: Relative humidity (%)	Inlet Scrubber liquor: pH	Inlet Scrubber liquor: Temp. (°F)	Outlet Scrubber liquor: pH	Outlet Scrubber liquor: Temp. (°F)	Scrubber pressure drop (in. H_2O)	Bulk density and sieve analysis
1415														
1418							74.7	30					12.3	
1425														Grab sample-cooler outlet product
1429				Stop, change ports										Grab sample-screened granulator product (cooler inlet product)
1430														
1445							75.2	30					11.9	
1452				Resume test 1-ORDC			75.8	28					12.5	
1500														
1512	20.85			Test 1-ORDC completed	stop		75.8	28					12.5	
1515														
1530							76.2	28					12.4	
1705						Begin cooler oulet test 1-CO							12.6	
1719						Test 1-CO at cooler outlet completed								

TABLE 1-5. SUMMARY LOG FOR SAMPLING OF THE ROTARY DRUM COOLER OUTLET, MARCH 9, 1979 (DAY 5)

Time	Production rate (tons/hr)	Rotary drum cooler outlet Method 5	Brink particle size distribution cooler outlet	Meteorological Data: Ambient temp. (°F)	Meteorological Data: Relative humidity (%)	Scrubber pressure drop (in. H_2O)	Bulk density and sieve analysis
0834	18.9		Begin test 2-CO				
0845				69.4	85	5.0	
0848			Test 2-CO completed				
0930	18.9			72.2	69	4.8	
0945	20.83	Begin test 2-ORDC		72.2	69	4.8	
1000				73.1	73	4.8	
1009		Stop, change ports					
1010							Grab sample-cooler outlet product
1014							Grab sample-screened granulator Product (cooler inlet product)
1015		Resume test 2-ORDC		73.4	73	4.9	
1030				73.8	69	4.8	
1038		Test 2-ORDC completed					
1045	20.83			74.1	69	4.8	
1058	22.24		Begin test 3-CO				
1100				75.5	62	4.8	
1112			Test 3-CO completed				
1515	22.24			77.0	56	4.5	
1516	20.85	Begin test 3-ORDC					
1530				77.2	56	4.5	
1540		Stop, change ports					Grab sample-cooler outlet product
1545		Resume test 3-ORDC		77.3	56	4.6	
1546							Grab sample-screened granulator product (cooler inlet product).
1600				77.5	53	4.5	
1608		Test 3-ORDC completed					
1615	20.85			77.5	53	4.5	

The analysis results of the quality assurance audit samples supplied by EPA are presented in Appendix K. Appendix O contains the results of the clean-up evaluations performed on the sample collectors used during the test program. Detailed description of methods and procedures, field and laboratory data, and calculations are presented in various appendices, as noted in the Table of Contents.

SECTION 2

SUMMARY OF TEST RESULTS

INTRODUCTION

In this section, the results of the testing program conducted at the Swift Chemical Company in Beaumont, Texas, are presented in Tables 2-1 through 2-27. The results are discussed briefly in eight separate sections. Detailed discussions of the procedures used are presented in Section 5, "Sampling and Analytical Procedures," and in related appendices.

Samples were collected at the inlet and outlet of the rotary drum granulator and on the uncontrolled emissions of the rotary drum cooler. Complete descriptions of the process is provided in Section 3, "Process Description and Operation." The sampling locations of the test are described in Section 4, "Location of Sample Points."

GRANULATOR TEST DATA

The results of the rotary drum granulator test are given in Tables 2-1 through 2-8.

COOLER TEST DATA

The test results of the cooler have been summarized in Tables 2-9 through 2-11.

PARTICLE SIZE TEST DATA

The particle size test data for the granulator have been summarized in Tables 2-12 through 2-14. The results are shown graphically in Figures 2-1 and 2-2.

Data for the cooler has been summarized in Tables 2-15 through 2-17. The results are presented graphically in Figures 2-3 and 2-4.

Visible Emissions Test Data

The visible emissions data from the outlet stack of the rotary drum granulator scrubber during emissions testing are presented in Table 2-18. The results are shown graphically in Figure 2-5.

TABLE 2-1. ROTARY DRUM GRANULATOR SCRUBBER EFFICIENCY-PARTICULATE AND AMMONIUM NITRATE CONCENTRATION (NO_3^- SELECTIVE ION ELECTRODE ANALYSIS) AND EMISSION DATA SUMMARY IN ENGLISH UNITS

Run number	Run 3		Run 4		Run 5		Average	
Location	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Date	3/7/79		3/7/79		3/8/79			
Volume of gas sampled - DSCF[a]	58.62	82.44	61.79	87.00	68.96	97.75	63.12	89.06
Percent moisture by volume	2.0	2.9	2.0	3.7	2.0	7.9	2.0	4.8
Average stack temperature - °F	166	100	186	109	180	115	177	108
Stack volumetric flow rate - DSCFM[b]	41,401	38,521	43,442	40,887	49,120	43,969	44,654	41,126
Percent isokinetic	102.6	98.1	103.1	97.5	101.7	101.9	102.5	99.2
Production rate - tons/hr	14.5		17.4		20.5		17.5	
Average percent opacity	f		5[g]		15		h	
Insoluble particulate								
Filter catch and collection water filtrate[c]								
mg	10.0	11.0	7.2	21.5	8.7	25.9	8.6	19.5
gr/DSCF	0.00263	0.00205	0.00179	0.00381	0.00194	0.00408	0.00212	0.00331
lb/hr	0.93	0.68	0.67	1.33	0.82	1.54	0.81	1.18
lb/ton	0.064	0.047	0.039	0.076	0.040	0.075	0.048	0.066
Collection efficiency, percent	22.1		i		i		j	
Ammonium nitrate particulate								
NO_3^- selective ion electrode analysis[d,e]								
mg	50,555	139.3	55,529	98.2	56,772	129.1	54,285	122.2
gr/DSCF	13.311	0.026	13.868	0.017	12.725	0.020	13.301	0.021
lb/hr	4,723.6	8.58	5,163.9	5.96	5,357.6	7.54	5,081.7	7.36
lb/ton	325.8	0.59	296.8	0.34	261.3	0.37	294.6	0.43
Collection efficiency, percent	99.8		99.9		99.8		99.8	
Total particulate								
Insoluble and ammonium nitrate								
mg	50,565	150.3	55,536	119.7	56,781	155.0	54,294	141.7
gr/DSCF	13.314	0.028	13.870	0.021	12.727	0.024	13.304	0.024
lb/hr	4,724.5	9.26	5,164.6	7.29	5,358.4	9.08	5,082.5	8.54
lb/ton	325.9	0.64	296.8	0.42	261.3	0.45	294.7	0.50
Collection efficiency, percent	99.8		99.8		99.8		99.8	

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c] Includes train filter, and impinger water filtrate.

[d] NO_3^- selective ion electrode analysis results (H_2O fraction only) measured as nitrate and reported as ammonium nitrate. Analysis was performed at the MRI lab in Kansas City, Missouri.

[e] Water fraction results include a 1.45 mg blank correction.

[f] Opacity measurements not recorded during test.

[g] Average percent opacity observed represents only 25 min of test 4-OS.

[h] Average opacity not calculated due to insufficient observations during testing.

[i] Negative number.

[j] No average calculated due to negative numbers in Run Nos. 4 and 5.

TABLE 2-2. ROTARY DRUM GRANULATOR SCRUBBER EFFICIENCY-PARTICULATE AND AMMONIUM NITRATE CONCENTRATION (NO_3^- SELECTIVE ION ELECTRODE ANALYSIS) AND EMISSION DATA SUMMARY IN METRIC UNITS

Run number	Run 3		Run 4		Run 5		Average	
Location	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Date	3/7/79		3/7/79		3/8/79			
Volume of gas sampled - DNM3[a]	1.66	2.33	1.75	2.46	1.95	2.77	1.79	2.52
Percent moisture by volume	2.0	2.9	2.0	3.7	2.0	7.9	2.0	4.8
Average stack temperature - °C	74	38	86	43	82	46	81	42
Stack volumetric flow rate - DNM3/M[b]	1,172	1,091	1,230	1,158	1,391	1,245	1,264	1,165
Percent isokinetic	102.6	98.1	103.1	97.5	101.7	101.9	102.5	99.2
Production rate - Mg/hr[c]	13.15		15.82		18.60		15.86	
Average percent opacity	h		5[i]		15		j	
Insoluble particulates								
Filter catch and collection water filtrate[d]								
mg	10.0	11.0	7.2	21.5	8.7	25.9	8.6	19.5
g/normalized cu meter	0.00601	0.00470	0.00411	0.00871	0.00445	0.00934	0.00486	0.00758
kg/hr	0.423	0.308	0.303	0.605	0.371	0.697	0.366	0.537
kg/Mg[e]	0.032	0.023	0.019	0.038	0.020	0.037	0.024	0.033
Collection efficiency, percent	21.8		k		k		l	
Ammonium nitrate particulate								
NO_3^- selective ion electrode analysis[f,g]								
mg	50,555	139.3	55,529	98.2	56,772	129.1	54,285	122.2
g/normalized cu meter	30.46	0.060	31.73	0.040	29.11	0.047	30.43	0.049
kg/hr	2,141.9	3.928	2,341.7	2.779	2,429.5	3.511	2,304.4	3.41
kg/Mg	162.9	0.299	148.0	0.176	130.6	0.189	147.2	0.221
Collection efficiency, percent	99.8		99.9		99.8		99.8	
Total particulate								
Insoluble and ammonium nitrate								
mg	50,565	150.3	55,536	119.7	56,781	155.0	54,294	141.7
g/normalized cu meter	30.47	0.065	31.73	0.049	29.11	0.056	30.44	0.057
kg/hr	2,142.3	4.236	2,342.0	3.384	2,429.9	4.208	2,304.7	3.943
kg/Mg	162.9	0.322	148.0	0.214	130.6	0.226	147.2	0.254
Collection efficiency, percent	99.8		99.8		99.8		99.8	

[a] Dry normal cubic meters at 20°C, 760 mm Hg.

[b] Dry normal cubic meters per minute at 20°C, 760 mm Hg.

[c] Mg/hr = megagrams (10^3 kg) per hour.

[d] Includes train filter, and impinger water filtrate.

[e] kg/Mg = kilograms/megagram.

[f] NO_3^- selective ion electrode analysis results (H_2O fraction only) measured as nitrate and reported as ammonium nitrate. Analysis was performed at the MRI lab in Kansas City, Missouri.

[g] Water fraction results include a 1.45 mg blank correction.

[h] Opacity measurements not recorded during test.

[i] Average percent opacity observed represents only 25 min of test 4-OS.

[j] Average opacity not calculated due to insufficient observations during testing.

[k] Negative number.

[l] No average calculated due to negative numbers in Run Nos. 4 and 5.

TABLE 2-3. SUMMARY OF EMISSION TEST RESULTS FOR NITRATE AND AMMONIA REPORTED AS AMMONIUM NITRATE UTILIZING AN NO_3^- SELECTIVE ION ELECTRODE AND DIRECT NESSLER ANALYSIS-ROTARY DRUM GRANULATOR SCRUBBER INLET

Run number	Run 3-IS		Run 4-IS		Run 5-IS		Average	
Date	3/7/79		3/7/79		3/8/79			
Volume of gas sampled - DSCF[a]	58.62		61.79		68.96		63.12	
Percent moisture by volume	2.0		2.0		2.0		2.0	
Average stack temperature - °F	166		186		180		177	
Stack volumetric flow rate - DSCFM[b]	41,401		43,442		49,120		44,654	
Percent isokinetic	102.6		103.1		101.7		102.5	
Production rate - tons/hr	14.5		17.4		20.5		17.5	
Insoluble particulates								
Filter catch and collection water filtrate[c]								
mg	10.0		7.2		8.7		8.6	
gr/DSCF	0.00263		0.00179		0.00194		0.00212	
lb/hr	0.93		0.67		0.82		0.81	
lb/ton	0.064		0.039		0.040		0.048	
Ammonium nitrate particulate	Measured by		Measured by		Measured by		Measured by	
Nitrate and ammonia reported as ammonium nitrate	SIE[d,e]	DN[f,g]	SIE	DN	SIE	DN	SIE	DN
mg	50,555	128,941	55,529	57,887	56,772	67,768	54,285	84,865
gr/DSCF	13.311	33.949	13.868	14.457	12.725	15.189	13.301	21.198
lb/hr	4,723.6	12,047.3	5,163.9	5,383.2	5,357.6	6,395.0	5,081.7	7,941.8
lb/ton	325.8	830.8	296.8	309.4	261.3	312.0	294.6	484.1
Total particulates								
Insoluble and ammonium nitrate								
mg	50,565	128,951	55,536	57,894	56,781	67,777	54,294	84,874
gr/DSCF	13.314	33.952	13.870	14.459	12.727	15.191	13.304	21.200
lb/hr	4,724.5	12,048.2	5,164.6	5,383.9	5,358.4	6,395.8	5,082.5	7,942.6
lb/ton	325.9	830.9	296.8	309.4	261.3	312.0	294.7	484.1
Percent insoluble catch of total catch	0.020	0.008	0.013	0.012	0.015	0.013	0.016	0.011

[a]Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c]Includes train filter, and impinger water filtrate.

[d]NO_3^- selective ion electrode analyses results (H_2O fraction only) measured as nitrate and reported as ammonium nitrate. Analysis was performed at the MRI lab in Kansas City, Missouri.

[e]Water fraction results include a 1.45 mg blank correction.

[f]Direct Nessler analyses results (H_2O fraction only) measured as ammonia and reported as ammonium nitrate. Analysis was performed at the MRI lab in Kansas City, Missouri.

[g]Zero blank correction.

TABLE 2-4. SUMMARY OF EMISSION TEST RESULTS FOR NITRATE AND AMMONIA REPORTED AS AMMONIUM NITRATE UTILIZING AN NO_3^- SELECTIVE ION ELECTRODE AND DIRECT NESSLER ANALYSIS-ROTARY DRUM GRANULATOR SCRUBBER OUTLET

Run number	Run 3-OS		Run 4-OS		Run 5-OS		Average	
Date	3/7/79		3/7/79		3/8/79			
Volume of gas sampled - DSCF[a]	82.44		87.00		97.75		89.06	
Percent moisture by volume	2.9		3.7		7.9		4.8	
Average stack temperature - °F	100		109		115		108	
Stack volumetric flow rate - DSCFM[b]	38,521		40,887		43,969		41,126	
Percent isokinetic	98.1		97.5		101.9		99.2	
Production rate - tons/hr	14.5		17.4		20.5		17.5	
Insoluble particulates								
Filter catch and collection water filtrate[c]								
mg	11.0		21.5		25.9		19.5	
gr/DSCF	0.00205		0.00381		0.00408		0.00331	
lb/hr	0.68		1.33		1.54		1.18	
lb/ton	0.047		0.076		0.075		0.066	
Ammonium nitrate particulate	Measured by		Measured by		Measured by		Measured by	
Nitrate and ammonia reported as ammonium nitrate	SIE[d,e]	DN[f,g]	SIE	DN	SIE	DN	SIE	DN
mg	139.3	164.5	98.2	105.3	129.1	341.5	122.2	203.8
gr/DSCF	0.026	0.031	0.017	0.019	0.020	0.054	0.021	0.035
lb/hr	8.58	10.24	5.96	6.66	7.54	20.35	7.36	12.42
lb/ton	0.59	0.71	0.34	0.38	0.37	0.99	0.43	0.69
Total particulates								
Insoluble and ammonium nitrate								
mg	150.3	175.5	119.7	126.8	155.0	367.4	141.7	223.2
gr/DSCF	0.028	0.033	0.021	0.023	0.024	0.058	0.024	0.038
lb/hr	9.26	10.92	7.29	7.99	9.08	21.89	8.54	13.60
lb/ton	0.64	0.76	0.42	0.46	0.45	1.07	0.50	0.76
Percent insoluble catch of total catch	7.3	6.3	18.0	17.0	16.7	7.0	14.0	10.1

[a]Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c]Includes train filter, and impinger water filtrate.

[d]NO_3^- selective electrode analyses results (H_2O fraction only) measured as nitrate and reported as ammonium nitrate. Analysis was performed at the MRI lab in Kansas City, Missouri.

[e]Water fraction results include a 1.45 mg blank correction.

[f]Direct Nessler analyses results (H_2O fraction only) measured as ammonia and reported as ammonium nitrate. Analysis was performed at the MRI lab in Kansas City, Missouri.

[g]Zero blank correction.

TABLE 2-5. AMMONIA CONCENTRATION DETERMINED BY DIRECT NESSLER ANALYSIS FOR THE ROTARY DRUM GRANULATOR SCRUBBER INLET AND OUTLET - ENGLISH UNITS

Run number	Run 3		Run 4		Run 5		Average	
Location	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Date	3/7/79		3/7/79		3/8/79			
Volume of gas sampled - DSCF[a]	58.62	82.44	61.79	87.00	68.96	97.75	63.12	89.06
Percent moisture by volume	2.0	2.9	2.0	3.7	2.0	7.9	2.0	4.8
Average stack temperature - °F	166	100	186	109	180	115	177	108
Stack volumetric flow rate - DSCFM[b]	41,401	38,521	43,442	40,887	49,120	43,969	44,654	41,126
Percent isokinetic	102.6	98.1	103.1	97.5	101.7	101.9	102.5	99.2
Production rate - tons/hr	14.5		17.4		20.5		17.5	
Ammonia concentration and mass flow rates								
Direct Nessler analysis[c,d]								
mg	36,400[g]	69.7	12,301	29.0	14,402	159.0	21,034[g]	85.9
gr/DSCF[e]	9.584	0.013	3.072	0.005	3.228	0.025	5.295	0.014
gr/ACF[f]	7.927	0.012	2.456	0.004	2.595	0.021	4.326	0.012
lb/hr	3,401.0	4.292	1,143.9	1.752	1,359.1	9.422	1,968.0	5.155
lb/ton	234.6	0.296	65.7	0.101	66.3	0.460	122.2	0.286
Collection efficiency, percent	99.9		99.8		99.2		99.6	

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c] Direct Nessler analysis results include both the water and acid fractions measured as ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[d] Zero blank correction.

[e] gr/DSCF = grains per dry standard cubic foot.

[f] gr/ACF = grains per actual cubic foot.

[g] Inlet Run No. 3 acid fraction results are inconsistently high with other test results. There may have been sample carryover in the impinger.

TABLE 2-6. AMMONIA CONCENTRATION DETERMINED BY DIRECT NESSLER ANALYSIS FOR THE ROTARY DRUM GRANULATOR INLET AND OUTLET - METRIC UNITS

Run number	Run 3		Run 4		Run 5		Average	
Location	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Date	3/7/79		3/7/79		3/8/79			
Volume of gas sampled - DNM3[a]	1.66	2.33	1.75	2.46	1.95	2.77	1.79	2.52
Percent moisture by volume	2.0	2.9	2.0	3.7	2.0	7.9	2.0	4.8
Average stack temperature - °C	74	38	86	43	82	46	81	42
Stack volumetric flow rate - DNM3/M[b]	1,172	1,091	1,230	1,158	1,391	1,245	1,264	1,165
Percent isokinetic	102.6	98.1	103.1	97.5	101.7	101.9	102.5	99.2
Production rate - Mg/hr[c]	13.15		15.82		18.60		15.86	
Ammonia concentration and mass flow rates								
Direct Nessler analysis[d,e]								
mg	36,400[i]	69.7	12,301	29.0	14,402	159.0	21,034[i]	85.9
g/normalized cu m[f]	21.93	0.030	7.03	0.012	7.39	0.057	12.12	0.033
g/actual cu m[g]	18.14	0.028	5.62	0.011	5.94	0.048	9.90	0.029
kg/hr	1,542.1	1.964	518.8	0.834	616.8	4.258	892.6	2.352
kg/Mg[h]	117.3	0.149	32.8	0.053	33.2	0.229	61.1	0.144
Collection efficiency, percent	99.9		99.8		99.2		99.6	

[a] Dry normal cubic meters at 20°C, 760 mm Hg.

[b] Dry normal cubic meters per minute at 20°C, 760 mm Hg.

[c] Mg/hr = Megagrams per hour (10^3 kg/hr).

[d] Direct Nessler analysis results include both the water and acid fractions measured as ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[e] Zero blank correction.

[f] g/normalized cubic meters = grams per (dry) normalized cubic meters.

[g] g/actual cubic meters = grams per actual cubic meters.

[h] kg/Mg = kilograms per Megagram.

[i] Inlet Run No. 3 acid fraction results are inconsistently high with other test results. There may have been sample carryover in the impinger.

TABLE 2-7. SUMMARY OF AMMONIA AND AMMONIUM NITRATE EMISSIONS CALCULATED FROM COLLECTED AMMONIA FOR THE ROTARY DRUM GRANULATOR SCRUBBER INLET

Run number Date	Run 3-IS 3/7/79	Run 4-IS 3/7/79	Run 5-IS 3/8/79	Average
Volume of gas sampled - DSCF[a]	58.62	61.79	68.96	63.12
Stack volumetric rate - DSCFM[b]	41,401	43,442	49,120	44,654
Production rate - tons/hr	14.5	17.4	20.5	17.5
Ammonia (laboratory analysis as ammonia)[c,d]	DN	DN	DN	DN
mg	36,400[g]	12,301	14,402	21,034[g]
gr/DSCF	9.584	3.072	3.228	5.295
lb/hr	3,401.0	1,143.9	1,359.1	1,968.0
lb/ton	234.6	65.7	66.3	122.2
Ammonium nitrate Calculated from moles of ammonia[d,e]				
mg	171,294	57,887	67,774	98,985
gr/DSCF	45.100	14.457	15.191	24.916
lb/hr	16,004.4	5,383.2	6,395.8	9,261.1
lb/ton	1,103.8	309.4	312.0	575.1
Excess ammonia Not combined with ammonium nitrate[f]				
mg	25,619[g]	493	2,325	9,479[g]
gr/DSCF	6.745	0.123	0.521	2.463
lb/hr	2,393.6	45.8	219.4	886.3
lb/ton	165.1	2.63	10.70	59.48

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c] Direct Nessler analyses results include both the water and acid fractions measured as ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[d] Zero blank correction.

[e] Direct Nessler analyses results include both the water and acid fractions. The ammonium nitrate data were calculated from the mole fraction of the measured ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[f] SIE water fraction results include a 1.45 mg blank correction. Acid fraction results had zero blank correction.

[g] Inlet Run No. 3 acid fraction results are inconsistently high with other test results. There may have been sample carryover in the impinger.

TABLE 2-8. SUMMARY OF AMMONIA AND AMMONIUM NITRATE EMISSIONS CALCULATED FROM COLLECTED AMMONIA FOR THE ROTARY DRUM GRANULATOR SCRUBBER OUTLET

Run number Date	Run 3-OS 3/7/79	Run 4-OS 3/7/79	Run 5-OS 3/8/79	Average
Volume of gas sampled - DSCF[a]	82.44	87.00	97.75	89.06
Stack volumetric flow rate - DSCFM[b]	38,521	40,887	43,969	41,126
Production rate - tons/hr	14.5	17.4	20.5	17.5
Ammonia (laboratory analysis as ammonia)[c,d]	DN	DN	DN	DN
mg	69.7	29.0	159.0	85.9
gr/DSCF	0.013	0.005	0.025	0.014
lb/hr	4.292	1.752	9.422	5.155
lb/ton	0.296	0.101	0.460	0.286
Ammonium nitrate Calculated from moles of ammonia[d,e]				
mg	328.0	136.5	748.2	404.2
gr/DSCF	0.062	0.024	0.118	0.068
lb/hr	20.5	8.4	44.5	24.5
lb/ton	1.41	0.48	2.17	1.35
Excess ammonia Not combined with ammonium nitrate[f]				
mg	40.1	2.65	121.9	54.9
gr/DSCF	0.008	0.0005	0.019	0.009
lb/hr	2.64	0.175	7.16	3.33
lb/ton	0.18	0.010	0.349	0.180

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c] Direct Nessler analyses results include both the water and acid fractions measured as ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[d] Zero blank correction.

[e] Direct Nessler analyses results include both the water and acid fractions. The ammonium nitrate data were calculated from the mole fraction of the measured ammonia. The lab analyses were performed at the MRI lab in Kansas City, Missouri.

[f] SIE water fraction results include a 1.45 mg blank correction. Acid fraction results had zero blank correction.

TABLE 2-9. SUMMARY OF EMISSION TEST RESULTS-PARTICULATE AND AMMONIUM NITRATE CONCENTRATION (NO_3^- SELECTIVE ION ELECTRODE ANALYSIS) FOR THE OUTLET OF THE ROTARY DRUM COOLER IN ENGLISH AND METRIC UNITS

	Units English	Units Metric	Run 1-ORDC English	Run 1-ORDC Metric	Run 2-ORDC English	Run 2-ORDC Metric	Run 3-ORDC English	Run 3-ORDC Metric	Average English	Average Metric
Date			3/8/79		3/9/79		3/9/79			
Volume of gas sampled	DSCF[d]	DNM3[g]	41.57	1.18	42.41	1.20	41.60	1.18	41.86	1.19
Percent moisture by volume			2.1	2.1	1.5	1.5	1.8	1.8	1.8	1.8
Average stack temperature	°F	°C	99	37	107	42	111	44	106	41
Stack volumetric flow rate	DSCFM[e]	DNM3/M[h]	20,464	579	19,948	565	19,620	556	20,011	567
Percent isokinetic			93.7	93.7	100.7	100.7	100.4	100.4	98.3	98.3
Production rate	ton/hr	Mg/hr[i]	20.85	18.96	20.82	18.87	20.85	18.96	20.84	18.93
Insoluble particulate Filter catch and collection water filtrate[a]										
		mg		69.9		43.1		15.5		42.8
	gr/DSCF[f]	g/NM3[j]	0.02590	0.05925	0.01565	0.03581	0.00574	0.01313	0.01576	0.03606
	lb/hr	kg/hr	4.547	2.064	2.680	1.214	0.965	0.438	2.731	1.239
	lb/ton	kg/Mg[k]	0.218	0.109	0.129	0.064	0.046	0.023	0.131	0.065
Ammonium nitrate particulate NO_3^- selective ion electrode analysis[b,c]										
		mg		5,137.7		4,764.0		4,930.0		4,943.9
	gr/DSCF	g/NM3	1.903	4.354	1.735	3.970	1.826	4.178	1.821	4.167
	lb/hr	kg/hr	333.8	151.3	296.7	134.6	307.1	139.4	312.5	141.8
	lb/ton	kg/Mg	16.0	8.0	14.3	7.1	14.7	7.4	15.0	7.5
Total particulate Insoluble and ammonium nitrate										
		mg		5,207.6		4,807.1		4,945.5		4,986.7
	gr/DSCF	g/NM3	1.929	4.413	1.751	4.010	1.832	4.191	1.837	4.205
	lb/hr	kg/hr	338.3	153.4	299.4	135.8	308.1	139.8	315.3	143.0
	lb/ton	kg/Mg	16.2	8.1	14.4	7.2	14.7	7.4	15.1	7.6

[a]Includes train filter, and impinger water filtrate.

[b]NO_3^- selective ion electrode analyses results (H_2O fraction only) measured as nitrate and reported as ammonium nitrate. Analyses were performed at the MRI lab in Kansas City, Missouri.

[c]Water fraction results include a 1.45 mg blank correction.

[d]Dry standard cubic feet at 68°F, 29.92 in. Hg.

[e]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[f]Grains per dry standard cubic foot.

[g]Dry normal cubic meters at 20°C, 760 mm Hg.

[h]Dry normal cubic meters per minute at 20°C, 760 mm Hg.

[i]Megagrams (10^3 kg) per hour.

[j]Grams per normalized (dry) cubic meters per minute.

[k]Kilograms per megagram (10^3 kg).

TABLE 2-10. SUMMARY OF EMISSION TEST RESULTS AT THE OUTLET OF THE ROTARY DRUM COOLER FOR NITRATE AND AMMONIUM NITRATE UTILIZING AN NO_3^- SELECTIVE ION ELECTRODE AND DIRECT NESSLER ANALYSIS

Run number Date	Run 1-ORDC 3/8/79		Run 2-ORDC 3/9/79		Run 3-ORDC 3/9/79		Average	
Volume of gas sampled - DSCF[a]	41.57		42.41		41.60		41.86	
Percent moisture by volume	2.1		1.5		1.8		1.8	
Average stack temperature - °F	99		107		111		106	
Stack volumetric flow rate - DSCFM[b]	20,464		19,948		19,620		20,011	
Percent isokinetic	93.7		100.7		100.4		98.3	
Static pressure, in. H_2O	-2.6		-2.6		-2.6		-2.6	
Production rate - tons/hr	20.85		20.82		20.85		20.84	
Insoluble particulate								
Filter catch and collection water filtrate[c]								
mg	69.9		43.1		15.5		42.8	
gr/DSCF	0.02590		0.01565		0.00574		0.01576	
lb/hr	4.547		2.680		0.965		2.731	
lb/ton	0.218		0.129		0.046		0.131	
Ammonium nitrate particulate								
Nitrate and ammonium reported as ammonium nitrate	Measured by		Measured by		Measured by		Measured by	
	SIE[d,e]	DN[f,g]	SIE	DN	SIE	DN	SIE	DN
mg	5,137.7	4,469.8	4,764.0	3,591.6	4,930.0	3,737.1	4,943.9	3,932.8
gr/DSCF	1.903	1.656	1.735	1.308	1.826	1.384	1.821	1.449
lb/hr	333.8	290.5	296.7	223.6	307.1	232.7	312.5	248.9
lb/ton	16.0	13.9	14.3	10.7	14.7	11.2	15.0	11.9
Total particulates								
Insoluble and ammonium nitrate								
mg	5,207.6	4,539.7	4,807.1	3,634.7	4,945.5	3,752.6	4,986.7	3,975.7
gr/DSCF	1.929	1.682	1.751	1.324	1.832	1.390	1.837	1.465
lb/hr	338.3	295.0	299.4	226.3	308.1	233.7	315.3	251.7
lb/ton	16.2	14.1	14.4	10.8	14.7	11.2	15.1	12.0
Percent insoluble catch of total catch	1.342	1.540	0.897	1.186	0.313	0.413	0.851	1.046

[a]Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c]Includes train filter, and impinger water filtrate.

[d]NO_3^- selective ion electrode analyses results (H_2O fraction only) measured as nitrate and reported as ammonium nitrate. Analyses were performed at the MRI lab in Kansas City, Missouri.

[e]Water fraction results include a 1.45 mg blank correction.

[f]Direct Nessler analyses results (H_2O fraction only) measured as ammonia and reported as ammonium nitrate. Analyses were performed at the MRI lab in Kansas City, Missouri.

[g]Zero blank correction.

TABLE 2-11. SUMMARY OF AMMONIA AND AMMONIUM NITRATE EMISSIONS CALCULATED FROM COLLECTED AMMONIA FOR THE OUTLET OF THE ROTARY DRUM COOLER

Run number Date	Run 1-ORDC 3/8/79	Run 2-ORDC 3/9/79	Run 3-ORDC 3/9/79	Average
Volume of gas sampled - DSCF[a]	41.57	42.41	41.60	41.86
Stack volumetric flow rate - DSCFM[b]	20,464	19,948	19,620	20,011
Production rate - tons/hr	20.85	20.82	20.85	20.84
Ammonia (laboratory analysis as ammonia)[c,d]	DN	DN	DN	DN
mg	954.1	763.2	796.6	838.0
gr/DSCF	0.353	0.278	0.295	0.309
lb/hr	61.9	47.5	49.6	53.0
lb/ton	3.0	2.3	2.4	2.6
Ammonium nitrate Calculated from moles of ammonia[d,e]				
mg	4,489.9	3,591.5	3,748.7	3,943.4
gr/DSCF	1.663	1.308	1.388	1.453
lb/hr	291.7	223.6	233.4	249.6
lb/ton	14.0	10.7	11.2	12.0
Excess ammonia Not combined with ammonium nitrate				
mg	f	f	f	f
gr/DSCF	f	f	f	f
lb/hr	f	f	f	f
lb/ton	f	f	f	f

[a]Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

[c]Direct Nessler analyses results include both the water and acid fractions measured as ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[d]Zero blank correction.

[e]Direct Nessler analyses results include both the water and acid fractions. The ammonium nitrate data were calculated from the mole fraction of the measured ammonia. The analyses were performed at the MRI lab in Kansas City, Missouri.

[f]No data presented, negative difference.

TABLE 2-12. BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM GRANULATOR SCRUBBER INLET, RUN NO. 1-IS

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	1-IS	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-07-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	85 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	77 DEG F	PERCENT O2	21.00
FILTER SET	10	BAROMETRIC PRESSURE	30.30 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-3.20 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1252 ACFM	IMPACTOR PRESSURE DROP	11.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	10.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	1.219 SCF				

RUN 1-IS SUMMARY- BRINK IMPACTOR RESULTS

STAGE	WEIGHT (GRAMS) TARE	WEIGHT (GRAMS) FINAL	WEIGHT (GRAMS) NET (ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	WITH OUT FILTER CUM	WITH FILTER	WITH FILTER CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.226500	.569700	.342800	97.94	97.94	98.03	98.03		7.00		
1	.416000	.423800	.007400	2.11	100.06	2.12	100.14	1213	3.08	.262	4.64
2	.423800	.424500	.000300	.09	100.14	.09	100.23	2388	1.82	.017	2.37
3	.431300	.431400	-.000300	-.09	100.06	-.09	100.14	3860	1.24	-.023	1.50
4	.427000	.427400	.000000	.00	100.06	.00	100.14	8407	.66	.000	.90
5	.344700	.344900	-.000200	-.06	100.00	-.06	100.09	14079	.41	-.012	.52
FILTER	.262500	.262600	-.000300			-.09	100.00				

.349700 GRAMS COLLECTED= 4.427 GR/SCF

TABLE 2-13. BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM GRANULATOR SCRUBBER INLET, RUN NO. 2-IS

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	2-IS	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-07-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	85 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	73 DEG F	PERCENT O2	21.00
FILTER SET	20	BAROMETRIC PRESSURE	30.30 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-3.10 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1201 ACFM	IMPACTOR PRESSURE DROP	11.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	12.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	1.404 SCF				

RUN 2-IS SUMMARY- BRINK IMPACTOR RESULTS

STAGE	WEIGHT (GRAMS) TARE	FINAL	NET (ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.219300	.983700	.764000	99.67	99.67	99.65	99.65		7.00		
1	.469500	.471600	.001700	.22	99.90	.22	99.87	1164	3.14	.054	4.69
2	.385900	.386500	.000200	.03	99.92	.03	99.90	2291	1.86	.010	2.42
3	.479800	.480400	.000200	.03	99.95	.03	99.92	3703	1.27	.013	1.54
4	.460900	.461600	.000300	.04	99.99	.04	99.96	8064	.67	.012	.93
5	.452100	.452600	.000100	.01	100.00	.01	99.97	13506	.42	.005	.53
FILTER	.259800	.260400	.000200			.03	100.00				

.766700 GRAMS COLLECTED= 8.430 GR/SCF

TABLE 2-14. BRINK IMPACTOR SAMPLING PARAMETERS - ROTARY DRUM GRANULATOR SCRUBBER INLET, RUN NO. 3-IS

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	3-IS	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-06-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	85 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	98 DEG F	PERCENT O2	21.00
FILTER SET	30	BAROMETRIC PRESSURE	30.08 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-4.10 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1184 ACFM	IMPACTOR PRESSURE DROP	11.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	10.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	1.142 SCF				

RUN 3-IS SUMMARY- BRINK IMPACTOR RESULTS

STAGE	-----WEIGHT (GRAMS)----- TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.220900	1.733500	1.512200	99.64	99.64	99.64	99.64		7.00		
1	.472300	.477300	.004600	.30	99.94	.30	99.95	1148	3.17	.180	4.71
2	.493400	.494300	.000500	.03	99.97	.03	99.98	2258	1.87	.030	2.43
3	.462800	.463400	.000200	.01	99.99	.01	99.99	3651	1.28	.016	1.55
4	.480700	.481300	.000200	.01	100.00	.01	100.01	7950	.68	.010	.93
5	.469700	.470100	.000000	.00	100.00	.00	100.01	13314	.42	.000	.53
FILTER	.261900	.262200	-.000100			-.01	100.00				

1.517600 GRAMS COLLECTED=20.511 GR/SCF

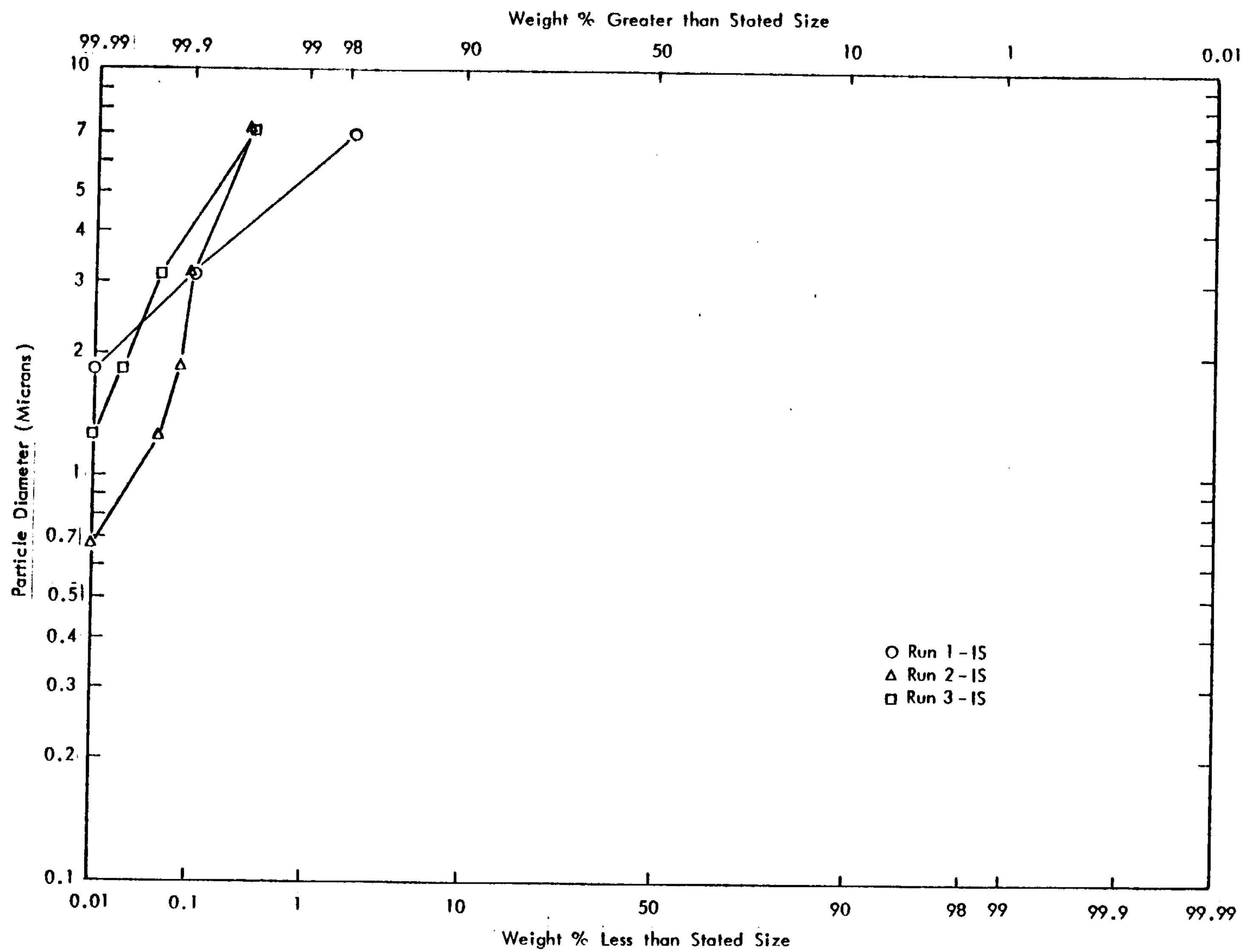


Figure 2-1. Brink impactor particle size results: particulate diameter versus percent weight less/greater than stated size - rotary drum granulator at inlet to scrubber, run Nos. 1 through 3.

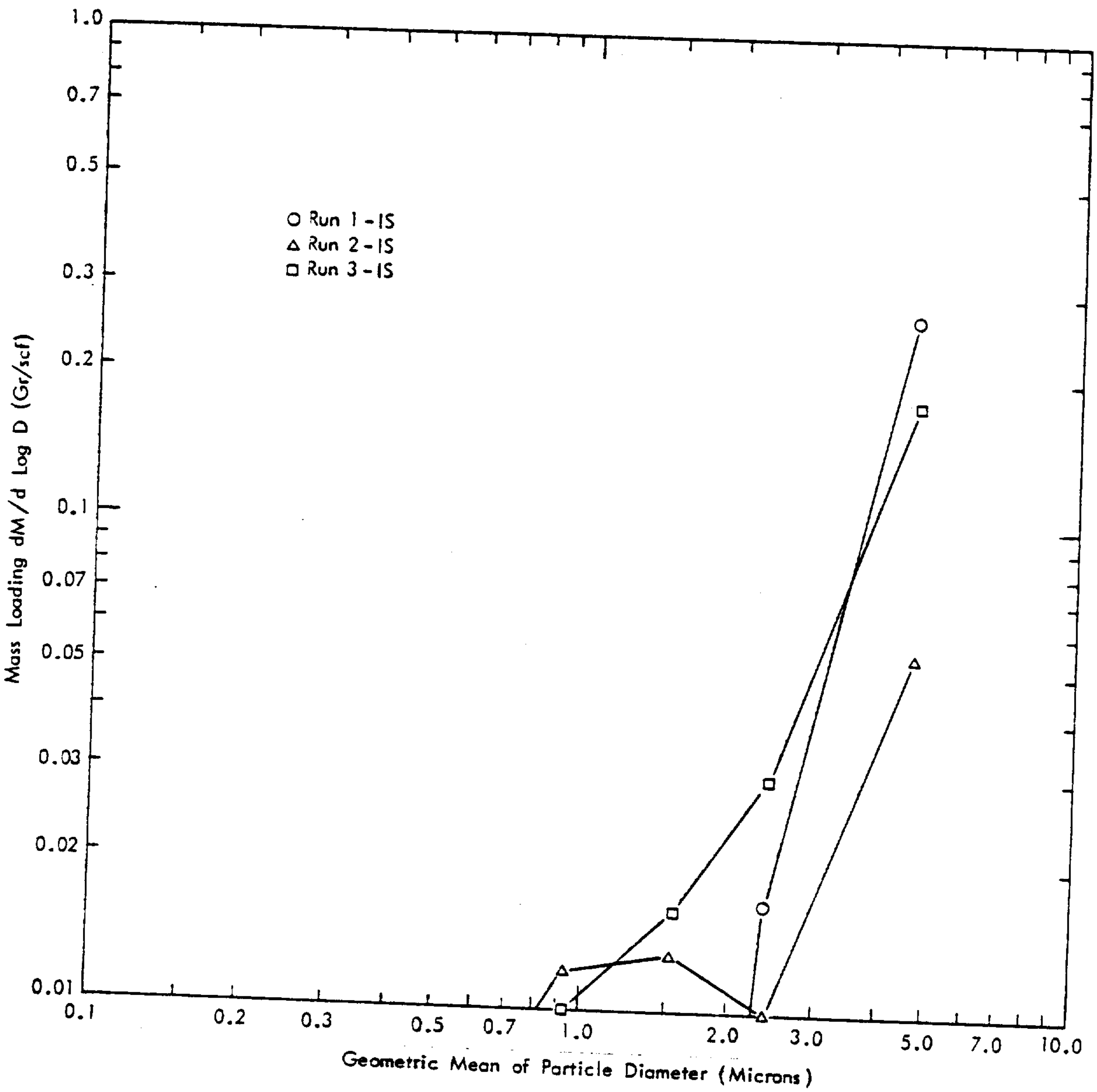


Figure 2-2. Brink impactor particle size results: differential mass-loading (dM/d Log D) versus particulate diameter - rotary drum granulator at inlet to scrubber, run Nos. 1 through 3.

TABLE 2-15. BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM COOLER OUTLET, RUN NO. 1-CO

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	1-CO	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-08-79	AMBIENT TEMPERATURE	4. DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	1. DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	78. DEG F	PERCENT O2	21.00
FILTER SET	40	BAROMETRIC PRESSURE	30.08 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-2.60 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1396 ACFM	IMPACTOR PRESSURE DROP	15.10 IN HG	PERCENT H2O	2.00
SAMPLING TIME	14.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	2.236 SCF				

RUN 1-CO SUMMARY- BRINK IMPACTOR RESULTS

STAGE	-----WEIGHT (GRAMS)----- TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.224200	.314200	.089600	99.45	99.45	100.11	100.11		7.00		
1	.423100	.425000	.001500	1.66	101.11	1.68	101.79	1353.	2.77	.026	4.40
2	.474900	.475100	-.000200	-.22	100.89	-.22	101.56	2663.	1.64	-.006	2.13
3	.347900	.348100	-.000200	-.22	100.67	-.22	101.34	4305.	1.12	-.008	1.36
4	.464900	.465100	-.000200	-.22	100.44	-.22	101.12	9374.	.59	-.005	.82
5	.473200	.473200	-.000400	-.44	100.00	-.45	100.67	15699.	.36	-.013	.47
FILTER	.268300	.268100	-.000600			-.67	100.00				

.089500 GRAMS COLLECTED= .618 GR/SCF

TABLE 2-16. BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM COOLER OUTLET, RUN NO. 2-CO

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	2-CO	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-09-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	1 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	74 DEG F	PERCENT O2	21.00
FILTER SET	50	BAROMETRIC PRESSURE	30.07 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-2.60 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1377 ACFM	IMPACTOR PRESSURE DROP	15.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	14.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	2.205 SCF				

RUN 2-CO SUMMARY- BRINK IMPACTOR RESULTS

STAGE	WEIGHT (GRAMS) TARE	WEIGHT (GRAMS) FINAL	WEIGHT (GRAMS) NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	WITH OUT FILTER CUM	WITH FILTER	WITH FILTER CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.222900	.418700	.195400	98.24	98.24	98.24	98.24		7.00		
1	.486400	.489500	.002700	1.36	99.60	1.36	99.60	1335	2.79	.047	4.42
2	.463400	.464200	.000400	.20	99.80	.20	99.80	2626	1.65	.012	2.14
3	.471400	.472100	.000300	.15	99.95	.15	99.95	4246	1.13	.013	1.37
4	.506100	.506600	.000100	.05	100.00	.05	100.00	9246	.60	.003	.82
5	.483300	.483700	.000000	.00	100.00	.00	100.00	15485	.37	.000	.47
FILTER	.260200	.260600	.000000			.00	100.00				

.198900 GRAMS COLLECTED= 1.392 GR/SCF

TABLE 2-17. BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM COOLER OUTLET, RUN NO. 3-CO

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	3-CO	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-09-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	1 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	77 DEG F	PERCENT O2	21.00
FILTER SET	60	BAROMETRIC PRESSURE	30.07 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-2.60 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1392 ACFM	IMPACTOR PRESSURE DROP	15.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	14.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	2.229 SCF				

RUN 3-CO SUMMARY- BRINK IMPACTOR RESULTS

STAGE	WEIGHT (GRAMS) TARE	WEIGHT (GRAMS) FINAL	WEIGHT (GRAMS) NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	WITH OUT FILTER CUM	WITH FILTER	WITH FILTER CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.222500	.330300	.107400	101.32	101.32	102.29	102.29		7.00		
1	.488400	.490700	.001900	1.79	103.11	1.81	104.10	1349	2.77	.033	4.40
2	.507600	.507700	-.000300	-.28	102.83	-.29	103.81	2655	1.64	-.009	2.13
3	.473600	.473100	-.000900	-.85	101.98	-.86	102.95	4292	1.12	-.038	1.36
4	.487600	.487000	-.001000	-.94	101.04	-.95	102.00	9347	.60	-.025	.82
5	.489100	.488400	-.001100	-1.04	100.00	-1.05	100.95	15654	.36	-.036	.47
FILTER	.265700	.265100	-.001000			-.95	100.00				

.105000 GRAMS COLLECTED= .727 GR/SCF

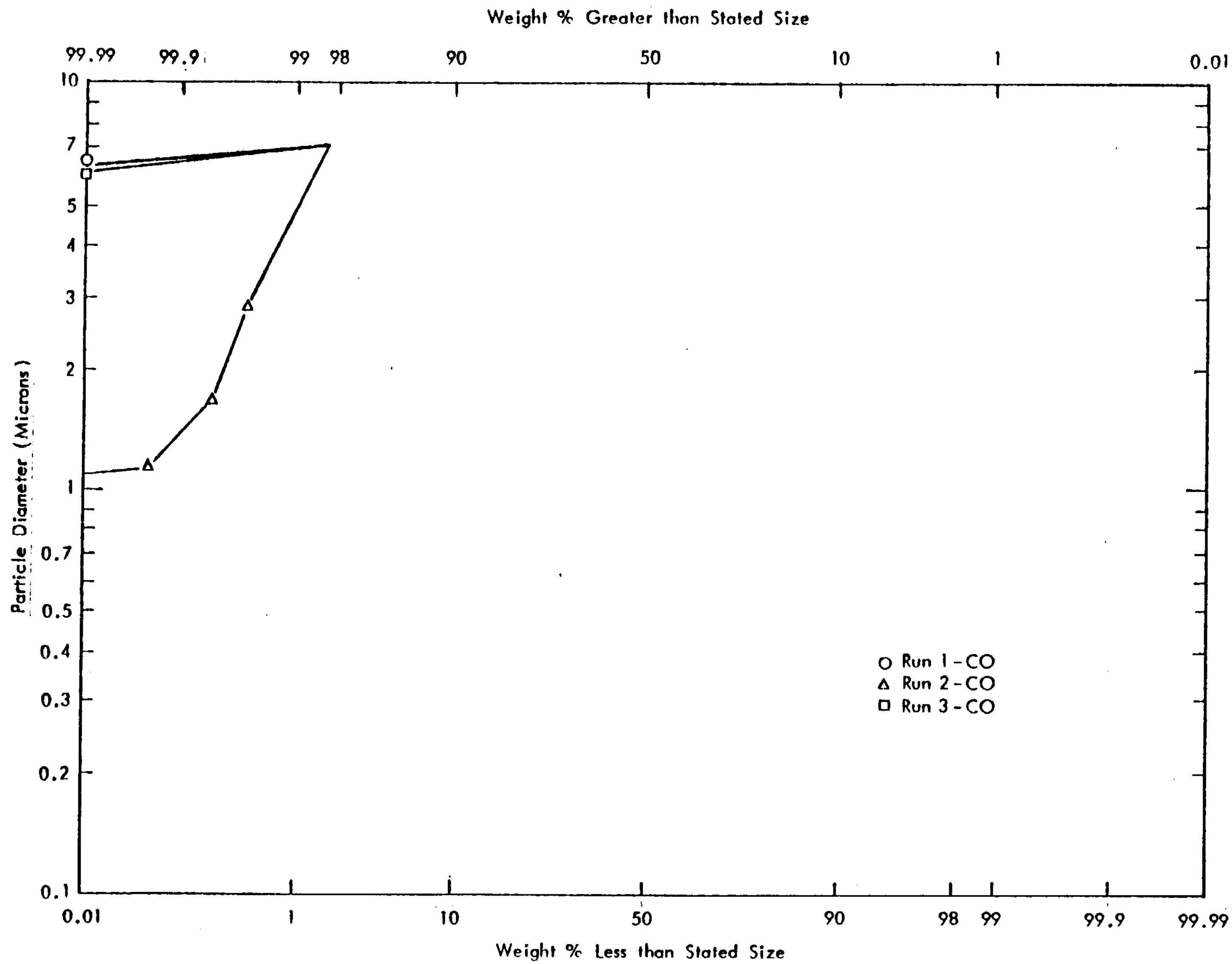


Figure 2-3. Brink impactor particle size results: particulate diameter versus percent weight less/greater than stated size - rotary drum cooler outlet, run Nos. 1 through 3.

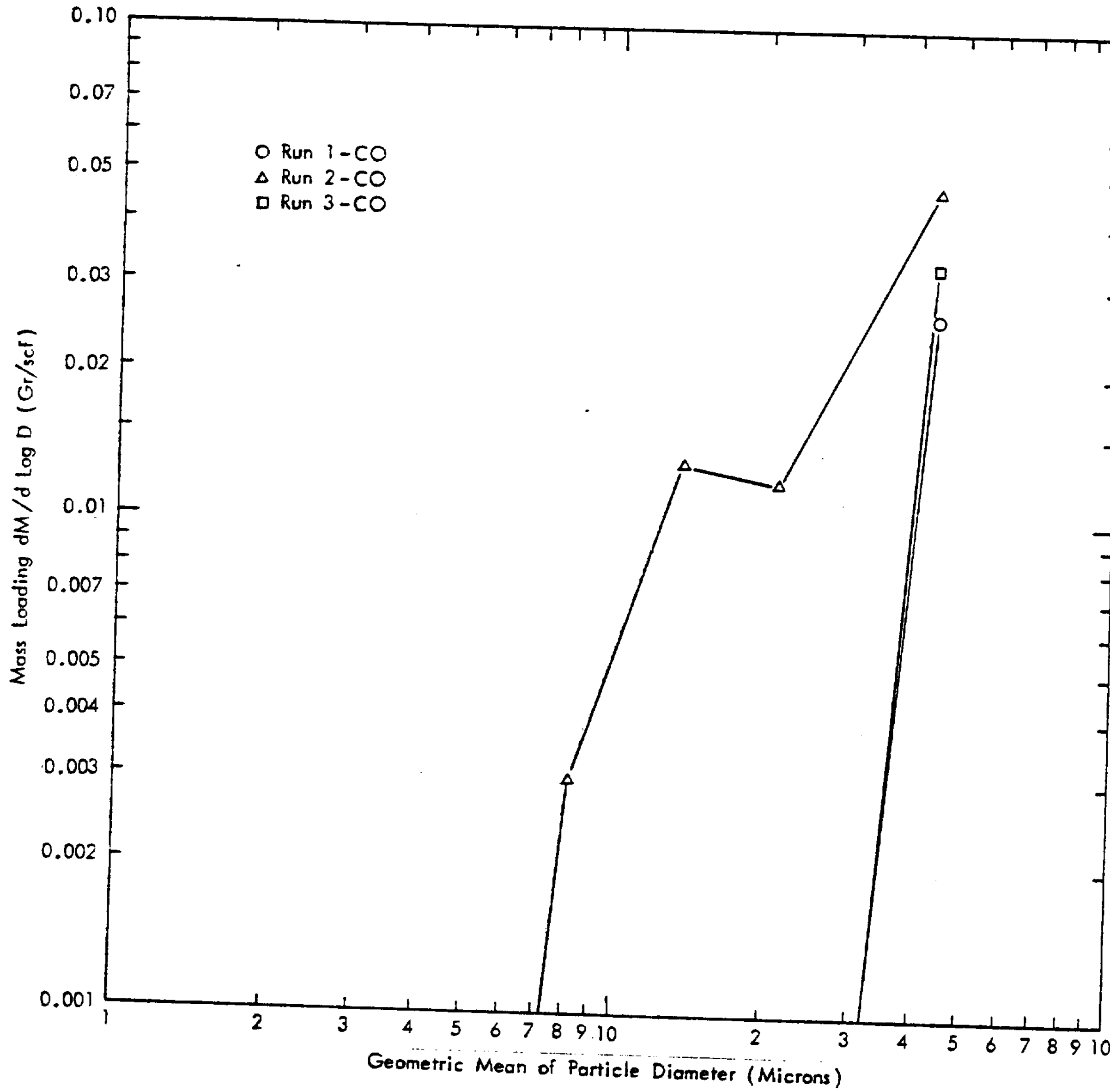


Figure 2-4. Brink impactor particle size results: differential mass-loading (dM/d Log D) versus particulate diameter - rotary drum cooler outlet, run Nos. 1 through 3.

TABLE 2-18. SIX MINUTE ARITHMETIC AVERAGE OPACITY READINGS FROM THE ROTARY DRUM GRANULATOR SCRUBBER OUTLET STACK, MARCH 7 AND 8, 1979

Time	Average opacity for ~ 6 min intervals, (%)	Date	MRI scrubber inlet test No.	MRI scrubber outlet test No.
16:40:15-16:46	5.0	03-07-79		
16:46:15-16:52	5.0			
16:52:15-16:58	5.0			
16:58:15-17:04	5.0		4-IS	4-OS
17:04:15-17:10	5.2			
17:10:15-17:16	5.4			
17:16:15-17:22	5.2			
17:22:15-17:28	5.6			
Average	5.2			
09:20-09:25:45	12.9	03-08-79		
09:26-09:31:45	13.5			
09:32-09:37:45	13.5			
Average	13.3			
09:52:15-09:58	14.0			
09:58:15-10:04	15.8			
10:04:15-10:10	14.8			
10:10:15-10:16	14.4			
10:16:15-10:22	14.8			
10:22:15-10:28	15.4			
Average	14.8			
10:33:45-10:39:30	17.3			
10:39:45-10:45:30	15.0			
10:45:45-10:51:30	15.8			
10:51:45-10:57:30	15.8			
Average	16.0		5-IS	5-OS
11:08:15-11:14	17.9			
11:14:15-11:20	15.6			
Average	16.8			
11:26-11:31:45	15.6			
11:32-11:37:45	14.6			
11:38-11:43:45	12.9			
Average	14.4			
11:50:15-11:56	14.4			
11:56:15-12:02	15.0			
12:02:15-12:08	14.2			
12:08:15-12:14	16.5			
12:14:15-12:20	17.5			
12:20:15-12:26	13.1			
12:26:15-12:32	13.8			
12:32:15-12:38	13.5			
12:38:15-12:44	12.1			
12:44:15-12:50	13.1			
12:50:15-12:56	14.4			
12:56:15-13:02	13.8			
Average	14.3			
13:35-13:40:45	19.4			
13:41-13:46:45	15.0			
13:47-13:52:45	14.4			
13:53-13:58:45	17.1			
Average	16.5			
14:03-14:08:45	15.4			
14:09-14:14:45	16.3			
14:15-14:20:45	17.3			
14:21-14:26:45	12.9			
14:27-14:32:45	14.6			
Average	15.3			
14:33-14:38:45	14.6			
14:39-14:44:45	15.8			
14:45-14:50:45	16.3			
14:51-14:56:45	13.5			
Average	15.1			

* Opacity observations recorded from the rotary drum granulator scrubber outlet stack correspond to MRI test 1-URDC at the uncontrolled outlet of the rotary drum cooler.

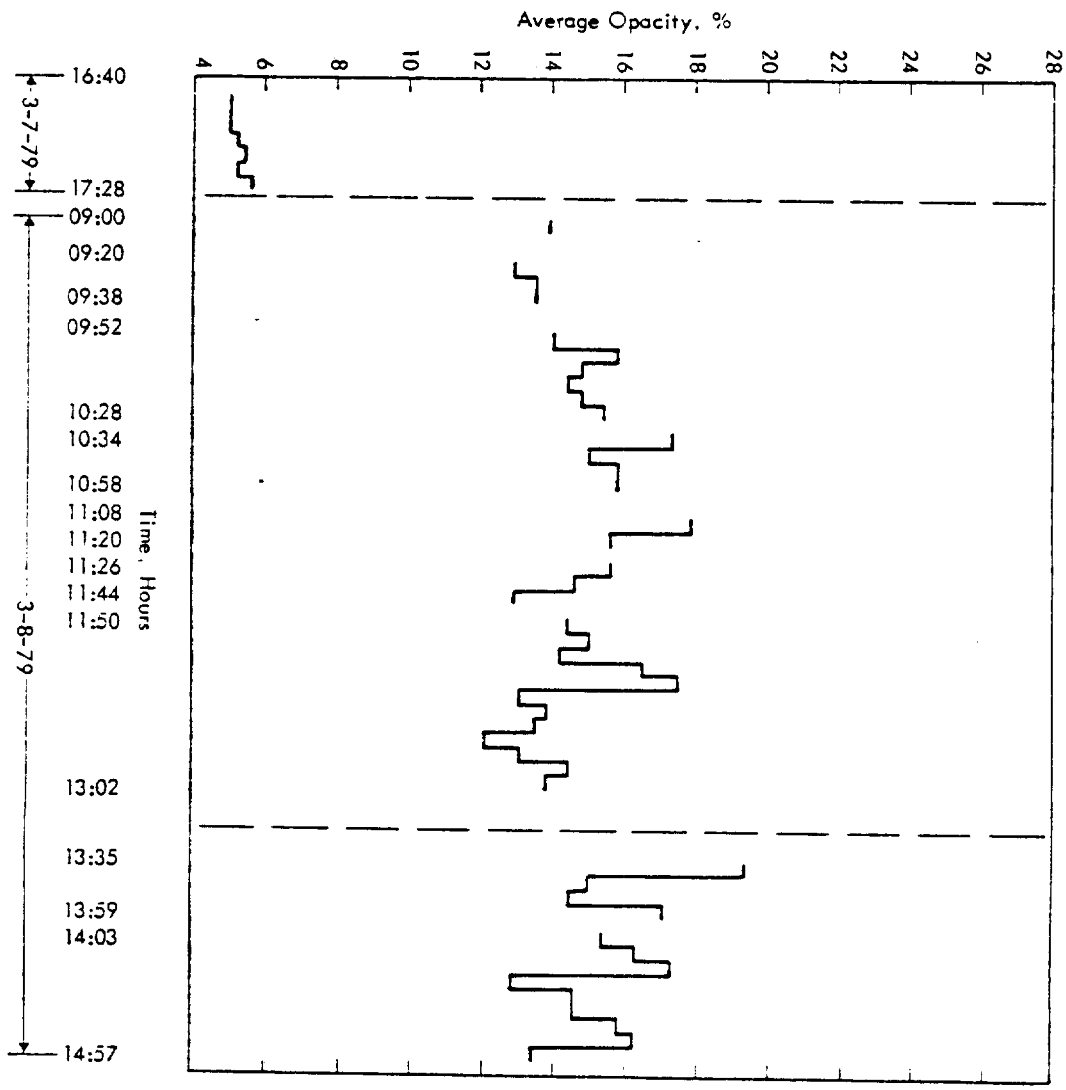


Figure 2-5. Summary of EPA Method 9 visible emissions from the rotary drum granulator scrubber outlet stack, March 7 and 8, 1979.

Pressure Drop Measurement Test Data

The inlet-to-outlet pressure drop measurements made at the rotary drum granulator scrubber are presented in Table 2-19. The results are graphically presented in Figure 2-6. The pressure drop measurements recorded from the rotary drum cooler are presented in Table 2-20. The results are graphically presented in Figure 2-7.

Relative Humidity and Ambient Temperature Measurement Test Data

The data for the relative humidity and ambient temperature measurements collected during emissions testing of the rotary drum granulator scrubber are presented in Table 2-21. The relative humidity results are graphically presented in Figure 2-8. The relative humidity and ambient temperature measurements collected during emissions testing of the uncontrolled rotary drum cooler are presented in Table 2-22. The relative humidity results are graphically presented in Figure 2-9.

Scrubber Liquor Test Data

The results of the chemical analysis of the scrubber liquor entering and exiting the rotary drum granulator scrubber on March 7 and 8, 1979, have been summarized in Table 2-23. The results of individual sample temperature and pH measurements have been tabulated in Table 2-24.

Process Sample Test Data

Process sample data results of product samples collected from the rotary drum granulator and rotary drum cooler have been summarized in Tables 2-25, 2-26, and 2-27. The chemical analysis data have been tabulated in Table 2-25. The sieve analysis and bulk density determination data of the unscreened granulator product samples collected during emissions testing are presented in Table 2-26. The sieve analysis and bulk density determination data of the screened product samples collected at the inlet to and outlet of the rotary drum cooler during emissions testing are presented in Table 2-27.

TABLE 2-19. ROTARY DRUM GRANULATOR SCRUBBER INLET-TO-OUTLET PRESSURE DROP MEASUREMENTS DURING EMISSIONS TESTING, MARCH 7 AND 8, 1979

Date	Clock time	ΔP cm H_2O	ΔP in. H_2O	Date	Clock time	ΔP cm H_2O	ΔP in. H_2O
03-07-79	0915	27.1	10.7	03-08-79	0916	33.8	13.3
(Scrubber in-	1003	*	*	(Scrubber in-	0932	34.8	13.7
let test No.	1019	*	*	let test No.	0947	33.5	13.2
3-IS and out-	1030	26.2	10.3	5-IS and out-	1003	31.8	12.5
let test No.	1047	25.7	10.1	let test No.	1018	31.8	12.5
3-OS)	1103	25.1	9.9	5-OS)	1033	31.2	12.3
	1118	25.1	9.9		1048	32.0	12.6
	1130	25.9	10.2		1103	32.8	12.9
	1145	23.9	9.4		1117	32.0	12.6
	1204	23.9	9.4		1134	32.0	12.6
	1217	24.1	9.5		Average	32.6	12.8
	1230	23.4	9.2				
	1245	22.4	8.8				
	1300	21.8	8.6				
	Average	24.6	9.7				
Scrubber in-	1445	24.6	9.7				
let test No.	1500	26.4	10.4				
4-IS and out-	1515	25.1	9.9				
let test No.	1530	26.7	10.5				
4-OS)	1545	26.7	10.5				
	1600	26.4	10.4				
	1615	25.9	10.2				
	1630	26.4	10.4				
	1645	26.4	10.4				
	1710	25.4	10.0				
	Average	26.0	10.2				

* Plugged inlet hose, no reading available.

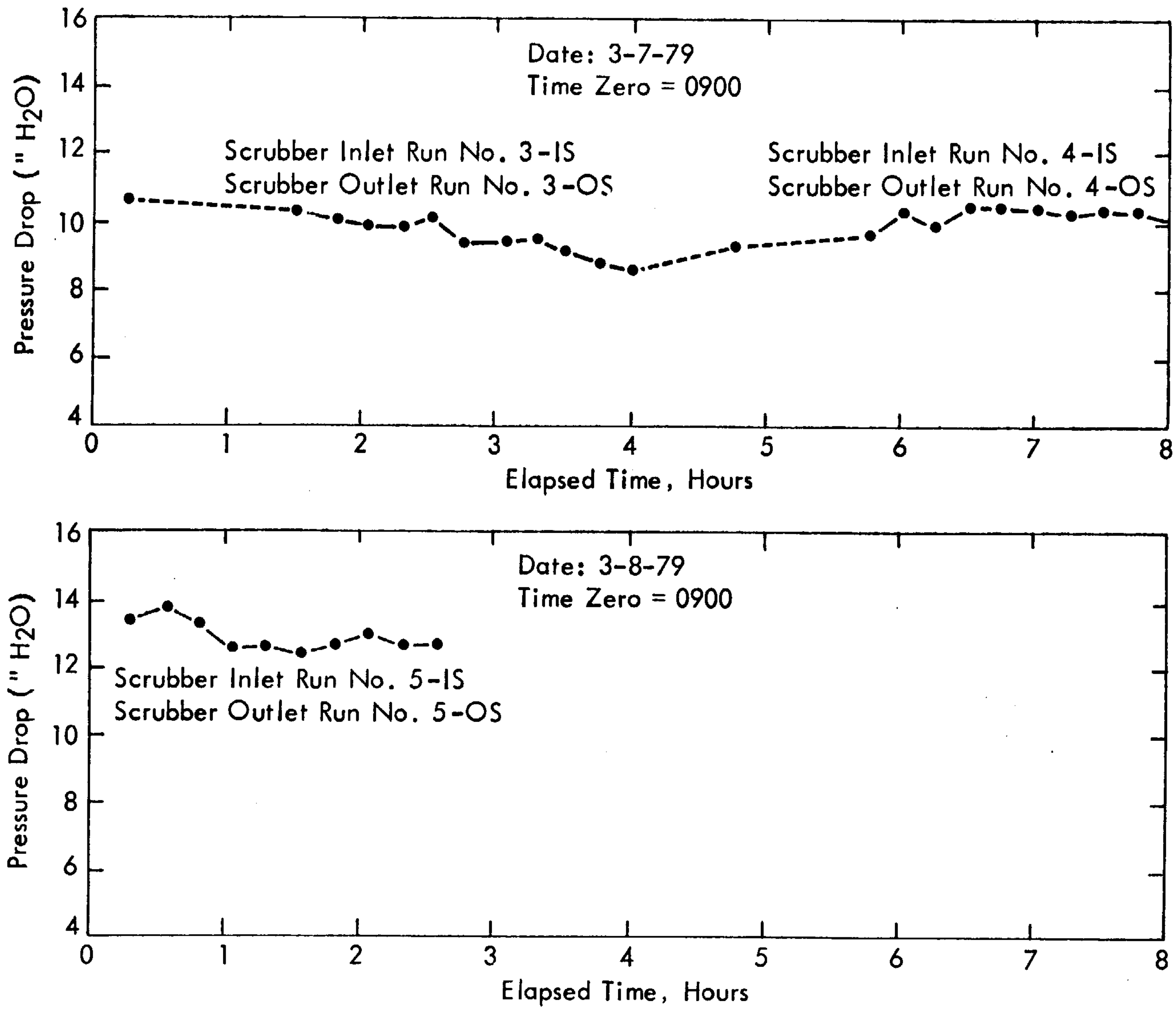


Figure 2-6. Summary of rotary drum granulator scrubber inlet-to-outlet pressure drop measurements during emissions testing, March 7 and 8, 1979.

TABLE 2-20. ROTARY DRUM COOLER PRESSURE DROP MEASUREMENTS DURING EMISSIONS TESTING, MARCH 8 AND 9, 1979

Date	Clock time	ΔP cm H_2O	ΔP in. H_2O
03-08-79 (Cooler outlet test No. 1-ORDC)	1405	30.0	11.8
	1418	31.2	12.3
	1433	30.2	11.9
	1448	31.8	12.5
	1505	31.8	12.5
	1518	31.5	12.4
	1533	32.0	12.6
	Average	31.2	12.3
03-09-79 (Cooler outlet test No. 2-ORDC)	0845	12.7	5.0
	0930	12.2	4.8
	0945	12.2	4.8
	1000	12.2	4.8
	1015	12.4	4.9
	1030	12.2	4.8
	1045	12.2	4.8
	1100	12.2	4.8
	Average	12.3	4.8
(Cooler outlet test No. 3-ORDC)	1515	11.4	4.5
	1530	11.4	4.5
	1545	11.7	4.6
	1600	11.4	4.5
	1615	11.4	4.5
	Average	11.5	4.5

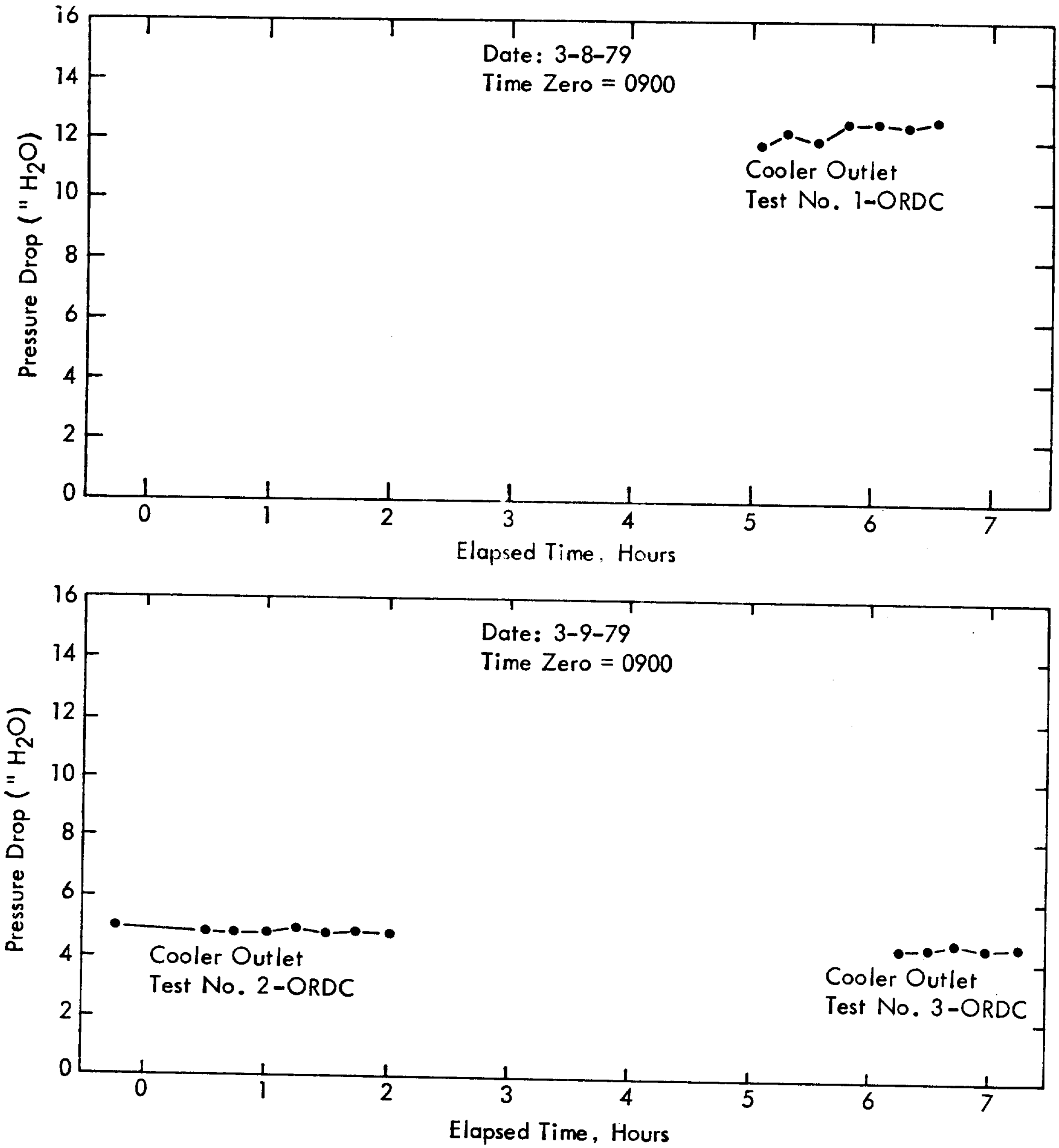


Figure 2-7. Summary of rotary drum cooler pressure drop measurements during emissions testing, March 8 and 9, 1979.

TABLE 2-21. AMBIENT TEMPERATURE AND RELATIVE HUMIDITY MEASUREMENTS DURING EMISSIONS TESTING OF THE ROTARY DRUM GRANULATOR SCRUBBER, MARCH 7 AND 8, 1979

Date	Clock time	Ambient temperature				Relative humidity, (%)
		Dry bulb		Wet bulb		
		(°C)	(°F)	(°C)	(°F)	
03-07-79 (Scrubber inlet test No. 3-IS and outlet test No. 3-OS)	0915	15.0	59.0	10.3	50.6	57
	1000	17.0	62.6	10.9	51.6	46
	1015	17.7	63.8	11.3	52.3	43
	1030	17.9	64.3	11.3	52.4	43
	1045	17.8	64.1	11.6	52.8	44
	1100	18.8	65.8	11.6	52.8	40
	1115	19.1	66.4	11.7	53.1	40
	1130	19.3	66.7	11.4	52.6	37
	1145	19.9	67.9	11.8	53.2	34
	1200	20.1	68.1	11.7	53.1	34
	1215	20.1	68.2	12.1	53.8	38
	1230	21.1	70.0	12.2	54.0	33
	1245	21.9	71.5	12.9	55.2	31
Average		18.9	66.0	11.6	44.8	40
(Scrubber inlet test No. 4-IS and outlet test No. 4-OS)	1445	25.2	77.4	13.7	56.6	26
	1500	25.2	77.4	13.1	55.6	26
	1515	25.1	77.2	14.1	57.4	23
	1530	24.9	76.8	13.1	55.6	23
	1545	24.9	76.8	13.5	56.3	23
	1600	25.0	77.0	13.7	56.6	26
	1615	24.8	76.7	13.5	56.3	23
	1630	24.3	75.8	13.3	56.0	25
	1645	24.1	75.4	13.6	56.4	27
	1710	23.9	75.0	13.5	56.3	27
Average		24.7	76.6	13.5	56.3	23
03-08-79 (Scrubber inlet test No. 5-IS and outlet test No. 5-OS)	0900	13.3	55.9	9.0	48.2	55
	0915	13.5	56.3	9.3	48.8	55
	0930	15.0	59.0	9.3	48.8	47
	0945	15.5	59.9	9.1	48.4	39
	1000	16.1	61.0	9.4	49.0	40
	1015	16.6	61.8	9.4	49.0	36
	1030	16.9	62.5	9.7	49.5	37
	1045	17.1	62.8	9.7	49.5	37
	1100	17.1	62.8	9.7	49.5	37
	1115	17.6	63.6	10.0	50.0	34
	1130	17.9	64.3	10.2	50.4	34
Average		16.1	60.9	9.5	49.2	41

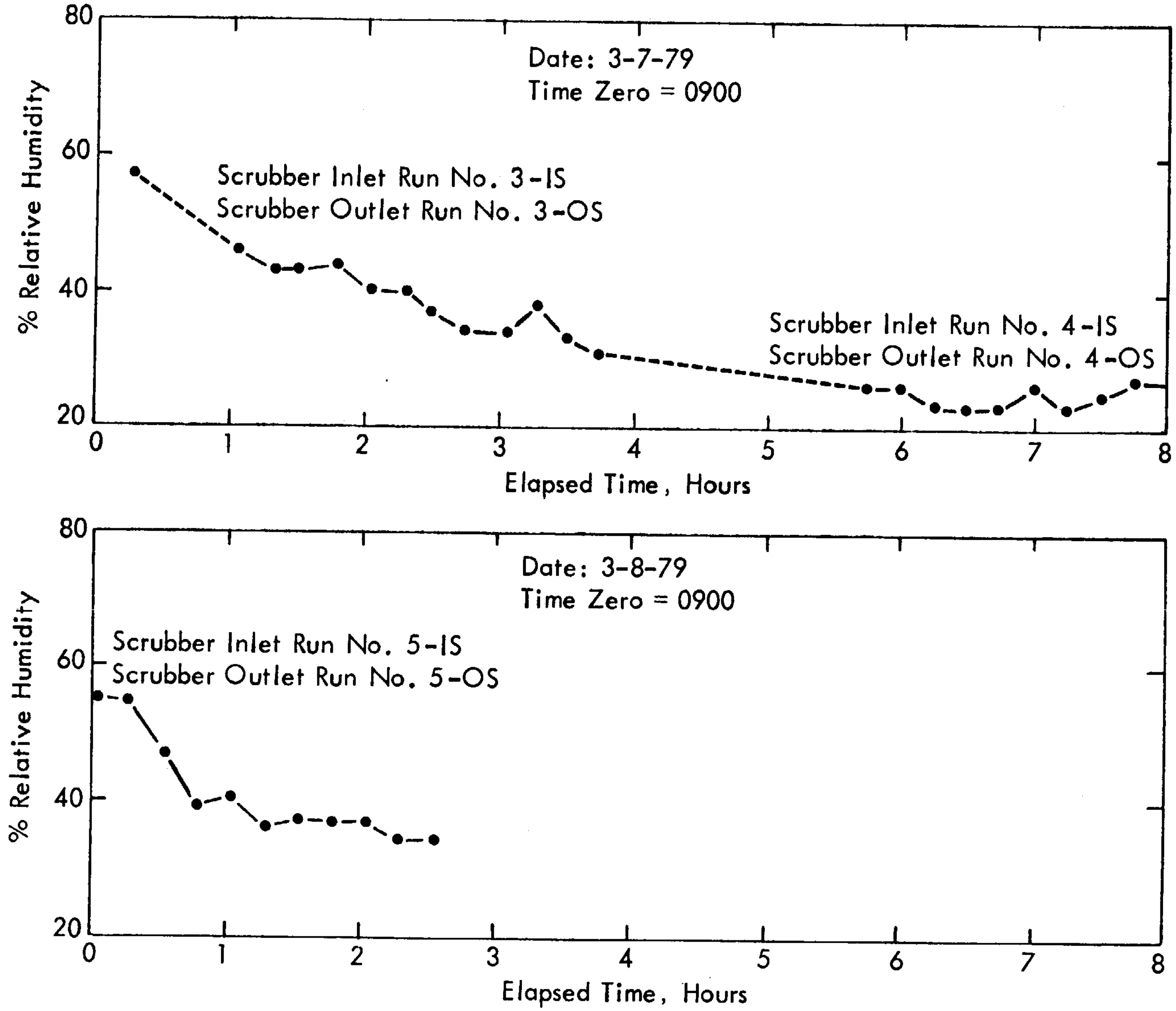


Figure 2-8. Summary of relative humidity measurements during emissions testing of the rotary drum granulator scrubber, March 7 and 8, 1979.

TABLE 2-22. AMBIENT TEMPERATURE AND RELATIVE HUMIDITY MEASUREMENTS DURING EMISSIONS TESTING OF THE ROTARY DRUM COOLER, MARCH 8 AND 9, 1979

Date	Date time	Ambient temperature				Relative humidity, (%)
		Dry bulb		Wet bulb		
		(°C)	(°F)	(°C)	(°F)	
03-08-79	1400	23.0	74.0	13.4	56.2	29
(Run No.	1415	23.7	74.7	13.7	56.7	30
1-ORDC)	1430	24.0	75.2	13.7	56.6	30
	1445	24.3	75.8	14.1	57.4	28
	1500	24.3	75.8	13.9	57.0	28
	1515	24.6	76.2	13.9	57.0	28
Average		24.0	75.3	13.8	56.8	29
03-09-79	0845	20.8	69.4	18.1	64.6	85
(Run No.	0930	22.3	72.2	18.4	65.2	69
2-ORDC)	0945	22.3	72.2	18.6	65.4	69
	1000	22.8	73.1	18.7	65.6	73
	1015	23.0	73.4	18.6	65.4	73
	1030	23.2	73.8	18.8	65.8	69
	1045	23.4	74.1	18.6	65.4	69
	1100	24.2	75.5	18.8	65.8	62
Average		22.8	73.0	18.6	65.4	71
(Run No.	1515	25.0	77.0	19.1	66.3	56
3-ORDC)	1530	25.1	77.2	19.1	66.4	56
	1545	25.2	77.3	19.1	66.4	56
	1600	25.3	77.5	19.1	66.3	53
	1615	25.3	77.5	18.9	66.0	53
Average		25.2	77.3	19.1	66.3	55

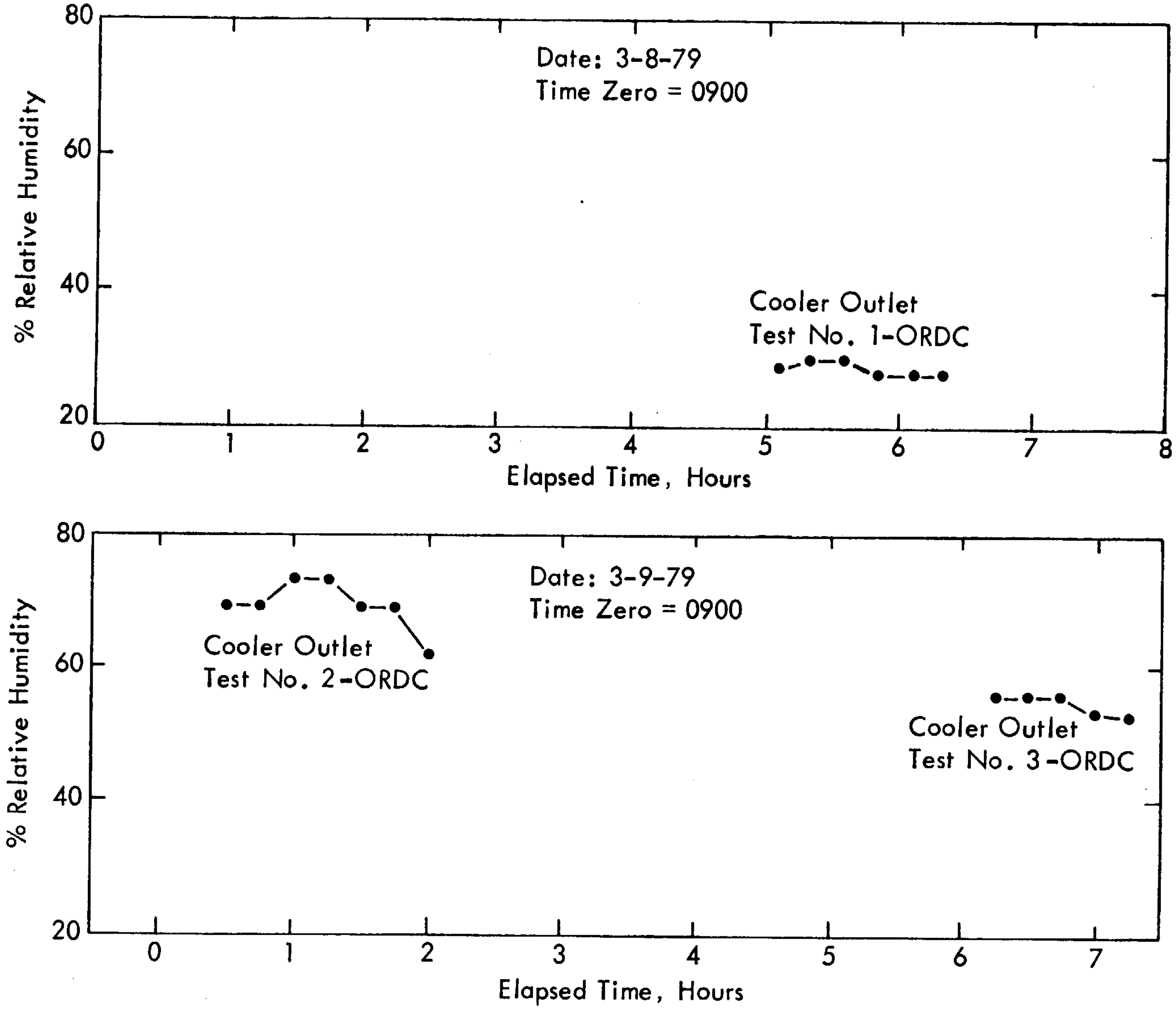


Figure 2-9. Summary of relative humidity measurements during emissions testing of the rotary drum cooler, March 8 and 9, 1979.

TABLE 2-23. SUMMARY OF CHEMICAL ANALYSIS DATA ON THE SCRUBBER LIQUOR ENTERING AND EXITING THE ROTARY DRUM GRANULATOR SCRUBBER DURING EMISSIONS TESTING, MARCH 7 AND 8, 1979

Run No.:	Run 3		Run 4		Run 5			
Date:	03-07-79		03-07-79		03-08-79		Average	
Sample location	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Ammonium nitrate concentration (mg/ℓ x 10^{-5})[a]								
Specific ion electrode analysis	2.40	5.47	1.99	7.04	1.57	7.38	2.15	6.63
Direct Nessler analysis	2.94	5.92	2.21	7.12	1.56	7.72	2.24	6.91
Ammonia concentration (mg/ℓ)			Did not do SIE on these samples					
Specific ion electrode analysis								
Direct Nessler analysis	62	126	47	152	33	164	47	147
pH[b]	6.60	6.05	6.57	5.19	7.17	5.84	6.78	5.69
Temperature:[c]								
°C	51	34	52	37	62	38	55	36
°F	124	94	125	99	143	100	131	98

a Milligrams per liter x 10^{-5}.

b Average of several individual liquor samples taken during each run.

c Average of individual temperatures taken shortly after collection.

TABLE 2-24. SUMMARY OF pH AND TEMPERATURE MEASUREMENTS ON INDIVIDUAL SAMPLES OF SCRUBBER LIQUOR ENTERING AND EXITING THE ROTARY DRUM GRANULATOR SCRUBBER DURING EMISSIONS TESTING, MARCH 7 AND 8, 1979

Run No.	Date	Sampling time	Scrubber inlet pH	Scrubber inlet °C	Scrubber inlet °F	Scrubber outlet pH	Scrubber outlet °C	Scrubber outlet °F
3	03-07-79	1030	6.65	58	136	-	-	-
		1045	-		-	5.99	33	92
		1115	6.70	49	120	5.80	34	94
		1145	6.60	49	121	6.18	34	94
		1215	-		-	5.74	34	94
		1230	6.52	51	123	-		-
		1245	-		-	6.55	34	94
		1300	6.51	50	122			
		Average	6.60	51	124	6.05	34	94
4	03-07-79	1500	6.59	49	121	5.23	37	98
		1530	6.55	51	124	-		-
		1545	-		-	5.00	37	98
		1600	6.57	53	127	-		-
		1615	-		-	5.11	37	99
		1645	6.55	53	128	5.30	37	99
		1715	-	-	-	5.29	37	99
		1745	6.60	52	125	-		-
		Average	6.57	52	125	5.19	37	99
5	03-08-79	0915	7.35	60	140	6.00	37	99
		0945	7.30	62	143	5.95	38	100
		1015	7.10	60	140	-		-
		1030	-	-	-	5.80	38	100
		1100	6.99	62	144	5.76	38	100
		1115	7.10	66	150	-		-
		1130	-	-	-	-	38	100
		Average	7.17	62	143	5.84	38	100

TABLE 2-25. SUMMARY OF CHEMICAL ANALYSIS RESULTS FOR PROCESS PRODUCT SAMPLES COLLECTED FROM THE ROTARY DRUM GRANULATOR AND ROTARY DRUM COOLER, MARCH 6 TO 9, 1979

Sample No.	Sample location	Date collected	Concentration (mg/ℓ) NH_4NO_3 by Nessler analysis	Concentration (mg/ℓ) NH_3 by Nessler analysis
301	Granulator inlet AN melt	03-06-79	4.12×10^5	87,660
303	Granulator outlet product composite	03-07 to 03-08-79	2.3×10^4	4,964
304	Cooler inlet product composite	03-08 to 03-09-79	2.5×10^4	5,312
305	Cooler outlet product composite	03-08 to 03-09-79	2.2×10^4	4,587

TABLE 2-26. SUMMARY OF SIEVE ANALYSIS AND BULK DENSITY DETERMINATIONS OF THE UNSCREENED PRODUCT SAMPLES COLLECTED DURING EMISSIONS TESTING OF THE ROTARY DRUM GRANULATOR SCRUBBER, MARCH 7 AND 8, 1979

	Scrubber emission test numbers								
	Inlet 3-IS		Outlet 3-OS	Inlet 4-IS		Outlet 4-OS	Inlet 5-IS		Outlet 5-OS
	Sample collected 03/07/79			Sample collected 03/07/79			Sample collected 03/08/79		
	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass
Sieve size:									
Sieve No. 6	-	10.0	100	-	18.0	100	-	21.9	100
Sieve No. 8	-	23.2	90.0	-	27.2	81.6	-	18.4	78.2
Sieve No. 12	-	37.8	67.0	-	34.0	54.4	-	31.2	59.8
Sieve No. 14	-	12.9	29.2	-	10.5	20.4	-	12.2	28.6
Sieve No. 16	-	8.4	16.4	-	5.8	9.9	-	8.2	16.4
Sieve No. 20	-	6.7	8.0	-	3.6	4.1	-	6.9	8.2
Pan	-	1.3	1.3	-	0.5	0.5	-	1.3	1.3
Bulk density:									
Grams per 250 mℓ	216.0			218.1			221.8		
lb/ft^3	53.94			54.46			55.38		

a Volumetrically determined.

b Percent of total mass retained on indicated sieve size.

TABLE 2-27. SUMMARY OF SIEVE ANALYSIS AND BULK DENSITY DETERMINATIONS OF THE SCREENED PRODUCT SAMPLES COLLECTED AT THE INLET TO AND OUTLET OF THE ROTARY DRUM COOLER DURING EMISSIONS TESTING OF THE ROTARY DRUM COOLER, MARCH 8 AND 9, 1979

	Rotary drum cooler outlet emissions test No. 1-ORDC					
	Sample collected 03/08/79 at inlet to cooler			Sampled collected 03/08/79 at outlet of cooler		
	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass
Sieve size:						
Sieve No. 6	-	2.9	100	-	3.8	100
Sieve No. 8	-	48.0	97.0	-	52.7	96.4
Sieve No. 12	-	41.3	49.0	-	37.8	43.8
Sieve No. 14	-	6.2	7.7	-	4.7	6.0
Sieve No. 16	-	1.4	1.5	-	1.1	1.3
Sieve No. 20	-	0.1	0.1	-	0.2	0.2
Pan	-	0.04	0.0	-	0.0	0.0
Bulk density:						
Grams per 250 mℓ	214.5			223.9		
lb/ft^3	53.56			55.91		

(continued)

TABLE 2-27. (continued)

	Rotary drum cooler outlet emissions test No. 2-ORDC					
	Sample collected 03/09/79 at inlet to cooler			Sampled collected 03/09/79 at outlet of cooler		
	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass
Sieve size:						
Sieve No. 6	-	4.6	100	-	5.7	100
Sieve No. 8	-	59.3	95.7	-	63.0	94.3
Sieve No. 12	-	33.3	36.4	-	28.9	31.3
Sieve No. 14	-	2.7	3.1	-	2.1	2.4
Sieve No. 16	-	0.3	0.4	-	0.2	0.3
Sieve No. 20	-	0.04	0.1	-	0.1	0.1
Pan	-	0.08	0.1	-	0.0	0.0
Bulk density:						
Grams per 250 mℓ	210.8			222.1		
lb/ft^3	52.64			55.46		

(continued)

TABLE 2-27. (concluded)

	Rotary drum cooler outlet emissions test No. 3-ORDC					
	Sample collected 03/09/79 at inlet to cooler			Sampled collected 03/09/79 at outlet of cooler		
	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass	Bulk density[a]	Percent of total mass[b]	Cumulative percent of total mass
Sieve size:						
Sieve No. 6	-	8.0	100	-	7.9	100
Sieve No. 8	-	58.4	91.9	-	57.7	92.2
Sieve No. 12	-	28.8	33.5	-	28.9	34.5
Sieve No. 14	-	3.8	4.7	-	4.4	5.6
Sieve No. 16	-	0.8	0.9	-	1.0	1.2
Sieve No. 20	-	0.04	0.1	-	0.09	0.2
Pan	-	0.07	0.1	-	0.14	0.1
Bulk density:						
Grams per 250 mℓ	212.7			221.7		
lb/ft^3	53.11			55.36		

a Volumetrically determined.

b Percent of total mass retained on indicated sieve size.

SECTION 3

PROCESS DESCRIPTION AND OPERATION

Preliminary Introduction

Emission tests were conducted on the ammonium nitrate emissions from the rotary drum granulator during March 7 and 8, 1979. The tests were designed to characterize and quantify uncontrolled emissions from the solids production (granulation) process, and to determine control equipment efficiency. Figure 3-1 presents a flow diagram for the granulator and its ancillary equipment. Emission tests were conducted on the inlet and outlet air streams of the rotary drum granulator scrubber. Particulate size characterization tests were conducted on the rotary drum granulator scrubber inlet stream on March 7 and 8, 1979. During these emission tests, grab samples were collected from various process streams in order to determine if the process was operating at representative steady-state conditions. Grab samples were collected from the ammonium nitrate melt feed (S1, Figure 3-1) and the solid unscreened product stream (S2) of the granulator along with the inlet (S3) and outlet (S4) liquor streams of the scrubber. The pressure drop across the scrubber was monitored. Aliquots of the grab samples collected from the scrubber inlet and outlet streams were combined to form composite samples (one inlet and one outlet). These were analyzed for ammonia and ammonium nitrate. The results of these analyses combined with their respective flow rates may be useful in calculating a material balance around the scrubber.

Tests of emissions from the rotary drum cooler before the two parallel cyclones were conducted on March 8 and 9, 1979. These were designed to characterize uncontrolled emissions from the cooler. Figure 3-1 also presents a simplified flow sheet for the cooler. Grab samples were collected of the cooler product in (S5) and out (S6) and analyzed for temperature, pH, and moisture.

Process Description

Process Equipment

The ammonium nitrate neutralizer facility reacts hot nitric acid (HNO_3) and ammonia (NH_3) to form ammonium nitrate (NH_4NO_3), steam and heat. This facility, designed by Mississippi Chemical Company, was installed in January of 1979. The neutralizer product (83% AN) flows to a two-stage vacuum falling film evaporator where it is concentrated to about 99% AN. From the concentrator, the AN melt flows to a head tank and is adjusted for pH by

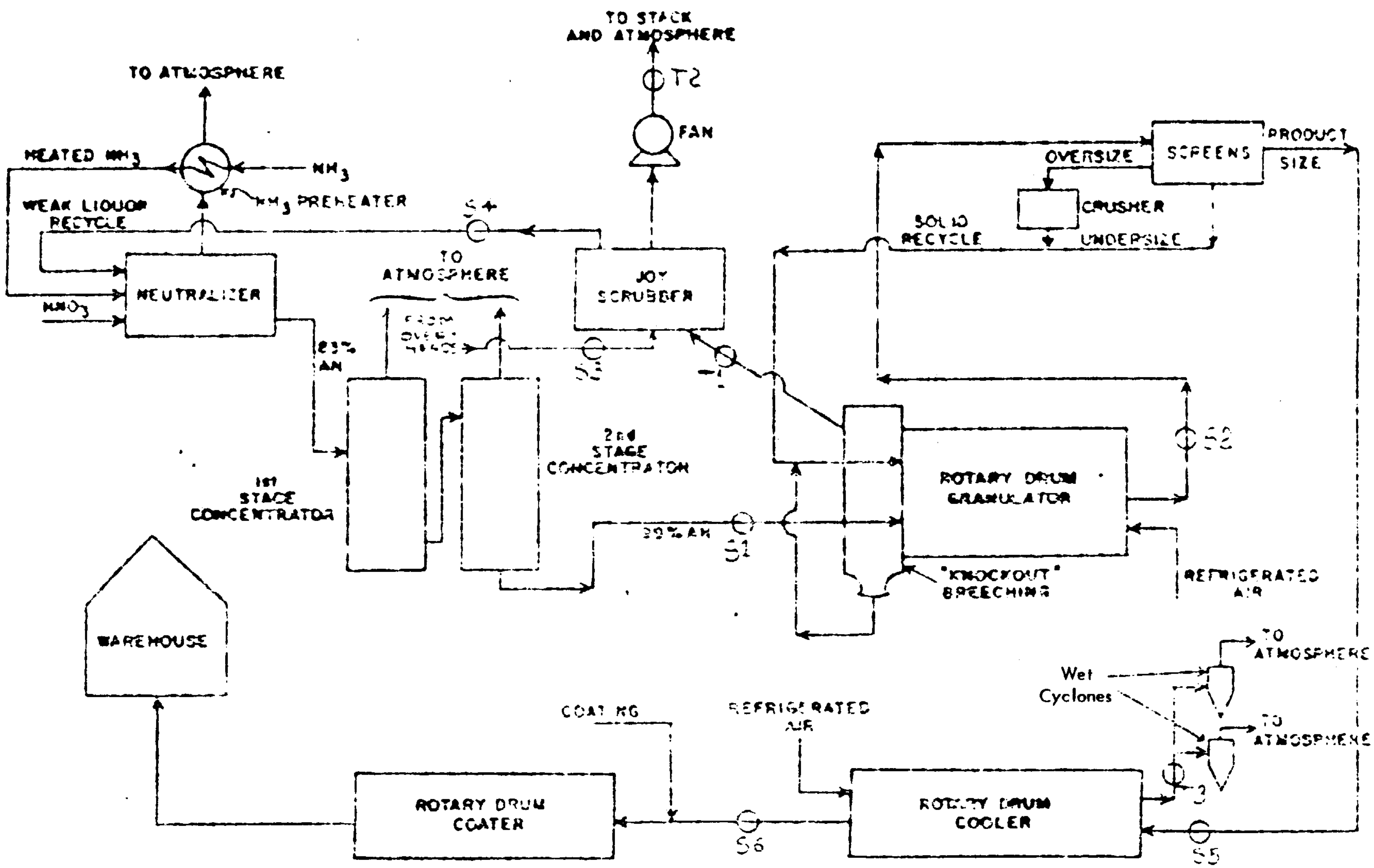


Figure 3-1. Flow diagram of the rotary drum granulator and rotary drum cooler.

ammonia injection. The AN melt is gravity fed to the C and I Girdler rotary drum granulator which has a design rating of 400 tons per day (15.15 x 10^3 kg/hr). Modifications to the lift flights in the granulator have increased the maximum production rate to approximately 500 tons/day (18.94 x 10^3 kg/hr). As the AN melt cools by countercurrent chilled air, it solidifies into spherical particles which are conveyed to a screening operation for sizing. A weigh belt records the weight of granules both before and after the screens. Undersized granules and crushed oversize granules are combined and sent back to the granulator as seed material. Correctly sized granules are conveyed to the rotary drum cooler where refrigerated air cools the granules. Clay coating of the cooled granules takes place in a rotary drum coater. From there the granules proceed to the warehouse.

Emission Control Equipment

The exhaust air from the granulator is ducted directly to a Joy "Type D" Turbulaire scrubber where it is combined with an ammonium nitrate-weak liquor scrubber solution.

Emissions from the rotary drum cooler are ducted to two parallel wet cyclones. There is one water spray in the duct itself and three sprays in each cyclone.

Process Operation

Production Rates

The feed rate of concentrated ammonium nitrate melt as measured by a volumetric flow meter was monitored and recorded. Two weigh belts recorded both the screened and unscreened product out of the granulator. Recent calibrations (February 1979) of the weigh belts presented an accurate production rate for the granulator. Average product rates during the granulator efficiency tests were calculated using the screened product weigh belt integrator and are presented in Table 3-1. Average product rates during the rotary drum cooler tests were calculated in the same manner as were the rotary drum granulator scrubber tests (i.e., weigh belt integrators) and are presented in Table 3-2. No integrator data was collected during the Particle Size Distribution Test No. 1-CO at the outlet of the rotary drum cooler. However, the weigh belt strip chart showed that the product rate of the rotary drum granulator during this test was approximately 18.9 x 10^3 kg/hr (20.8 tons/hr).

Production and Control Equipment Operation

The flow rate, temperature, and pressure of the AN melt to the granulator, the inlet and outlet air stream temperatures, the granulator bed temperature, and the temperature of the granules leaving the granulator were monitored and recorded during testing. The temperature and make-up rate of the scrubber liquor were also recorded. Temperatures during all testing were recorded as variations from a predetermined artificial zero. This method of recording the data was used in order to avoid confidentiality complications.

TABLE 3-1. AVERAGE ROTARY DRUM GRANULATOR PRODUCT RATES DURING GRANULATOR EMISSIONS TESTING

Date	Test location	Test type	MRI test No.	Product rate[a] (10^3 kg/hr)	Product rate[a] (tons/day)
03-07-79	Inlet and outlet rotary drum granulator scrubber	Modified EPA Method 5	3-IS and 3-OS	13.15	347.8
03-07-79	Inlet and outlet rotary drum granulator scrubber	Modified EPA Method 5	4-IS and 4-OS	15.82	418.7
03-08-79	Inlet and outlet rotary drum granulator scrubber	Modified EPA Method 5	5-IS and 5-OS	18.60	493.0
03-07-79	Rotary drum granulator scrubber inlet	Brink impactor particle size distribution	1-IS	14.71	389.3
03-07-79	Rotary drum granulator scrubber inlet	Brink impactor particle size distribution	2-IS	14.00	370.2
03-08-79	Rotary drum granulator scrubber inlet	Brink impactor particle size distribution	3-IS	18.59	492.0

a Data obtained by Mr. Timothy L. Curtin, Environmental Engineer, GCA Corporation, Technology Division, Chapel Hill, North Carolina.

TABLE 3-2. AVERAGE ROTARY DRUM GRANULATOR PRODUCT RATES DURING EMISSIONS TESTING OF THE ROTARY DRUM COOLER

Date	Test location	Test type[a]	MRI test No.	Product rate[b] (10^3 kg/hr)	Product rate[b] (tons/day)
03-08-79	Rotary drum cooler outlet	Modified EPA Method 5	1-ORDC	18.96	500.5
03-09-79	Rotary drum cooler outlet	Modified EPA Method 5	2-ORDC	18.87	499.8
03-09-79	Rotary drum cooler outlet	Modified EPA Method 5	3-ORDC	18.96	500.5
03-08-79	Rotary drum cooler outlet	Brink impactor particle size distribution	1-CO	-[c]	-[c]
03-09-79	Rotary drum cooler outlet	Brink impactor particle size distribution	2-CO	17.15	453.6
03-09-79	Rotary drum cooler outlet	Brink impactor particle size distribution	3-CO	20.32	533.8

a Tests conducted to characterize uncontrolled emissions from the cooler.

b Data obtained by Mr. Timothy L. Curtin, Environmental Engineer, GCA Corporation, Technology Division, Chapel Hill, North Carolina.

c No integrator data was collected during the particle size test No. 1-CO of the rotary drum cooler outlet. The product rate of the rotary drum granulator during this test showed the product rate to be approximately 18.9 x 10^3 kg/hr or 499.2 tons/day.

During emissions testing of the rotary drum cooler, the cooler inlet air temperature was also monitored in addition to the above mentioned parameters.

Average and standard deviations of the above parameters during the emissions tests have been calculated and are presented in Table 3-3. The average and the standard deviation are expressed as percentages of the overall average value. The average value of each parameter is used to calculate the overall average for that parameter, but is not presented as a percentage in Table 3-3. Standard deviations are not presented for tests where the number of readings were three or less. Actual values of monitored parameters are presented in Appendix M.

Granulator, Scrubber, and Cooler Operation

Minor plant upsets occurred during the entire testing program. Problems with controlling the fan damper on the rotary drum granulator and scrubber and a malfunctioning scrubber liquor level controller voided the first 2 days of testing. Liquor level was maintained through the utilization of the sight glass in the scrubber, although the level controller recorder continued to read high during all testing. A "snowing" condition occurred at the rotary drum granulator scrubber stack outlet and was believed to have been the result of inadequate scrubber liquor level control.

On day three (March 7, 1979) only three out of four granulator nozzles were operative due to the limited quantity of AN melt available. The third particulate concentration test on the inlet and outlet to the rotary drum granulator scrubber (MRI Test Nos. 3-IS and 3-OS, respectively) were conducted at this lower production rate. The fourth granulator nozzle was brought back on line during the early afternoon (Day 3, March 7, 1979) and continued on line for the remainder of the testing.

On day four (March 8, 1979), the granulator was put on total recycle with no additional AN melt being added due to an excessively low level in the head tank. Fortunately this happened between tests and should not affect the results of the testing of the rotary drum cooler.

On day five (March 9, 1979), the compressor on the inlet air cooler of the granulator went out of service causing granulator temperatures to be excessively high. Trouble continued with the fan damper serving the granulator and scrubber. The combined effect of these two problems eventually led to a rise in the granulator bed temperature to a point where the granules were agglomerating, forming "rocks." At this point, the granulator was shut down until the problem could be corrected. Testing did not resume until steady-state conditions were again attained. Refer to Appendix M for actual times of plant operations and breakdowns as they interact with test times.

TABLE 3-3. RELATIVE AVERAGE VALUES OF OPERATING PARAMETERS DURING TESTING[a]

Parameter	Plant guage code	Particulate concentration - rotary drum granulator scrubber inlet and outlet tests						Particulate concentration - uncontrolled rotary drum cooler outlet emissions tests					
		MRI Test No. 3		MRI Test No. 4		MRI Test No. 5		MRI Test No. 1-ORDC		MRI Test No. 2-ORDC		MRI Test No. 3-ORDC	
		Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.
Production rate parameters													
AN melt feed rate	FRC-1	79	0.23	94	0.32	107	0.47	107	0.00	107	0.00	97	0.00
AN melt pressure at nozzles	PR-2	114	0.00	77	0.00	106	0.00	108	0.00	106	0.00	83	0.00
Weigh rate of product	WR-19	75	1.00	91	0.98	109	3.01	112	4.22	110	4.72	93	9.34
Granulator bed temperature	-	98	0.41	102	0.26	99	0.34	99	0.39	102	0.98	99	0.45
AN melt temperature	T1405-8	102	0.29	102	0.28	103	0.25	99	0.35	98	0.89	98	0.62
Granulator inlet air temperature	TRC6	81	1.99	89	1.07	84	0.70	84	0.00	135	3.62	147	0.99
Granulator outlet air temperature	TR4	88	0.67	19	0.39	100	0.55	100	0.31	106	0.78	99	0.00
Granulator product temperature	TR439-10	95	0.02	100	0.01	98	0.01	94	0.01	99	0.01	118	0.03
Scrubber parameters													
Liquor level	LRC45	99	1.25	98	1.82	99	1.27	103	1.30	100	1.75	102	0.00
Liquor temperature	TR439-11	91	1.02	97	0.54	95	0.49	100	0.91	105	0.52	105	1.05
Liquor feed rate	FRC44	98	0.67	98	0.00	98	0.00	98	0.00	102	0.00		
Cooler parameters													
Air temperature in	-						97	2.63	101	2.61			

(continued)

TABLE 3-3. (concluded)

Parameter	Plant guage code	Brink impactor particle size rotary drum granulator scrubber inlet tests			Brink impactor particle size uncontrolled rotary drum cooler outlet tests		
		MRI test No. 1-IS avg.	MRI test No. 2-IS avg.	MRI test No. 3-IS avg.	MRI test No. 1-CO avg.	MRI test No. 2-CO avg.	MRI test No. 3-CO avg.
Production rate parameters							
AN melt feed rate	FRC-1	92	94	107	-[b]	107	107
AN melt pressure at nozzles	PR-2	106	77	108	-[b]	106	106
Weigh rate of product	WR-19	83	85	112	-[b]	96	133
Granulator bed temperature	-	102	101	98	-[b]	100	101
AN melt temperature	T1405-8	101	102	99	-[b]	99	98
Granulator inlet air temperature	TRC6	82	82	84	-[b]	128	138
Granulator outlet air temperature	TR4	94	100	101	-[b]	104	107
Granulator product temperature	TR439-10	99	105	93	-[b]	94	104
Scrubber parameters							
Liquor level	LRC45	100	98	104	-[b]	98	100
Liquor temperature	TR439-11	94	96	100	-[b]	105	109
Liquor feed rate	FRC44	98	98	98	-[b]	102	107
Cooler parameters							
Air temperature in	-				-[b]	101	101

a Data obtained by Mr. Timothy L. Curtin, Environmental Engineer, GCA Corporation, Technology Division, Chapel Hill, North Carolina.

b Data not obtained during testing.

SECTION 4

LOCATION OF SAMPLING POINTS

Introduction

Tests were conducted on the rotary drum granulator emissions and the uncontrolled emissions of the rotary drum cooler at the Swift Chemical Company ammonium nitrate manufacturing facility in Beaumont, Texas. The tests were designed to determine the uncontrolled and controlled emissions at maximum production rate considering ambient temperature conditions.

In general, sampling locations included the inlet and outlet of the rotary drum granulator scrubber, scrubber liquors, granulator feed, granulator product, and the uncontrolled outlet of the rotary drum cooler. During the sampling, the ambient air temperature, relative humidity, and pressure drop across the emisson control equipment were recorded.

This section presents detailed descriptions of the sampling locations for the measurement of relative humidity and ambient air temperature, scrubber pressure drop, ammonia, nitrate, pH, particulate mass, particle size distribution, process and product samples, and visible emissions.

Physical Description of Facilities

A generalized overview of the Swift Chemical Company, Beaumont, Texas, ammonium nitrate manufacturing facility is presented in Figure 4-1. The exhaust air from the rotary drum granulator is passed through a Joy "Type D" Turbulaire scrubber, located west of the AN rotary drum granulator and rotary drum cooler building, and is then discharged to the atmosphere through a stack.

The AN granules of product size are cooled by treated air in a rotary drum cooler, which is located in the AN rotary drum granulator and rotary drum cooler building. The exhaust air from the rotary drum cooler is ducted to two parallel wet cyclones and discharged to the atmosphere.

Rotary Drum Granulator Sampling Locations

The locations of the ports used to sample the inlet to the rotary drum granulator scrubber is presented in Figure 4-2. View A is from the southwest and View B is from the northwest. The ports are located in a 49.5 in. inside diameter horizontal section of duct. The two ports are positioned 90° apart and located 157 cm (62 in.), or 1.25 duct diameters, downstream from a right-angle bend in the duct leading to the scrubber. The distance from the two ports to the nearest upstream disturbance; which is a flange where the outlet duct from the rotary drum granulator is reduced in size, is 278 cm (109.5 in.), or 2.21 duct diameters.

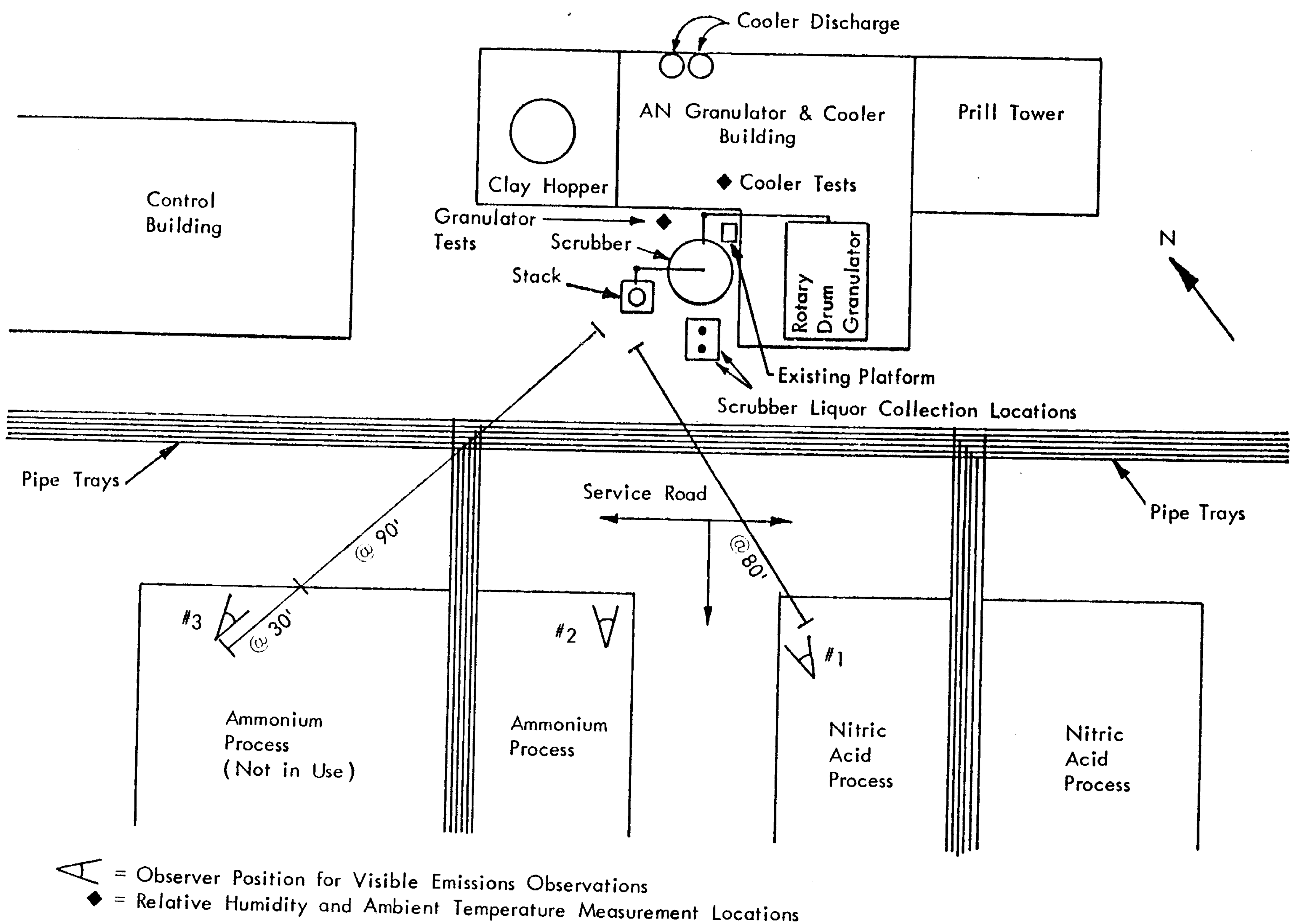


Figure 4-1. Overview of the Swift Chemical Company's Beaumont, Texas, ammonium nitrate manufacturing facility.

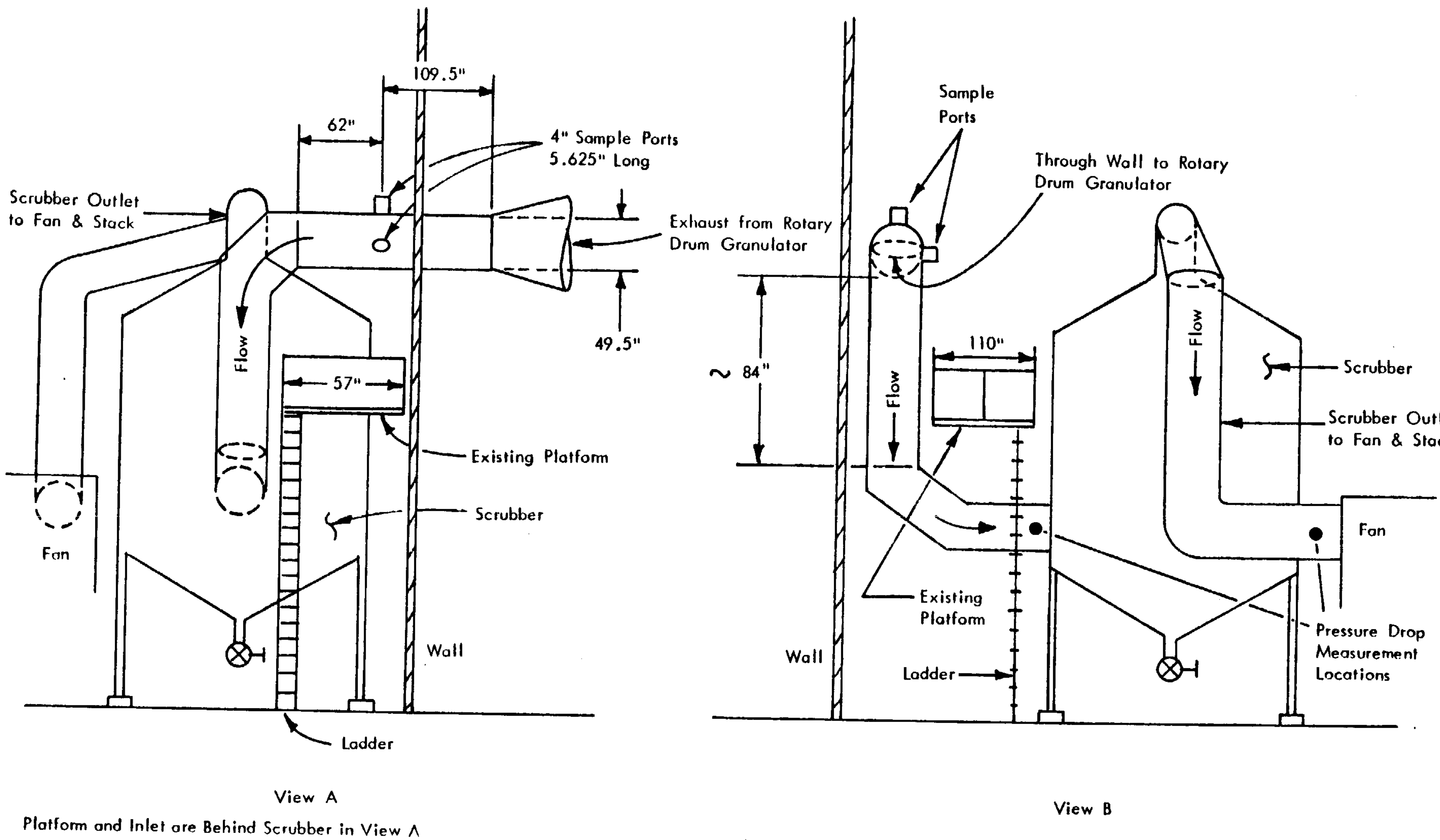


Figure 4-2. Schematic of sampling port locations used to sample the inlet of the rotary drum granulator wet scrubber.

This scrubber inlet sampling location did not meet the "8 and 2 diameter" criterion as outlined in EPA Reference Method 1 (Federal Register, Vol. 42, No. 160, Thursday, August 18, 1977). Consequently, 24 sampling points were chosen for each axis traverse for a total of 48 sampling points as specified in the method. Figure 4-3 shows the location of the sampling points. The distance of the points from the outside flange edge of the sample port are presented in Table 4-1.

There was an accumulation of material in the bottom of the scrubber inlet duct. Since the maximum depth of the material was 1.9 cm (0.75 in.), it did not interfere with sampling, even when the probe nozzle was at sampling point number 2-24. The presence of the material was noted and calculations made to correct the total area of the duct with respect to this obstructed region. The cross-sectional area of the obstructed region was 0.0059 m^2 (0.063 ft^2) in the 1.2509 m^2 (13.465 ft^2) duct. The 0.47% reduction in the total duct area is not considered to significantly affect the flow rate calculations.

The locations of the sampling ports on the exhaust stack of the rotary drum granulator scrubber are shown in Figure 4-4. The two ports are positioned 90° apart in a horizontal plane, 7.1 duct diameters downstream and 2.5 duct diameters upstream from the nearest disturbances.

This scrubber outlet sampling location also did not meet the "8 and 2 diameter" criterion as outlined in EPA Reference Method 1 (Federal Register, Vol. 42, No. 160, Thursday, August 18, 1977). Consequently, 12 sampling points were chosen for each axis traverse for a total of 24 sampling points as specified in the method. Figure 4-5 shows the location of the sampling points. The distance of the points from the outside flange edge of the sample port are presented in Table 4-2.

Rotary Drum Cooler Sampling Locations

The locations of the ports used to sample the uncontrolled outlet of the rotary drum cooler are presented in Figure 4-6. The two ports are located in a 27.75 in. inside diameter horizontal section of duct. The two ports are positioned 90° apart and located 25 cm (10 in.), or 0.4 duct diameters, upstream from an air plenum and 130 cm (51 in.), or 1.8 duct diameters, downstream from the opening to the duct leading to the two parallel wet cyclones.

The rotary drum cooler uncontrolled outlet sampling location did not meet the "8 and 2 diameter" criterion as outlined in EPA Reference Metod 1 (Federal Register, Vol. 42, No. 160, Thursday, August 18, 1977). Consequently, 24 sampling point locations were chosen for each axis traverse for a total of 48 sampling points as specified in the method. Figure 4-7 shows the location of the sampling points. The distance of the points from the outside flange edge of the sample port is presented in Table 4-3.

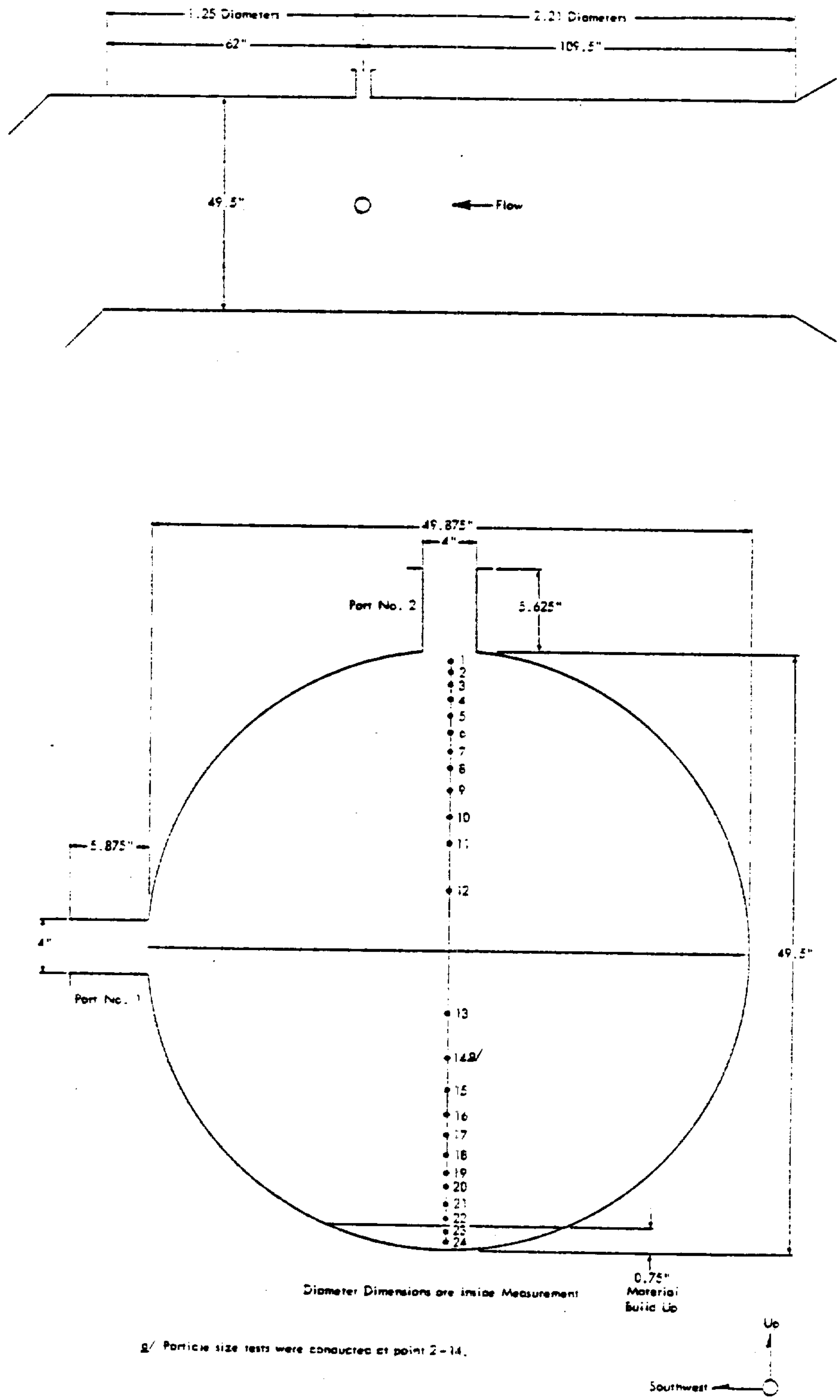


Figure 4-3. Sampling point locations at the rotary drum granulator scrubber inlet duct.

TABLE 4-1. ROTARY DRUM GRANULATOR SCRUBBER INLET SAMPLING POINT LOCATIONS

Point No.	Fraction of inside diameter	Distance from outside of sample port (cm)	Distance from outside of sample port (in.)
1	0.020[a]	17	6 5/8
2	0.032	18	7 1/4
3	0.055	21	8 3/8
4	0.079	24	9 1/2
5	0.105	28	10 7/8
6	0.132	31	12 1/8
7	0.161	35	13 5/8
8	0.194	39	15 1/4
9	0.230	43	17
10	0.272	49	19 1/8
11	0.323	55	21 5/8
12	0.398	64	25 3/8
13	0.602	90	35 3/8
14	0.677	99	39 1/8
15	0.728	106	41 5/8
16	0.770	111	43 3/4
17	0.806	116	45 1/2
18	0.839	120	47 1/8
19	0.868	124	48 5/8
20	0.895	127	49 7/8
21	0.921	130	51 1/4
22	0.945	133	52 3/8
23	0.968	136	53 1/2
24	0.980[a]	137	54 1/8

a One inch from duct wall.

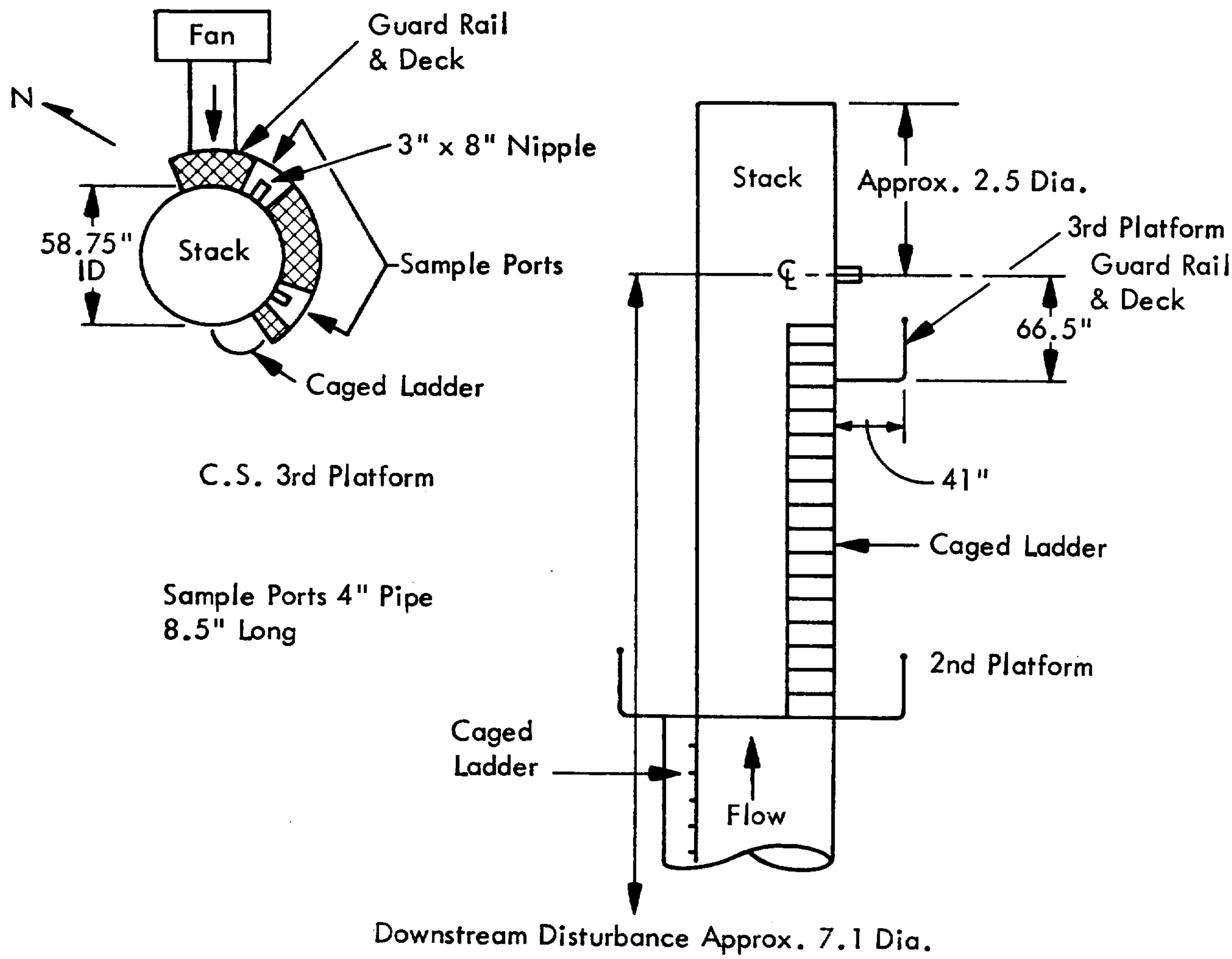


Figure 4-4. Schematic of sampling port locations used to sample the rotary drum granulator scrubber exhaust stack.

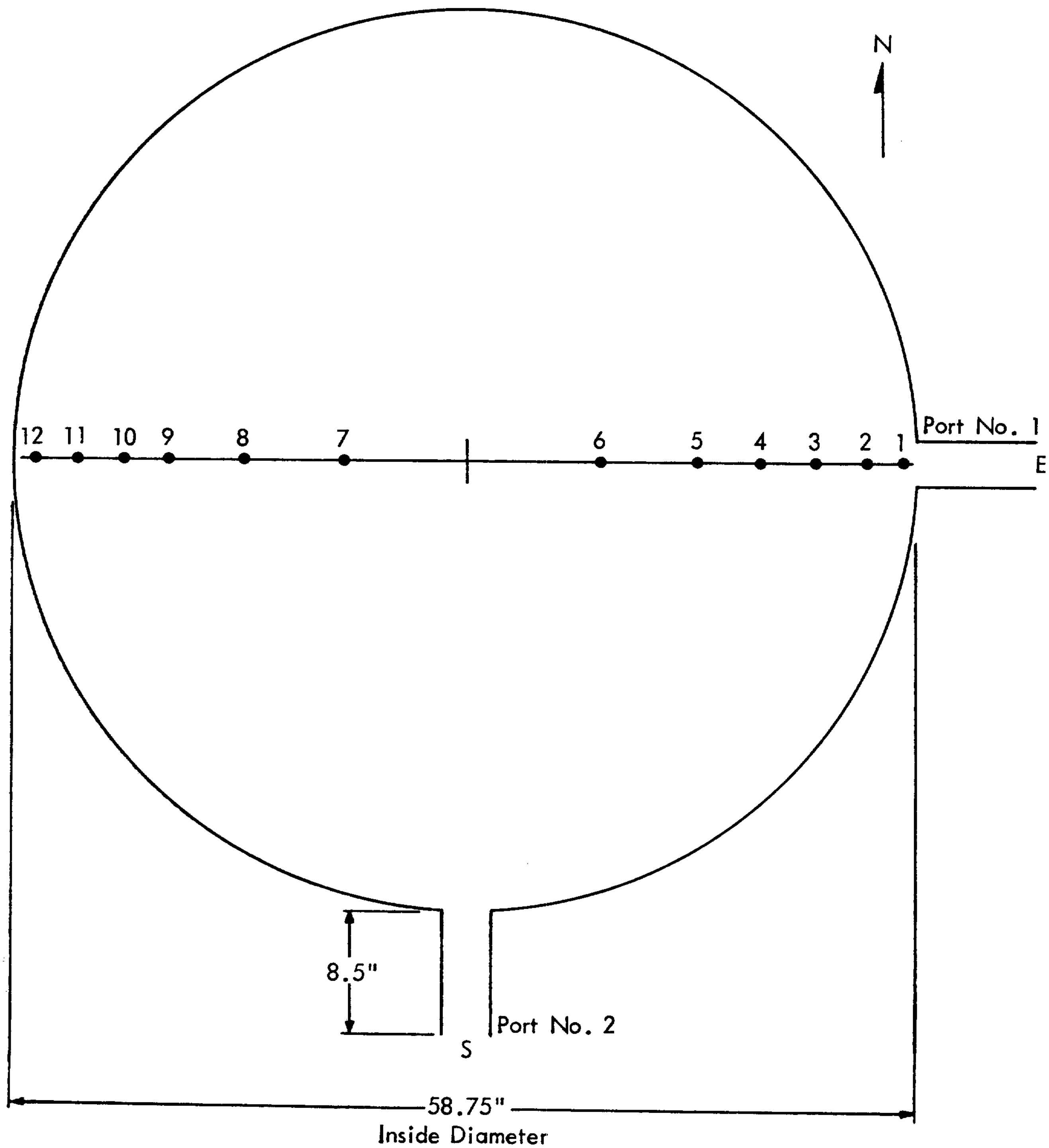


Figure 4-5. Sampling point locations on the exhaust stack of the rotary drum granulator scrubber.

TABLE 4-2. ROTARY DRUM GRANULATOR SCRUBBER OUTLET SAMPLING POINT LOCATIONS

Point No.	Fraction of inside diameter	Distance from outside of sample port (cm)	(in.)
1	0.021	25	9 3/4
2	0.067	31	12 3/8
3	0.118	39	15 3/8
4	0.177	50	18 7/8
5	0.250	59	23 1/8
6	0.356	75	29 3/8
7	0.644	118	46 3/8
8	0.750	133	52 1/2
9	0.823	144	56 7/8
10	0.882	153	60 3/8
11	0.933	161	63 3/8
12	0.979	168	66

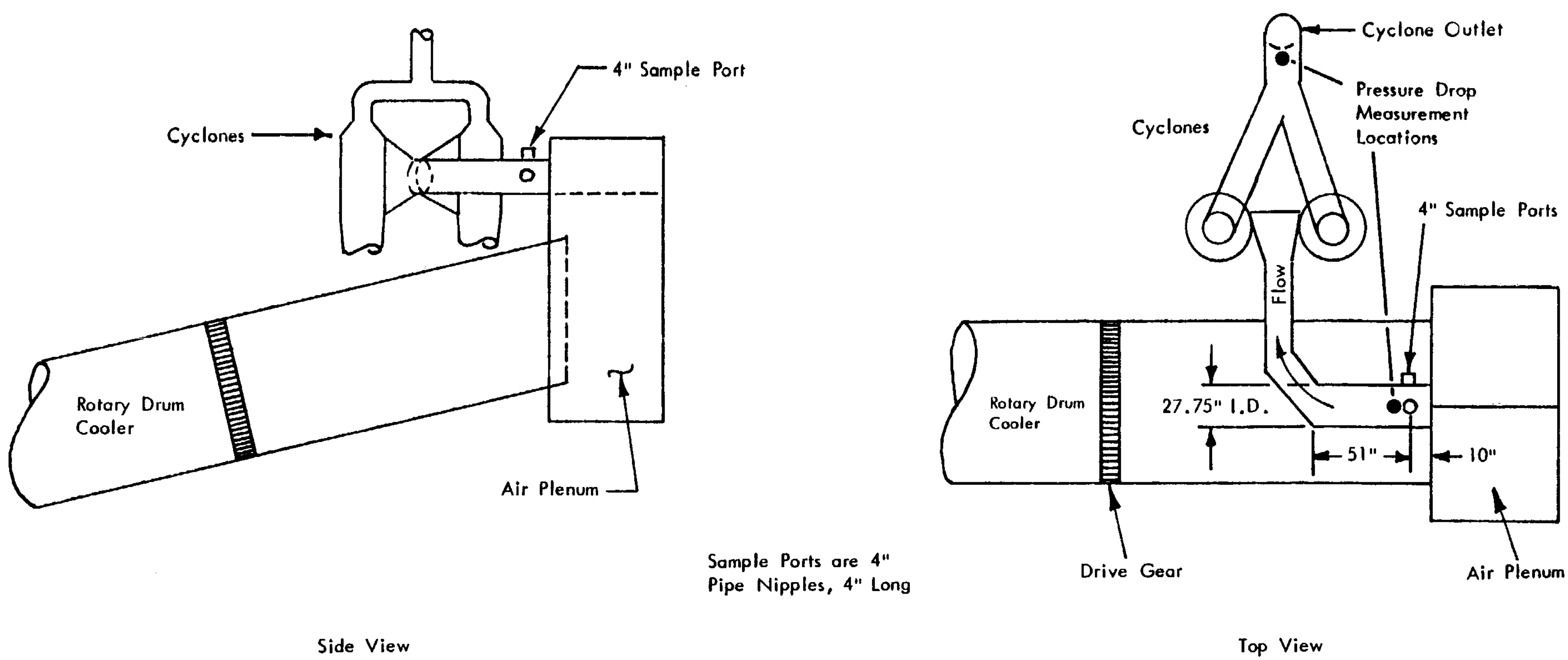


Figure 4-6. Schematic of sampling port locations used to sample the outlet duct of the rotary drum cooler.

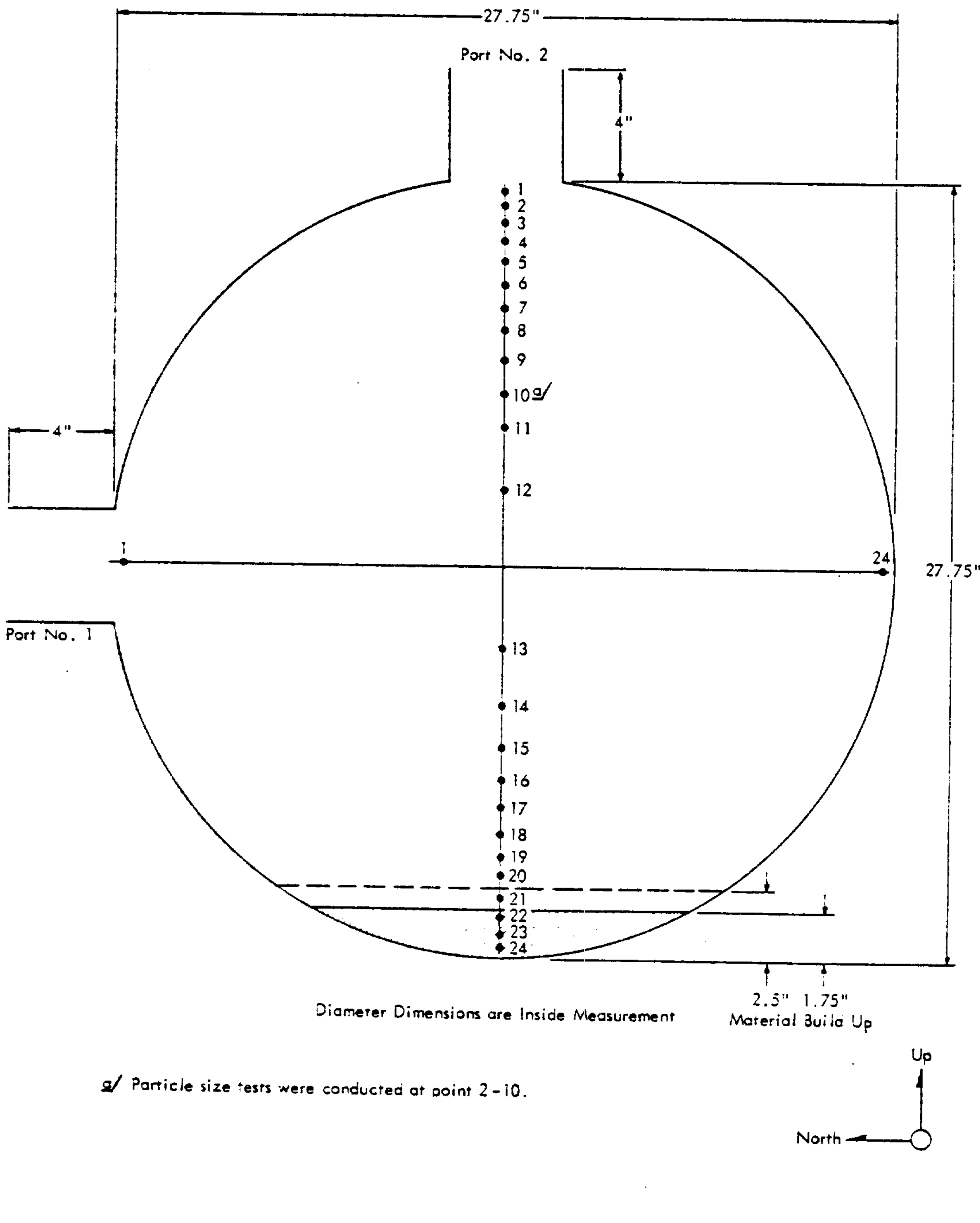


Figure 4-7. Sampling point locations used to sample the outlet duct of the rotary drum cooler.

TABLE 4-3. ROTARY DRUM COOLER OUTLET SAMPLING POINT LOCATIONS

Point No.	Fraction of inside diameter	Distance from outside of sample port: Port No. 1 (cm)	Port No. 1 (in.)	Port No. 2 (cm)	Port No. 2 (in.)
1	0.011	10.3	4 1/16	11.3	4 7/16
2	0.032	11.8	4 5/8	12.7	5
3	0.055	13.4	5 1/4	14.4	5 11/16
4	0.079	15.1	5 15/16	16.0	6 5/16
5	0.105	16.9	6 11/16	17.9	7
6	0.132	18.8	7 7/16	19.8	7 13/16
7	0.161	20.9	8 1/4	21.8	8 5/8
8	0.194	23.2	9 1/8	24.2	9 1/2
9	0.230	25.7	10 1/8	26.7	10 1/2
10	0.272	28.7	11 5/16	29.7	11 11/16
11	0.323	32.3	12 11/16	33.2	13 1/16
12	0.398	37.6	14 13/16	38.5	15 3/16
13	0.602	52.0	20 7/16	52.9	20 13/16
14	0.677	57.3	22 9/16	58.2	22 15/16
15	0.728	60.8	23 15/16	61.8	24 5/16
16	0.770	63.8	25 1/8	64.8	25 1/2
17	0.806	66.3	26 1/8	67.3	26 1/2
18	0.839	68.7	27	69.6	27 7/16
19	0.868	70.7	27 13/16	71.7	28 3/16
20	0.895	72.6	28 5/8	73.6	29
21	0.921	74.4	29 5/16	75.4	29 11/16
22	0.945	76.1	30	77.1	30 3/8
23	0.968	77.9	30 11/16	78.7	31
24	0.989	79.2	31 3/16	80.2	31 9/16

There was an accumulation of material on the bottom of the rotary drum cooler test duct. This material prevented the sampling of three or four points during the traverse of port No. 2. The depth of the material was 4.4 cm (1.75 in.) during Test No. 1-ORDC (March 8, 1979) with sampling points 2-22, 2-23, and 2-24 of port No. 2 not sampled. The depth of the material on the bottom of the duct increased to 6.35 cm (2.5 in.) for test Nos. 2-ORDC and 3-ORDC (March 9, 1979) with sampling points 2-21, 2-22, 2-23, and 2-24 of port No. 2 not sampled during either test.

The cross-sectional area of the obstructed region during test No. 1-ORDC was 0.0095 m^2 (0.1027 ft^2), or 2.45% of the 0.3902 m^2 (4.2 ft^2) duct area. During test Nos. 2-ORDC and 3-ORDC the cross-sectional area of the obstructed region was 0.0174 m^2 (0.1872 ft^2), or 4.46% of the 0.3902 m^2 (4.2 ft^2) duct area.

The percentage of duct area obstructed during the EPA Modified Method 5 testing at the uncontrolled outlet of the rotary drum cooler was considered significant. Before each of the three particulate tests the depth of the material was measured and recorded. Prior to subsequent computer computations of this data, the cross-sectional area of the obstructed region at the sampling location was determined. An example calculation and the formula to correct for the area of obstruction is presented in Section B-3 of Appendix B. The area of the obstructed region of the duct was calculated and subtracted from the total area of the duct. This corrected duct area was then used for the appropriate test number in the computer computations of the field data for the outlet of the rotary drum cooler.

Brink Impactor Particle Size Distribution Test Locations

Three particle size distribution tests were performed on the inlet duct to the rotary drum granulator scrubber. The samples were obtained at traverse point number 2-14, port No. 2. The location of the sampling ports is shown in Figure 4-2. The sample point location is shown in Figure 4-3.

Three particle size distribution tests were also performed on the uncontrolled outlet duct of the rotary drum cooler. The samples were obtained at traverse point No. 2-10, port No. 2. The location of the sampling ports is shown in Figure 4-6. The sample point location is shown in Figure 4-7.

Visible Emission Observation Locations

EPA Method 9, visible emissions observations, were made of the exhaust plume of the rotary drum granulator scrubber. The observer's three positions utilized during the field test are shown in Figure 4-8. The observer was at ground level varying from 24 m (80 ft) to 37 m (120 ft) from the base of the rotary drum granulator scrubber exhaust stack. The position of the observer varied depending upon cloud cover, wind speed, and wind direction. The plume was observed against the blue sky.

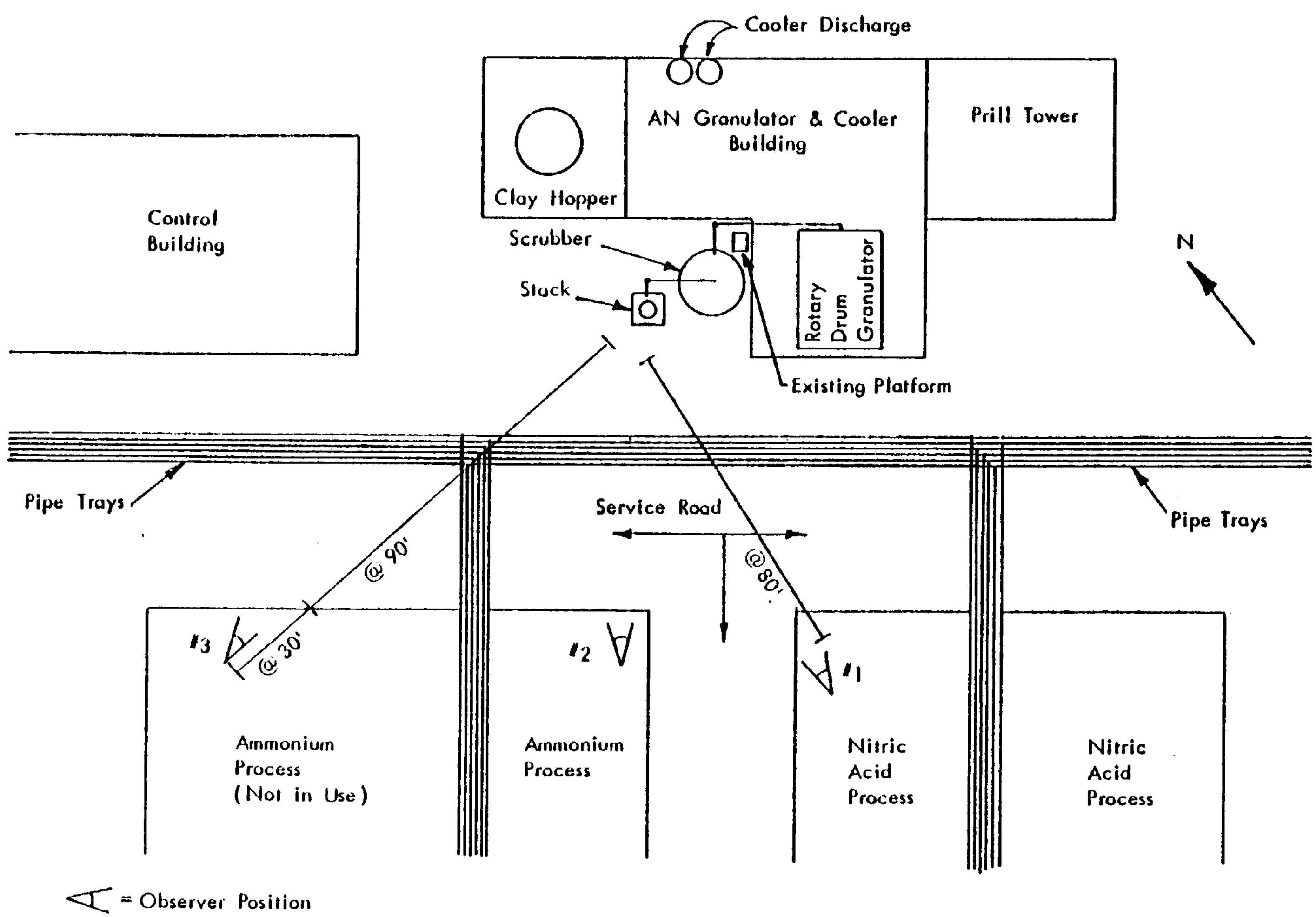


Figure 4-8. Schematic plan indicating relative positions of plant equipment and visible emission observer positions.

Rotary Drum Granulator Scrubber and Rotary Drum Cooler Inlet-to-Outlet Differential Pressure Drop Measurement Locations

The rotary drum granulator scrubber and rotary drum cooler inlet-to-outlet differential pressure drop data were measured and recorded during the field test by Mr. Timothy L. Curtin of GCA Corporation, Technology Division, and by Mr. Clyde E. Riley of the U.S. EPA, Emission Measurement Branch.

The differential pressure drop measurement locations on the rotary drum granulator scrubber are shown in Figure 4-2. The measurement locations for the differential pressure drop on the rotary drum cooler are shown in Figure 4-6.

Relative Humidity and Ambient Temperature Measurement Locations

The relative humidity and ambient temperature data during the field test were measured and recorded by Mr. Timothy L. Curtin of GCA Corporation, Technology Division, and by Mr. Clyde E. Riley of the U.S. EPA, Emission Measurement Branch.

The two locations of the equipment used to obtain relative humidity and ambient temperature data during emissions testing are shown in Figure 4-1. As indicated in the figure, a different location was used depending upon the emission control device that was being tested.

Rotary Drum Granulator Scrubber Liquor Collection Locations

Scrubber liquor samples were collected by MRI field personnel during the field test. Samples were obtained from the inlet and outlet streams of the rotary drum granulator scrubber. The location of these sampling points is shown in Figure 4-1.

Process Sample Collection Locations

These samples were collected and recorded by MRI field personnel during the field test. A single sample of the AN (ammonium nitrate) melt was collected at the inlet to the rotary drum granulator. Four samples of the rotary drum granulator product before screening were collected. Three of these samples, coincident with test Nos. 3, 4, and 5 on the granulator were composited. Three samples were also collected of the screened granulator product going into the rotary drum cooler and three samples were collected of the screened product exiting the rotary drum cooler. These samples were collected at their respective locations and recorded by MRI field personnel during the field test.

SECTION 5

SAMPLING AND ANALYTICAL PROCEDURES

INTRODUCTION

This section describes the sampling and analytical procedures used by MRI at the Swift Chemical Company ammonium nitrate manufacturing plant in Beaumont, Texas. Brief descriptions of the techniques used have been presented here. Additional details may be found in various appendices as referenced in the text.

FEDERAL REGISTER METHODS

Standard EPA methodologies as described in the Federal Register, Vol. 42, No. 160, Part II - Thursday, August 18, 1977, were used wherever applicable for Methods 1, 2, 4, and 5. The molecular weight of the stack gas was assumed to be 28.84. Opacity measurements were conducted according to Method 9 procedures described in the Federal Register, Vol. 36, No. 247 - Thursday, December 23, 1971.

EPA Method 1 - Sample and Velocity Traverses for Stationary Sources

All sample locations were determined using the procedures discussed in Method 1. The field data are presented in Appendix C.

The sample port locations at the rotary drum granulator scrubber outlet did not meet the Method 1 criteria of 8 downstream and 2 upstream duct diameters. Field measurements indicated a distance of 7.1 duct diameters downstream and 2.5 duct diameters upstream from the nearest disturbance. These measurements did meet the minimum requirements of 2 downstream and 0.5 upstream duct diameters.

Field measurements of the sample port locations at the rotary drum granulator scrubber inlet indicated a distance of 1.25 duct diameters downstream and 2.21 duct diameters upstream from the nearest disturbance. These measurements did not meet either the 8 downstream and 2 upstream duct diameter requirements, or the minimum requirements of 2 downstream and 0.5 upstream duct diameters. There was no indication of cyclonic flow and approval was obtained from the EPA technical manager to use the sample location.

The sample port locations at the rotary drum cooler uncontrolled outlet did not meet either the 8 downstream and 2 upstream duct diameter requirements, or the minimum requirements of 2 downstream and 0.5 upstream duct diameters. Field measurements indicated the sample ports were 1.8 duct diameters downstream and 0.4 duct diameters upstream from the nearest disturbance. There was no indication of cyclonic flow and approval was obtained from the EPA technical manager to use the sample location.

At both the scrubber inlet and uncontrolled cooler outlet test locations there was an accumulation of material on the bottom of the test duct. Section 4 described in detail this condition at these two sample locations. Prior to each test at these locations, the depth of material was measured and recorded. Appendix B contains the calculations used to determine the obstructed area of the ducts. Appendix C presents the field data.

EPA Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

All velocity measurements were made using standard Method 2 techniques and equipment. There was an accumulation of material in the bottom of the rotary drum granulator scrubber inlet duct. The presence of the material did not interfere with sampling. The bottom of the rotary drum cooler uncontrolled outlet duct also had accumulated material present. At this location, the accumulated material did interfere with sampling and the last few points could not be sampled. The field data are presented in Appendix C.

EPA Method 4 - Determination of Moisture Content in Stack Gases

Standard Method 4 determinations were made at the scrubber and the cooler locations. The moisture content of the scrubber inlet was assumed to be 2%. This was because buildup of the product in the sample line made it necessary to repeatedly rinse the line with distilled water. Since this rinse was added to the impingers, it was impractical to do a moisture determination using Method 4.

EPA Method 5 - Determination of Particulate Emissions from Stationary Sources

A modified EPA Method 5 train was used during this test. A complete description of the apparatus and techniques used is contained in the following Section entiled, "Ammonium Nitrate Emissions." The field data is given in Appendix C.

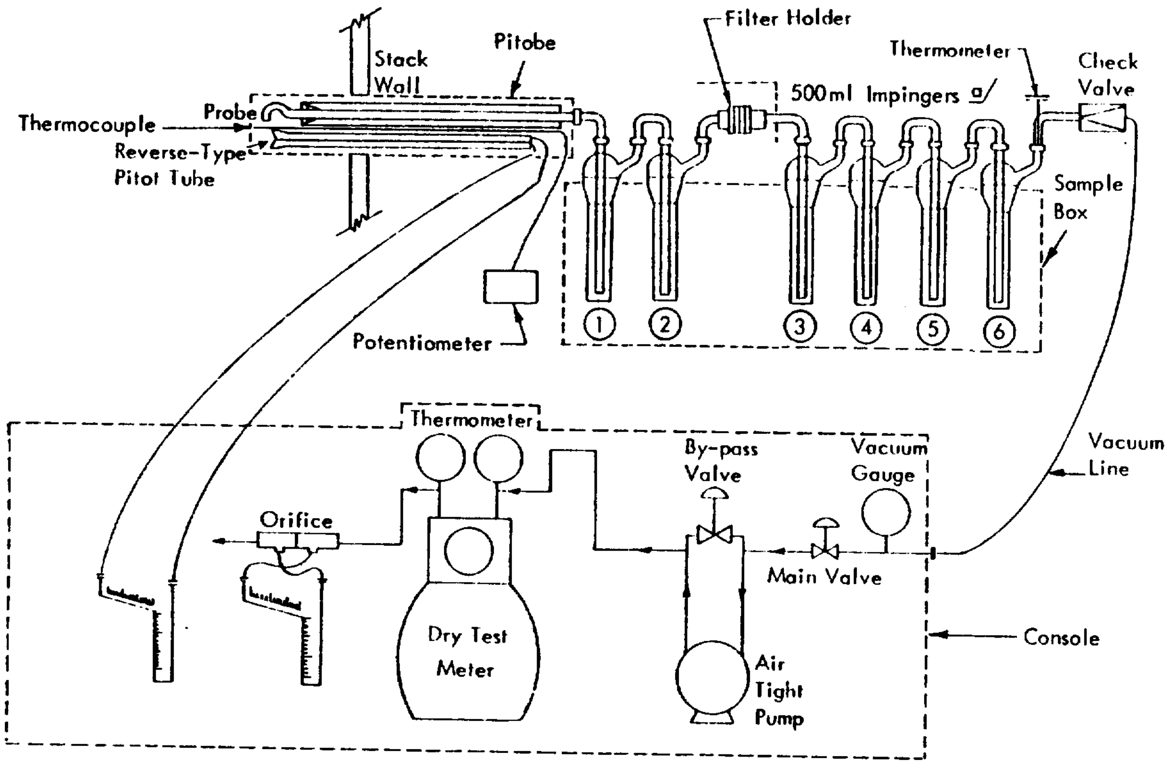
EPA Method 9 - Visual Determination of the Opacity of Emissions from Stationary Sources

Standard Method 9 techniques by a certified opacity reader were used for these tests. The field data are recorded in Appendix E.

AMMONIUM NITRATE EMISSIONS

Sampling Techniques

Figure 5-1 is a schematic of the modified EPA Reference Method 5 train used to collect isokinetic ammonium nitrate samples at the rotary drum granulator scrubber inlet and outlet and at the uncontrolled rotary drum cooler exhaust. The sample probe used at the scrubber outlet was a conventional stainless steel sheath with heated glass liner connected directly to the impinger train box.



a/ Impingers 1,3,5 and 6 are of the Modified Greenburg-Smith Type
Impingers 2 and 4 are of the Greenburg-Smith Design
Impinger 1 and 2 Contain 100ml Water
Impinger 3 and 4 contain 100ml $1NH_2SO_4$
Impinger 5 Empty
Impinger 6 Contains 200-300 Grams Silica Gel

Figure 5-1. Schematic of modified EPA reference Method 5 sampling train.

The scrubber inlet and uncontrolled cooler outlet sampling sites contained vertical traverse sample locations. A conventional sampling probe arrangement was not feasible at these two sites. The probe used for testing these sites was modified by attaching a 1/2-in. OD flexible teflon tube at the nozzle end inside a conventional probe sheath. The Teflon tube passed through the entire probe sheath and extended for approximately 15 ft, where it was adapted to a ball socket spherical joint for attachment to the glassware in the impinger train. An electrical heating tape wrapped around the Teflon tube inside the probe sheath and extended approximately 5 ft beyond the sheath to prevent moisture condensation in that portion of the sample line.

At all sampling locations (scrubber inlet, scrubber outlet, and uncontrolled cooler outlet) probe temperatures during sampling were maintained at approximately stack temperature plus 10°F.

The first, third, fifth, and sixth impingers used were of the modified Greenburg-Smith design, and the second and fourth impingers were the regular Greenburg-Smith units with orifice plates.

A glass-fiber (Gelman type A/E) filter with stainless steel back-up frit and glass filter holder was placed between the second and third impingers. The filter was not weighed but was added to the impinger water collection at the conclusion of each test.

The sample train was prepared for testing by placing 100 mℓ of distilled, deionized water in impinger Nos. 1 and 2. Impinger Nos. 3 and 4 contained 100 mℓ of 1 Normal sulfuric acid (1 N H_2SO_4), and the fifth impinger was empty. The sixth impinger contained a weighed quantity (approximately 200 g) of indicating silica gel.

Sampling procedures were as described in EPA Reference Method 5, except that the filter was not heated and the probe was heated to the stack temperature plus 10°F.

Sample Recovery

Sample recovery at the conclusion of each test consisted of:

1. The sampling nozzle and probe (glass or Teflon as applicable) were brushed and washed three times into a collection flask using a nylon brush on a Teflon rod and washing with distilled, deionized water (DDW). The probe wash was then added to the collection from the first two impingers, along with the DDW rinse of all connecting glassware up to but not including the third impinger. The filter and the DDW rinse from the filter holder were also added to this collection, which was placed in a labeled, 32-oz, widemouthed jar.

2. The contents of the third, fourth, and fifth impingers were transferred to a sample bottle. The impingers and all connecting glassware were rinsed with 1 N H_2SO_4 and added to the second container collection.

As in EPA Method 5, the volume of the collection from the impingers was recorded and used to determine the moisture content. An exception to this method occurred involving the scrubber inlet tests. The heavy loading of ammonium nitrate in that part of the process caused periodic stoppage in the Teflon sample line. It was necessary to stop sampling when this occurred and flush the obstruction into the impinger train using DDW. This addition of DDW to the impinger train made the sample collection appear to contain a much higher moisture content than actually existed. Therefore, instead of using the volume of impinger water collected to determine moisture content, an assumed value of 2% moisture by volume was used for all the scrubber inlet tests.

During the first test at the rotary drum cooler exhaust (Run No. 1-ORDC), the sample nozzle size diameter was changed from 0.1875 to 0.250 in. The results of this test were entered into the computer in two parts. Values entered for Total Moisture Collected and Total Particulate Collected were calculated, using the proportions of gas volume measured for first and second parts of the test. The proportions are:

12.47% for the first part, using 0.1875-in. nozzle
87.53% for the second part, using 0.250-in. nozzle

The results of the computer run for both parts of test No. 1-ORDC are combined and presented as one.

Sample Analysis

Only one sample train was operated for each set of analyses using the modified Method 5 train as described in Figure 5-1. Upon the conclusion of each test, the samples were recovered according to the procedures described in the previous section; "Sample Recovery." The two sample containers from each test run were then pretreated in the following manner in the field for subsequent laboratory analyses:

The water content of the first sample container (front half, or water fraction) was filtered using a tared glass fiber filter and a vacuum filtration assembly to remove all traces of undissolved material. A vacuum flask, vacuum pump, Buchner funnel, and tared glass fiber filters were used for this filtration operation. The tared glass fiber funnel filter was stored in a petri dish for subsequent desiccation and weighing at MRI's Kansas City laboratories.

The filtered water from the first sample container was then divided into two equal portions with concentrated H_2SO_4 being added to one portion until the pH was 6.0 or less. The second equal portion of the filtered water was not pretreated.

The sample content of the second container from each test run (back half, or acid fraction) did not receive any pretreatment.

The collected samples from the modified EPA Method 5 test runs were analyzed in the laboratory according to the following format:

1. The untreated portion of the water sample (front half), including the Buchner funnel filter was analyzed for nitrate using an ion specific electrode.

2. The pH treated portion of the water sample (front half) was analyzed for ammonia using the Direct Nesslerization method.

3. The 1 Normal H_2SO_4 impinger contents (back half, or acid fraction) from Impingers 3, 4, and 5 was analyzed for nitrate and ammonia using an ion specific electrode and the Direct Nesslerization method.

Each of the laboratory methods used in the analysis of the modified EPA Method 5 samples is briefly described in the following sections.

Specific Ion Electrode Measurements

A nitrate ion electrode (Orion) and a potentiometer (Leeds and Northrup) were calibrated using solutions of known concentration. The electrode was then placed into the sample and a millivolt reading was recorded as soon as the meter stabilized. Three aliquots of each sample were measured and the average value was used to determine the concentration of the sample. Where necessary, the samples were diluted prior to the measurement.

This method was used on both the water and acid fractions obtained from the modified Method 5 train.

Direct Nesslerization

A colorimeter (B&L Spectronic 20) was calibrated using solutions of known concentration. Absorbances of each solution were measured following appropriate dilution to keep the absorbances within the range of the calibration.

This technique involves adjusting the pH of the solution to between 8 and 10, adding the Nessler reagent and diluting to known volume. The solution is allowed to stand for approximately 30 min before the absorbance is read. Three aliquots of each sample were measured and the average was used to calculate the concentration.

This technique was used on both the acid and water fractions obtained from the modified Method 5 train.

Location and Time Frame of Analysis

The audit samples supplied by EPA were analyzed for nitrate in the field at the Swift Chemical Company laboratory. These nitrate analyses were accomplished using an ion specific electrode which was calibrated in the field laboratory. However, do to time limitations, none of the test samples were analyzed in the field. Therefore, all test samples were returned to the MRI laboratories in Kansas City, Missouri, for analysis. The ion specific electrode (nitrate) and Direct Nesslerization (ammonia) analyses of the samples occurred approximately 10 days after the completion of the field test.

Interferences

Several ions can interfere with the specific ion electrode. These include: $10^{-7}M\ ClO_4^-$; $10^{-5}M\ I^-$; $10^{-4}M\ ClO_3^-$; $10^{-1}M\ Ac^-$. In the calculations shown in this report, these interferences were assumed to be absent.

Interferences for the Nessler method include calcium, magnesium, iron, and sulfide. These were also assumed to be absent for the calculations.

Insoluble Particulate Emissions

Insoluble particulates were determined by filtering the impinger solutions through tared glass fiber filters. Filtering occurred as the samples were transferred from the impingers into the sample bottles. The filters were rinsed, air dried, and returned to the laboratory where they were weighed under temperature and humidity controlled conditions.

Particle Size

Testing for particle size distribution in the scrubber inlet duct and the uncontrolled rotary drum cooler exhaust was done using Brink cascade impactors with preselector cyclones. The Brink Cascade Impactor (BMS II), classifies particles into six (6) size ranges. A precyclone fabricated by MRI was used during testing to provide a seventh range. Figure 5-2 shows the Brink sampler assembled with cyclone and sampling nozzle. Also shown in Figure 5-2 is the vacuum pump and sample rate indicating manometer used for controlling the sampling. The entire assembly was placed inside the duct during sampling. The impactor assembly was allowed to equilibrate thermally in the duct at the scrubber inlet for at least 20 min before testing was started. The cooler exhaust duct was very near ambient temperature, therefore, no conditioning period was required.

During the temperature conditioning period, the nozzle was replaced with a swagelock tube cap, and the vacuum line at the pump was closed to prevent air from being drawn through the impactor due to the relatively high negative static pressures in the ducts sampled. Just before starting the sizing test, the impactor was withdrawn from the stream, the nozzle attached to the cyclone inlet, and the vacuum pump started. Sample flow was started through the impactor simultaneously with the nozzle entry into the sample port.

During sampling, the flow was adjusted to the predetermined flow rate as indicated by the manometer monitoring the pressure drop across the impactor orifices. Sample time at the uncontrolled cooler outlet location for all three test runs was 14 min. At the scrubber inlet location, test runs Nos. 1 and 3 were 10 min in duration, while test run No. 2 was 12 min in duration. At the conclusion of the sampling period, the impactor assembly was withdrawn from the duct with a sample continuing to be drawn until the nozzle cleared the sample port, at which time the vacuum pump was turned off. The time required to perform this "sampling while inserting and withdrawing" was typically not more than 5 sec each way and is a negligible portion of the total sample period. This technique insures that the collection substrates and the impacted sample particulates remain in place during the insertion and withdrawal period.

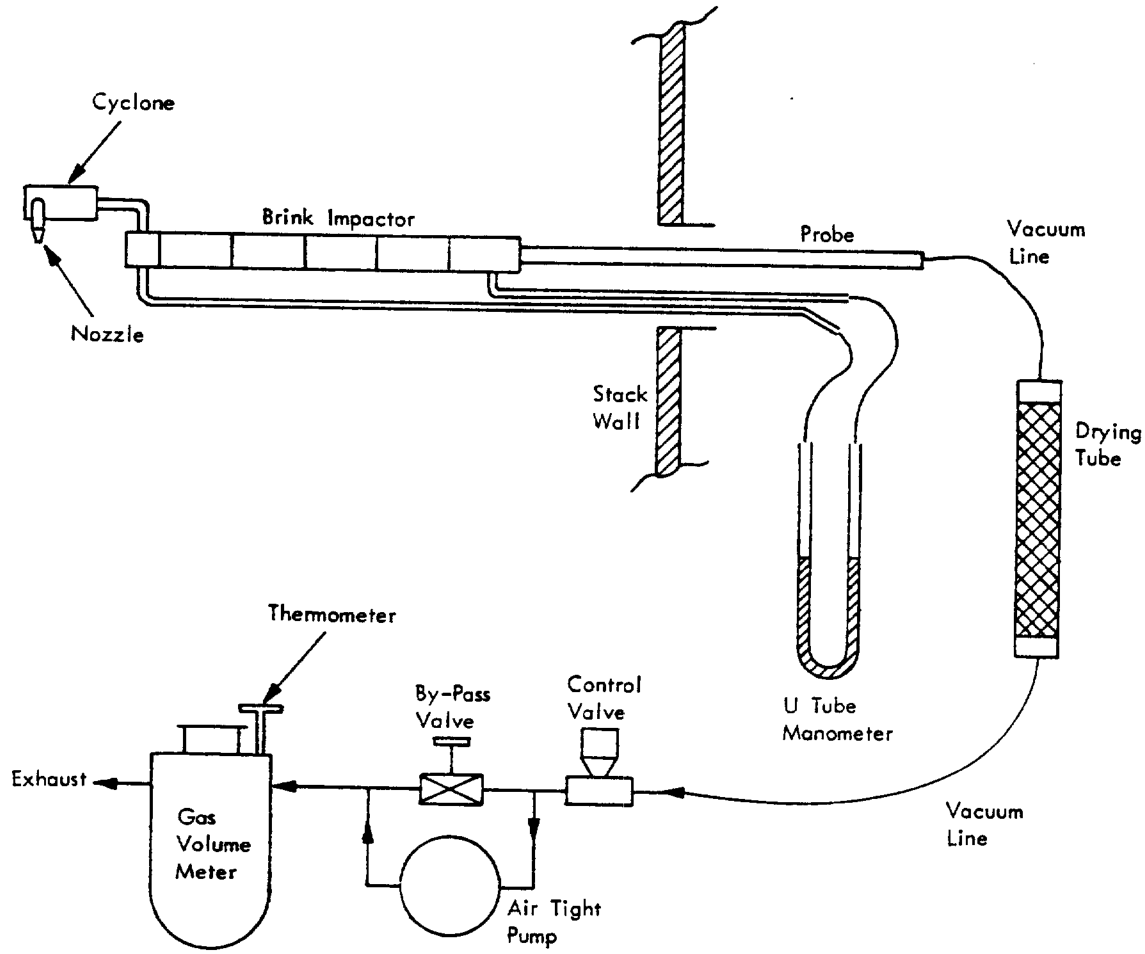


Figure 5-2. Schematic of Brink impactor sampling train.

The normally used aluminum stage substrates had to be replaced with glass fiber (Gelman type A/E) discs for this series of tests because of the corrosive action of the ammonium nitrate in the process stream. These collection substrates were conditioned in silica gel desiccators and tare-weighed in the field laboratory (Swift Chemical Company laboratory). Plastic sample beakers (5 mℓ capacity) were used as impactor sample containers during the conditioning periods. These beakers were also used as containers for the cyclone catch and the final filter.

Upon completion of each particle size test, the Brink impactor was held in an upright, vertical position to prevent movement of impacted particles and transported to the field laboratory. In the laboratory the impactor was secured by a bench-clamp in a vertical position for sample recovery. The impactor was disassembled and the sample recovered as follows:

1. The nozzle and precyclone were removed from the impactor. Particulate matter from the nozzle and the precyclone was brushed with a balance brush into a marked, tared 5 ml capacity plastic sample beaker.

2. Impactor stages 1-5 were individually separated and recovered from the impactor. For each stage, the metal clip was removed first with a laboratory tweezers and placed in a marked, tared 5 ml plastic sample beaker. The glass fiber filter was then removed and placed in the same sample container. The impactor stage was then cleaned with a brush and any particulate matter present was added to the sample beaker containing the clip and filter of that particular stage.

3. The final filter was removed with a tweezers from the impactor and placed in a marked, tared 5 ml plastic sample beaker.

Upon completion of the sample recovery, the plastic sample beakers were conditioned in silica gel desiccators and final-weighed in the field laboratory.

Visible Emissions Observations

EPA Method 9 visible emissions observations were done in accordance to accepted EPA procedures. Observations were made at 15-sec intervals from a point sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to the observer's back. These observations were made concurrent with several of the scrubber emissions tests. The observer had been certified within the previous 6-month period.

Pressure Drop Measurements

During emissions testing at the rotary drum granulator scrubber and the uncontrolled rotary drum cooler outlet locations, differential pressure drop data were recorded approximately every 15 min. The data were obtained using a "U" tube manometer with attached Tygon tubing extending into the inlet and outlet locations at these sites. Pressure drop measurmeents were observed and recorded in inches of water.

The equipment used to collect these data were provided and installed by MRI. The EPA Technical Manager and Mr. Timothy L. Curtin of GCA collected and recorded the pressure drop measurement data during the field test.

Scrubber Liquor Collection and Analysis

Sampling Method

A 1-liter aliquot was collected at the beginning and each half hour afterwards at both the inlet and outlet.

Sample Preparation

After the test, the aliquots were combined to form one composite sample. The samples were then filtered through a tared filter and divided for analysis.

Sample Analysis

pH and temperature readings were taken both at collection time and when the samples reached room temperature. The samples were divided for analysis of ammonia and ammonia nitrate by Nessler and specific ion electrode. These analysis techniques were discussed in an earlier part of this section.

Ambient Temperature and Relative Humidity

Ambient temperature and relative humidity measurements were collected by the EPA Technical Manager during the field test. Sampling equipment consisted of a dry bulb and a wet bulb mercury thermometer. The thermometers were positioned on top of a tripod. Both dry bulb and wet bulb temperatures were observed approximately every 15 min during emissions testing at the rotary drum granulator scrubber and the uncontrolled rotary drum cooler outlet locations. Data were observed and recorded in degrees Fahrenheit for both dry bulb and wet bulb thermometers. From these readings the percent relative humidity was then determined. The equipment used for these measurements were supplied and installed by MRI.

Process Sample Collection and Analysis

Sampling Method

Process samples were collected from the granulator inlet, granulator outlet, cooler inlet, and cooler outlet. Solid samples were collected in shallow pans and returned to the laboratory. Samples were then weighed for the bulk density and sieve analysis. Aliquots were dissolved in distilled water and analyzed by ion electrode for nitrate and Nessler for ammonia as described earlier.

Bulk Density determination

Bulk density was determined by filling a tared 250 mℓ graduate and weighing. The bulk density was then calculated according to the equation:

$$\text{Bulk density (lb/ft}^3\text{)} = \text{(wt. of sample)(0.2497)}$$

Sieve Analysis, Analytical Procedure

Sieve analysis was performed to determine the particle size of the product. The equipment used included a sieve shaker, timer, balance, and sieves (sieves 6, 8, 12, 14, 16, 20, and a pan were used). A sample of approximately 200 g was weighed on a single pan balance to $\pm$ 0.1 g and placed into the top sieve. The material was shaken for 20 min and the bottom pan was weighed. Following the initial weighing, the pan was returned to the shaker, the sample was shaken for an additional 10 min, and the pan was weighed a second time. This process was repeated for a second 10 min interval. At the conclusion of the shaking (a total of 40 min) all the sieves and the pan were weighed. The percent of material retained in each sieve was calculated according to the equation:

$$\%\ \text{retained} = \frac{\text{weight of material on sieve x 100}}{\text{total weight of material}}$$

United States
Environmental Protection
Agency

Office of Air, Noise, and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Publication No. EMB Report 79-NHF-11

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Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

EMB Report 79-NHF-11
July 1980

Air

EPA

Ammonium Nitrate

Emission Test Report
Swift Chemical Company
Beaumont, Texas

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

DATE: 7/28/80

SUBJECT: Source Test Report

FROM: J. E. McCarley, Chief, Field Testing Section, Emission Measurement Branch, ESED (MD-13)

TO: See Below

The enclosed final source test report is submitted for your information. Any questions regarding the test should be directed to the Project Officer (telephone: 8/629-5243). Additional copies of this report are available from the ERC Library, Research Triangle Park, North Carolina 27711.

Industry: Ammonium Nitrate

Process:

Company: Swift Chemical Company

Location: Beaumont, Texas

Project Report Number: EMB Report 79-NHF-11

Project Officer: Thomas Bibb

Enclosure

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Director, Air & Hazardous Materials Division, Region VI
(copy enclosed for State agency)
Bob Kilgore, EPA Library Services (MD-35)

MEASUREMENT OF EMISSIONS FROM A MODERN AMMONIUM NITRATE MANUFACTURING PLANT, SWIFT CHEMICAL COMPANY, BEAUMONT, TEXAS

by

Mark D. Hansen
Bruce C. DaRos
Robert C. Stultz

VOLUME II

(APPENDICES)

FINAL REPORT
July 23, 1980

EPA Contract No. 68-02-2814, Work Assignment No. 18
MRI Project No. 4468-L(18)

For

Environmental Protection Agency
Emission Measurement Branch
Emission Standards and Engineering Division
MD-13
Research Triangle Park, North Carolina 27711

Attn: Mr. J. E. McCarley

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A-3 ROTARY DRUM COOLER UNCONTROLLED OUTLET RESULTS

A-3-1 ROTARY DRUM COOLER UNCONTROLLED OUTLET RESULTS-ENSLIGH AND METRIC UNITS

A-1 SUMMARY OF TESTING RESULTS

TABLE 1-A-1. SUMMARY OF MODIFIED EPA METHOD 5 TESTING/ROTARY DRUM GRANULATOR SCRUBBER AND ROTARY DRUM COOLER

Run No.	Date	Time	Sampling location	Isokinetic (%)	Average velocity (fpm)	Average flowrate (acfm) ($\times 10^3$)	Average flowrate (dscfm) ($\times 10^3$)	Particulate collected (mg)	Particulate emission rate English units (lb/hr)	English units (gr/acf) ($\times 10^{-3}$)	English units (gr/dscf) ($\times 10^{-3}$)	Particulate emission rate metric units (kg/hr)	metric units (mg/m^3)	metric units (mg/nm^3)
3-IS	3-7-79	1031-1234	Scrubber inlet	102.6	3,752	50.1	41.4	10.0	0.93	2.2	2.6	0.423	4.97	6.01
4-IS	3-7-79	1500-1707	Scrubber inlet	103.1	4,073	54.3	43.4	7.2	0.67	1.4	1.8	0.303	3.28	4.11
5-IS	3-8-79	0919-1116	Scrubber inlet	101.7	4,580	61.1	49.1	8.7	0.82	1.6	1.9	0.371	3.57	4.45
3-OS	3-7-79	1030-1238	Scrubber outlet	98.1	2,235	41.9	38.5	11.0	0.68	1.9	2.1	0.308	4.32	4.70
4-OS	3-7-79	1501-1705	Scrubber outlet	97.5	2,427	45.5	40.9	21.5	1.33	3.4	3.8	0.605	7.83	8.71
5-OS	3-8-79	0911-1123	Scrubber outlet	101.9	2,760	51.7	44.0	25.9	1.54	3.5	4.1	0.697	7.94	9.34
1-ORDC	3-8-79	1405-1523	Uncontrolled cooler exhaust	93.6	5,428	22.2	20.4	69.9	4.54	23.9	25.9	2.060	54.74	59.24
2-ORDC	3-9-79	0945-1038	Uncontrolled cooler exhaust	100.7	5,428	21.8	19.9	43.1	2.68	14.3	15.7	1.214	32.76	35.81
3-ORDC	3-9-79	1516-1608	Uncontrolled cooler exhaust	100.4	5,423	21.7	19.6	15.5	0.96	5.2	5.7	0.438	11.89	13.11

A-2 ROTARY DRUM GRANULATOR SCRUBBER RESULTS

A-2-1 ROTARY DRUM GRANULATOR SCRUBBER INLET RESULTS-ENGLISH AND METRIC UNITS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 1-IS 03-05-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
70	30.40	-3.10	13.40	.0	9.7	9.3	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		743.93								
1 01	3.0	744.65	.92	.21	68	68	0.0	100		3326
1 02	3.0	745.40	.79	.18	68	68	0.0	85		3041
1 03	3.0	746.27	.95	.22	70	69	2.0	182		3619
1 04	3.0	747.08	.95	.22	72	69	6.0	109		3407
1 05	3.0	748.15	1.60	.38	73	70	1.0	185		4708
1 06	3.0	749.50	2.18	.50	74	71	2.0	184		5491
1 08	3.0	750.85	3.00	.70	78	72	3.0	185		6447
1 09	3.0	752.32	3.10	.70	80	72	3.0	184		6548
1 10	3.0	753.54	2.10	.49	78	73	2.5	185		5394
1 11	3.0	754.75	1.80	.42	76	73	2.0	183		4986
1 12	3.0	756.08	1.90	.44	79	75	2.0	181		5114
1 13	3.0	757.15	1.60	.38	81	76	2.0	181		4693
1 14	3.0	758.32	1.90	.44	81	76	2.0	181		5114
1 15	3.0	759.45	1.60	.38	82	77	2.0	182		4697
1 16	3.0	760.59	1.70	.41	84	77	2.0	183		4845
1 17	3.0	761.78	1.90	.44	86	78	2.0	185		5130
1 18	3.0	762.95	1.80	.42	88	79	2.0	180		4974
1 19	3.0	764.13	1.90	.44	88	79	2.0	187		5138
1 20	3.0	765.31	1.80	.42	88	80	2.0	187		5001

METER -Q FACTOR= 1.000 PITOT COFF= .840 PROBE DIAM.= .1230 IN.
19 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 2-1S 01-06-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.30	-1.20	13.40	.0	6.2	28.3	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		765.44								
1 01	2.0	766.48	.55	.60	57	57	0.0	109		2597
1 02	2.0	767.47	.92	1.00	59	57	2.0	175		3548
1 03	2.0	768.64	1.10	1.10	61	57	2.0	183		3904
1 04	2.0	770.01	1.50	1.75	62	57	3.0	184		4563
1 05	2.0	771.48	1.60	1.85	67	58	3.0	184		4712
1 06	2.0	773.02	1.80	1.95	69	59	3.0	185		5002
1 07	2.0	774.57	1.90	2.05	72	60	3.0	184		5135
1 08	2.0	776.11	1.75	1.90	75	60	3.0	184		4928
1 09	2.0	777.63	1.80	1.95	77	61	3.0	184		4998
1 10	2.0	779.16	1.70	1.85	78	62	3.0	183		4854
1 11	2.0	780.67	1.75	1.90	80	63	3.0	183		4925
1 12	2.0	782.18	1.75	1.90	82	64	3.0	184		4928
1 13	2.0	783.84	2.20	2.30	83	65	4.0	184		5526
1 14	2.0	785.49	2.00	2.20	85	66	3.5	184		5269
1 15	2.0	787.04	1.75	1.90	87	67	3.0	187		4940
1 16	2.0	788.67	2.00	2.20	88	68	3.5	187		5281
1 17	2.0	790.25	1.90	2.05	90	69	3.0	187		5147
1 18	2.0	791.80	1.80	1.95	90	70	3.5	187		5010
1 19	2.0	793.39	1.90	2.05	91	71	3.5	187		5147
1 20	2.0	794.96	1.80	1.95	92	72	3.5	187		5010
1 21	2.0	796.48	1.75	1.90	92	73	3.0	187		4940
1 22	2.0	798.03	1.80	1.95	93	74	3.0	186		5006
1 23	2.0	799.62	1.95	2.10	94	75	3.5	186		5210
1 24	2.0	801.17	1.80	1.95	94	76	3.5	185		5002
2 01	2.0	802.14	.70	.80	68	72	6.0	69		2825
2 02	2.0	803.08	.95	1.00	68	71	12.0	180		3620
2 03	2.0	804.29	1.10	1.20	69	70	2.0	180		3895
2 04	2.0	805.66	1.40	1.50	72	70	3.0	185		4411
2 05	2.0	807.11	1.60	1.75	75	70	3.0	185		4716
2 06	2.0	808.64	1.80	1.90	79	71	3.5	186		5006
2 07	2.0	810.18	1.80	1.90	81	71	3.5	186		5006
2 08	2.0	811.74	1.85	2.00	84	72	3.5	186		5075
2 09	2.0	813.28	1.80	1.90	85	72	3.5	187		5010
2 10	2.0	814.82	1.80	1.90	86	73	3.5	187		5010
2 11	2.0	816.39	1.85	2.00	88	73	3.5	185		5071
2 12	2.0	817.98	1.90	2.05	90	74	3.5	185		5139
2 13	2.0	819.57	1.90	2.05	92	74	4.0	183		5131
2 14	2.0	820.95	1.40	1.50	94	75	3.0	183		4405
2 15	2.0	822.29	1.30	1.40	94	76	3.0	182		4241
2 16	2.0	823.58	1.20	1.30	93	76	3.0	181		4071

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 2-IS 03-06-79

PORT-POINT	SAMP TIME (MIN)	METER VOL (OCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
2 17	2.0	824.92	1.10	1.20	93	77	3.0	182		4071
2 18	2.0	826.02	1.00	1.10	93	78	3.0	182		3720
2 19	2.0	827.05	.70	.80	92	78	2.5	181		3110
2 20	2.0	827.99	.57	.62	92	79	2.0	182		2808
2 21	2.0	828.84	.45	.50	90	79	2.0	180		2491
2 22	2.0	829.49	.23	.26	89	79	2.0	178		1778
2 23	2.0	830.22	.35	.38	88	79	2.0	175		2188
2 24	2.0	830.90	.25	.28	87	79	2.0	174		1848

METER -0 FACTOR= 1.000 PITOT COEF= .840 PROBE DIAM.= .1875 IN.
48 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 3-15 03-07-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (%)	DRY GAS CO2 (%)	DRY GAS CO (%)
70	30.10	-2.40	13.40	.0	10.0	25.4	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		831.40								
1 01	2.0	832.23	.60	.70	64	64	2.0	129		2766
1 02	2.0	833.43	.80	.95	66	65	2.0	165		3290
1 03	2.0	834.60	.89	1.00	68	65	2.0	165		3470
1 04	2.0	835.98	1.20	1.40	71	65	2.0	167		4036
1 05	2.0	837.28	1.40	1.60	74	66	2.5	167		4360
1 06	2.0	838.70	1.45	1.65	76	66	2.5	169		4444
1 07	2.0	840.16	1.50	1.70	79	67	2.5	168		4516
1 08	2.0	841.59	1.45	1.65	80	67	2.5	168		4440
1 09	2.0	843.04	1.50	1.70	82	68	2.5	168		4516
1 10	2.0	844.48	1.45	1.65	83	69	2.5	169		4444
1 11	2.0	846.00	1.55	1.75	84	70	2.5	168		4591
1 12	2.0	847.43	1.50	1.70	85	71	2.5	169		4520
1 13	2.0	849.00	1.80	2.05	87	72	3.0	170		4955
1 14	2.0	850.52	1.60	1.84	89	72	2.5	170		4672
1 15	2.0	852.04	1.60	1.84	89	73	2.5	170		4672
1 16	2.0	853.51	1.50	1.70	91	74	2.5	170		4524
1 17	2.0	854.98	1.55	1.75	91	75	2.5	170		4598
1 18	2.0	856.48	1.30	1.50	91	75	2.5	169		4208
1 19	2.0	857.90	1.60	1.84	91	76	3.0	171		4676
1 20	2.0	859.34	1.45	1.65	92	77	2.5	169		4444
1 21	2.0	860.81	1.50	1.70	92	77	2.5	170		4524
1 22	2.0	862.25	1.45	1.65	92	78	2.5	170		4448
1 23	2.0	863.65	1.35	1.55	92	79	3.0	170		4291
1 24	2.0	865.10	1.50	1.70	93	80	4.0	170		4524
2 01	2.0	865.90	.60	.70	75	76	2.0	140		2792
2 02	2.0	866.85	.65	.72	75	75	2.0	165		2966
2 03	2.0	867.96	.80	.92	76	76	2.0	168		3298
2 04	2.0	869.12	.83	.95	78	77	2.0	168		3359
2 05	2.0	870.35	1.00	1.20	80	77	2.0	170		3693
2 06	2.0	871.62	1.10	1.30	82	78	2.0	170		3874
2 07	2.0	872.96	1.22	1.40	84	78	2.0	170		4080
2 08	2.0	874.34	1.30	1.50	86	78	2.5	171		4215
2 09	2.0	875.72	1.30	1.50	88	78	2.0	170		4211
2 10	2.0	877.13	1.35	1.55	89	79	2.5	170		4291
2 11	2.0	878.50	1.25	1.45	90	79	2.0	170		4129
2 12	2.0	879.88	1.30	1.50	91	79	2.5	170		4211
2 13	2.0	881.35	1.50	1.70	92	80	2.5	169		4520
2 14	2.0	882.60	1.00	1.20	92	81	2.0	167		3685
2 15	2.0	883.76	.80	.95	92	91	2.0	161		3285
2 16	2.0	884.89	.76	.90	92	92	2.0	164		3204

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 3-15 03-07-79

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
2 17	2.0	886.03	.80	.95	92	82	2.0	169		3204
2 18	2.0	887.11	.71	.85	91	82	2.0	165		3100
2 19	2.0	887.99	.43	.50	90	83	1.0	150		2383
2 20	2.0	888.71	.27	.32	89	83	1.0	165		1911
2 21	2.0	889.31	.18	.22	88	83	1.0	166		1562
2 22	2.0	889.79	.11	.14	87	83	1.0	155		1210
2 23	2.0	890.19	.06	.75	86	83	1.0	153		892
2 24	2.0	890.83	.28	.32	86	84	1.0	148		1920

METER -D FACTOR= 1.000 PITOT COEFF= .840 PROBE DIAM.= .1875 IN.
48 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 4-1S 01-07-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
75	30.10	-3.10	13.40	.0	7.2	26.7	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		891.50								
1 01	2.0	892.80	1.10	1.30	77	78	3.5	175		3892
1 02	2.0	894.00	.90	1.05	79	79	3.0	186		3551
1 03	2.0	895.39	1.35	1.55	80	78	4.0	190		4363
1 04	2.0	896.81	1.40	1.60	83	78	4.0	188		4436
1 05	2.0	898.26	1.50	1.70	86	78	4.5	187		4588
1 06	2.0	899.74	1.55	1.80	88	79	4.5	188		4668
1 07	2.0	901.24	1.55	1.80	90	79	4.5	187		4664
1 08	2.0	902.77	1.60	1.85	93	80	5.0	186		4735
1 09	2.0	904.28	1.55	1.80	94	81	4.5	189		4671
1 10	2.0	905.76	1.50	1.70	97	82	4.5	188		4592
1 11	2.0	907.25	1.55	1.80	98	82	4.5	187		4664
1 12	2.0	908.73	1.50	1.70	98	83	4.5	189		4595
1 13	2.0	910.34	1.85	2.10	97	84	5.0	190		5107
1 14	2.0	911.87	1.60	1.85	97	84	4.5	192		4757
1 15	2.0	913.40	1.60	1.85	98	84	4.5	191		4753
1 16	2.0	914.97	1.70	1.90	98	85	5.0	191		4900
1 17	2.0	916.48	1.55	1.80	98	85	4.5	190		4675
1 18	2.0	917.99	1.55	1.80	99	85	4.5	190		4675
1 19	2.0	919.53	1.60	1.85	100	86	5.0	193		4761
1 20	2.0	921.07	1.60	1.85	100	86	5.0	192		4757
1 21	2.0	922.60	1.60	1.85	100	87	5.0	193		4761
1 22	2.0	924.14	1.60	1.85	101	88	5.0	192		4757
1 23	2.0	925.69	1.65	1.90	102	88	5.0	192		4831
1 24	2.0	927.23	1.60	1.85	103	89	5.0	191		4753
2 01	2.0	928.29	.75	.90	82	85	4.0	84		2975
2 02	2.0	929.30	.80	.95	83	85	10.0	183		3340
2 03	2.0	930.56	1.00	1.20	83	84	3.5	184		3737
2 04	2.0	931.85	1.15	1.30	85	85	4.0	188		4020
2 05	2.0	933.28	1.40	1.60	88	85	4.5	189		4439
2 06	2.0	934.51	1.40	1.60	87	84	4.5	190		4443
2 07	2.0	935.92	1.40	1.60	86	84	4.5	194		4456
2 08	2.0	937.38	1.45	1.70	88	85	4.5	192		4528
2 09	2.0	938.86	1.45	1.70	90	85	4.5	191		4525
2 10	2.0	940.35	1.50	1.75	92	85	4.5	192		4606
2 11	2.0	941.78	1.40	1.60	94	85	4.0	194		4456
2 12	2.0	943.28	1.50	1.75	94	86	4.5	193		4609
2 13	2.0	944.77	1.50	1.75	95	86	4.5	191		4602
2 14	2.0	946.09	1.10	1.30	95	85	4.0	190		3938
2 15	2.0	947.39	1.10	1.30	95	86	4.0	188		3932
2 16	2.0	948.58	.85	1.00	94	86	3.5	187		3454

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 4-15 03-07-79

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
2 17	2.0	949.69	.78	.90	94	86	3.5	188		3454
2 18	2.0	950.79	.78	.90	93	86	3.5	187		3308
2 19	2.0	951.85	.68	.80	91	86	3.0	185		3084
2 20	2.0	952.59	.28	.33	92	86	2.5	183		1976
2 21	2.0	953.17	.16	.20	90	86	2.0	183		1493
2 22	2.0	953.77	.22	.26	88	86	2.0	185		1754
2 23	2.0	954.31	.15	.18	88	86	2.0	177		1439
2 24	2.0	955.02	.32	.38	87	86	2.5	180		2107

METER -0 FACTOR= 1.000 PITOT COEF= .840 PROBE DIAM.= .1875 IN.
48 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 5-15 03-08-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
70	30.08	-4.10	13.40	.0	8.7	29.8	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		956.63								
1 01	2.0	958.05	1.30	1.50	64	63	4.0	176		4241
1 02	2.0	959.40	1.30	1.50	68	64	4.0	155		4171
1 03	2.0	960.79	1.40	1.60	72	64	4.5	177		4405
1 04	2.0	962.33	1.75	2.00	76	64	5.5	180		4937
1 05	2.0	963.93	1.85	2.10	79	65	6.0	182		5084
1 06	2.0	965.59	2.00	2.30	83	66	6.5	183		5290
1 07	2.0	967.29	2.05	2.35	86	67	6.5	181		5347
1 08	2.0	968.89	1.90	2.10	88	68	6.0	182		5152
1 09	2.0	970.53	2.00	2.20	90	69	6.0	184		5294
1 10	2.0	972.23	2.10	2.40	92	70	6.5	185		5429
1 11	2.0	973.92	2.05	2.30	92	71	6.5	184		5360
1 12	2.0	975.60	2.05	2.30	93	72	6.5	183		5356
1 13	2.0	977.44	2.50	2.80	94	74	8.0	183		5914
1 14	2.0	979.29	2.10	2.40	95	74	7.0	182		5416
1 15	2.0	980.92	2.10	2.40	95	75	7.0	184		5425
1 16	2.0	982.65	2.15	2.45	95	76	7.0	183		5485
1 17	2.0	984.37	2.10	2.40	96	77	7.0	185		5429
1 18	2.0	986.07	2.00	2.30	97	78	6.5	184		5294
1 19	2.0	987.79	2.10	2.40	98	78	7.0	185		5429
1 20	2.0	989.51	2.15	2.45	99	79	7.0	185		5493
1 21	2.0	991.14	1.85	2.10	98	79	6.0	183		5088
1 22	2.0	992.83	2.00	2.30	98	80	7.0	185		5298
1 23	2.0	994.46	1.85	2.10	99	81	7.0	185		5096
1 24	2.0	995.87	1.30	1.50	98	82	4.5	184		4268
2 01	2.0	997.02	.95	1.10	76	78	3.5	125		3477
2 02	2.0	998.42	1.40	1.60	78	78	4.5	180		4415
2 03	2.0	999.86	1.45	1.65	82	79	4.5	174		4472
2 04	2.0	1001.44	1.70	2.00	87	79	5.5	185		4885
2 05	2.0	1003.03	1.75	2.00	90	79	5.5	185		4956
2 06	2.0	1004.64	1.80	2.10	93	79	6.0	185		5026
2 07	2.0	1006.26	1.80	2.10	96	80	5.5	185		5026
2 08	2.0	1007.90	1.90	2.20	98	80	6.0	185		5164
2 09	2.0	1009.57	1.95	2.25	100	81	6.0	185		5231
2 10	2.0	1011.25	1.95	2.25	102	82	6.0	187		5240
2 11	2.0	1012.92	1.95	2.25	102	82	6.5	186		5235
2 12	2.0	1014.63	2.05	2.35	104	82	7.0	186		5368
2 13	2.0	1016.32	2.05	2.35	106	83	7.5	182		5351
2 14	2.0	1017.72	1.40	1.60	107	84	7.0	182		4422
2 15	2.0	1018.99	1.05	1.20	106	84	6.5	178		3818
2 16	2.0	1020.24	1.15	1.30	106	85	7.0	181		4005

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 5-1S 03-08-79

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
2 17	2.0	1021.55	1.20	1.40	104	85	10.0	182		4005
2 18	2.0	1022.78	.98	1.10	104	86	9.0	182		3700
2 19	2.0	1023.97	.90	1.05	103	86	7.5	183		3548
2 20	2.0	1024.89	.44	.52	101	86	4.5	183		2481
2 21	2.0	1025.52	.20	.25	100	86	2.5	180		1669
2 22	2.0	1026.05	.15	.18	98	86	2.0	176		1440
2 23	2.0	1026.61	.17	.20	96	86	2.0	173		1530
2 24	2.0	1027.17	.16	.19	94	86	2.0	173		1484

METER -0 FACTOR= 1.000 PITOT COEF= .840 PROBE DIAM.= .1875 IN.
48 POINTS

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DN	PROBE TIP DIAMETER	IN	.123	.188	.188	.188	.188
TT	NET TIME OF RUN	MIN	57	96	96	96	96
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	IN.HG	30.40	30.30	30.10	30.10	30.08
PM	AVG ORIFICE PRES DROP	IN.H2O	.41	1.57	1.29	1.44	1.82
VM	VOL DRY GAS-METER COND	DCF	21.18	65.46	59.43	63.52	70.54
TM	AVG GAS METER TEMP	DEG.F	76	76	80	88	85
VMSTD	VOL DRY GAS-STD COND	DSCF	21.41	65.54	58.62	61.79	68.96
VW	TOTAL H2O COLLECTED	ML	9.3	28.3	25.4	26.7	29.8
VWV	VOL H2O VAPOR-STD COND	SCF	.44	1.34	1.20	1.27	1.41
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
MD	MOLE FRACTION DRY GAS		.980	.980	.980	.980	.980
PCO2	PERCENT CO2 BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.62	28.62	28.62	28.62
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPS	AVG STACK VELOCITY HEAD	IN.H2O	1.76	1.45	1.11	1.24	1.59
TS	AVG STACK TEMPERATURE	DEG.F	170	180	166	186	180
NP	NET SAMPLING POINTS		19	48	48	48	48
PST	STATIC PRES OF STACK	IN.HG	-.23	-.24	-.18	-.23	-.30
PS	STACK PRESSURE, ABSOLUTE	IN.HG	30.17	30.06	29.92	29.87	29.78
VS	AVG STACK GAS VELOCITY	FPM	4827	4378	3752	4073	4580
AT	STACK AREA	FT2	13.40	13.40	13.40	13.40	13.40
QS	STK FLOWRATE, DRY,STD CN	DSCFM	53325	47475	41401	43442	49120
QA	ACTUAL STACK FLOWRATE	ACFM	64389	58403	50052	54338	61093
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
TC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00
CAN	PART.LOAD-PTL,STD CN	GR/DSCF	.000	.000	.000	.000	.000
CAO	PART.LOAD-TTL,STD CN	GR/DSCF	.00698	.00146	.00263	.00179	.00194
CAT	PART.LOAD-PTL,STK CN	GR/ACF	.000	.000	.000	.000	.000
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.00578	.00118	.00217	.00143	.00156
CAW	PARTIC EMIS-PARTIAL	LB/HR	0	0	0	0	0
CAX	PARTIC EMIS-TOTAL	LB/HR	3.19	.59	.93	.67	.82
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

SUMMARY OF RESULTS

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTD	VOL DRY GAS-STD COND	DSCF	21.41	65.54	58.62	61.79	68.96
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
TS	AVG STACK TEMPERATURE	DEG.F	170	190	166	186	180
QS	STK FLOWRATE, DRY,STD CN	DSCFM	53325	47475	41401	43442	49120
QA	ACTUAL STACK FLOWRATE	ACFM	64389	58403	50052	54338	61093
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

PARTICULATES -- PARTIAL CATCH

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
CAN	PART.LOAD-PTL,STD CN	GR/DSCF	.000	.000	.000	.000	.000
CAT	PART.LOAD-PTL,STK CN	GR/ACF	.000	.000	.000	.000	.000
CAM	PARTIC EMIS-PARTIAL	LB/HR	0	0	0	0	0

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
CAO	PART.LOAD-TTL,STD CN	GR/DSCF	.00698	.00146	.00263	.00179	.00194
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.00578	.00118	.00217	.00143	.00156
CAX	PARTIC EMIS-TOTAL	LB/HR	3.19	.59	.93	.67	.82
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-TS	2-TS	3-TS	4-TS	5-TS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DNA	PROBE TIP DIAMETER	MM	3.1	4.8	4.8	4.8	4.8
TT	NET TIME OF RUN	MIN	57	96	96	96	96
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PBM	BAROMETRIC PRESSURE	MM HG	772.2	769.6	764.5	764.5	764.0
PMA	AV ORIFICE PRESSURE DROP	MM H2O	10.4	40.0	32.7	36.5	46.3
VMM	VOL DRY GAS-METER COND	NM3	.61	1.85	1.68	1.80	2.00
TMM	AVG GAS METER TEMP	DEG.C	25	25	27	31	30
VMSTM	VOLUME DRY GAS-STD COND	NCM	.61	1.86	1.66	1.75	1.95
VW	TOTAL H2O COLLECTED	ML	9.3	28.3	25.4	26.7	29.8
VWM	VOL H2O VAPOR-STD COND	NM3	.01	.04	.03	.04	.04
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
MD	MOLE FRACTION DRY GAS		.980	.980	.980	.980	.980
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.62	28.62	28.62	28.62
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPSM	AVG STK VELOCITY HEAD	MM H2O	44.8	36.9	28.1	31.6	40.5
TSM	AVG STACK TEMPERATURE	DEG.C	77	82	74	86	82
NP	NET SAMPLING POINTS		19	48	48	48	48
PSTM	STATIC PRES OF STACK	MM HG	-5.79	-5.98	-4.48	-5.79	-7.66
PSM	STACK PRESSURE. ABSOLUTE	MM HG	766.4	763.6	760.1	758.8	756.4
VSM	AVG STACK GAS VELOCITY	M/MIN	1471	1334	1144	1242	1396
ASM	STACK AREA	M2	1.2	1.2	1.2	1.2	1.2
QSM	STK FLOWRATE.DRY.STD CN	NM3/MIN	1510	1344	1172	1230	1391
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1823	1654	1417	1539	1730
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00
CANM	PART. LOAD-PTL.STD CN	MG/NM3	0	0	0	0	0
CAOM	PART. LOAD-TTL.STD CN	MG/NM3	15.96	3.33	6.01	4.11	4.45
CATM	PART. LOAD-PTL.STD CN	MG/M3	0	0	0	0	0
CAUM	PART. LOAD-TTL.STD CN	MG/M3	13.22	2.71	4.97	3.28	3.57
CAWM	PARTIC EMIS-PARTIAL	KG/HR	0	0	0	0	0
CAXM	PARTIC EMIS-TOTAL	KG/HR	1.446	.269	.423	.303	.371
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTM	VOLUME DRY GAS-STD COND	NCM	.61	1.86	1.66	1.75	1.95
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
TSM	AVG STACK TEMPERATURE	DEG.C	77	82	74	86	82
QSM	STK FLOWRATE.DRY.STD CN	NM3/MIN	1510	1344	1172	1230	1391
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1823	1654	1417	1539	1730
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583
PARTICULATES -- PARTIAL CATCH							
MN	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
CANM	PART. LOAD-PTL.STD CN	MG/NM3	0	0	0	0	0
CATM	PART. LOAD-PTL.STD CN	MG/M3	0	0	0	0	0
CAHM	PARTIC EMIS-PARTIAL	KG/HR	0	0	0	0	0
PARTICULATES -- TOTAL CATCH							
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
CAOM	PART. LOAD-TTL.STD CN	MG/NM3	15.96	3.33	6.01	4.11	4.45
CAUM	PART. LOAD-TTL.STD CN	MG/M3	13.22	2.71	4.97	3.28	3.57
CAXM	PARTIC EMIS-TOTAL	KG/HR	1.446	.269	.423	.303	.371
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00

SOTDAT VALUES

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1823	1654	1417	1539	1730
ASM	STACK AREA	M2	1.2	1.2	1.2	1.2	1.2
TSM	AVG STACK TEMPERATURE	DEG.C	77	82	74	86	82
PSCM	STACK PRESSURE, ABSOLUTE	CM HG	76.6	76.4	76.0	75.9	75.6
NP	NET SAMPLING POINTS		19	48	48	48	48
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
PCO2W	PERCENT CO2 BY VOL, WET		0.0	0.0	0.0	0.0	0.0
PCOW	PERCENT CO BY VOL, WET		0.0	0.0	0.0	0.0	0.0
PO2W	PERCENT O2 BY VOL, WET		21.4	21.4	21.4	21.4	21.4
PN2W	PERCENT N2 BY VOL, WET		80.6	80.6	80.6	80.6	80.6
VSMS	AVG STACK GAS VELOCITY	M/SEC	24.5	22.2	19.1	20.7	23.3
TMM	AVG GAS METER TEMP	DEG.C	25	25	27	31	30

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DN	PROBE TIP DIAMETER	IN	.123	.198	.188	.188	.188
TT	NET TIME OF RUN	MIN	57	96	96	96	96
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	IN.HG	30.40	30.30	30.10	30.10	30.08
PM	AVG ORIFICE PRES DROP	IN.H2O	.41	1.57	1.29	1.44	1.82
VM	VOL DRY GAS-METER COND	DCF	21.38	65.46	59.43	63.52	70.54
TM	AVG GAS METER TEMP	DEG.F	76	76	80	88	85
VMSTD	VOL DRY GAS-STD COND	DSCF	21.41	65.54	58.62	61.79	68.96
VW	TOTAL H2O COLLECTED	ML	9.3	28.1	25.4	26.7	29.8
VWV	VOL H2O VAPOR-STD COND	SCF	.44	1.34	1.20	1.27	1.41
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
MD	MOLE FRACTION DRY GAS		.980	.980	.980	.980	.980
PCO2	PERCENT CO2 BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.62	28.62	28.62	28.62
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPS	AVG STACK VELOCITY HEAD	IN.H2O	1.76	1.45	1.11	1.24	1.59
TS	AVG STACK TEMPERATURE	DEG.F	170	180	166	186	180
NP	NET SAMPLING POINTS		19	48	48	48	48
PST	STATIC PRES OF STACK	IN.HG	-.23	-.24	-.18	-.23	-.30
PS	STACK PRESSURE, ABSOLUTE	IN.HG	30.17	30.06	29.92	29.87	29.78
VS	AVG STACK GAS VELOCITY	FPM	4827	4378	3752	4073	4580
AT	STACK AREA	FT2	13.40	13.40	13.40	13.40	13.40
QS	STK FLOWRATE, DRY,STD CN	DSCFM	53325	47475	41401	43442	49120
QA	ACTUAL STACK FLOWRATE	ACFM	64389	58403	50052	54338	61093
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
CAO	PART.LOAD-TTL,STD CN	GR/DSCF	.00698	.00146	.00263	.00179	.00194
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.00578	.00118	.00217	.00143	.00156
CAX	PARTIC EMIS-TOTAL	LB/HR	3.19	.59	.93	.67	.82

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DN	PROBE TIP DIAMETER	MM	3.1	4.8	4.8	4.8	4.8
TT	NET TIME OF RUN	MIN	57	96	96	96	96
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	MM HG	772.2	769.6	764.5	764.5	764.0
PM	AV ORIFICE PRESSURE DROP	MM H2O	10.4	40.0	32.7	36.5	46.3
VM	VOL DRY GAS-METER COND	NM3	.61	1.85	1.68	1.80	2.00
TM	AVG GAS METER TEMP	DEG.C	25	25	27	31	30
VMSTM	VOLUME DRY GAS-STD COND	NCM	.61	1.86	1.66	1.75	1.95
VW	TOTAL H2O COLLECTED	ML	9.3	28.3	25.4	26.7	29.8
VWV	VOL H2O VAPOR-STD COND	NM3	.01	.04	.03	.04	.04
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
MD	MOLE FRACTION DRY GAS		.980	.980	.980	.980	.980
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.62	28.62	28.62	28.62
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPSQ	AVG STK VELOCITY HEAD	MM H2O	44.8	36.9	28.1	31.6	40.5
TS	AVG STACK TEMPERATURE	DEG.C	77	82	74	86	82
NP	NET SAMPLING POINTS		19	48	48	48	48
PSTI	STATIC PRES OF STACK	MM HG	-5.79	-5.98	-4.48	-5.79	-7.66
PSM	STACK PRESSURE, ABSOLUTE	MM HG	766.4	763.6	760.1	758.8	756.4
VSM	AVG STACK GAS VELOCITY	M/MIN	1471	1336	1144	1242	1396
ASM	STACK AREA	M2	1.2	1.2	1.2	1.2	1.2
QSD	STK FLO RATE,DRY,STD CN	NM3/MIN	1510	1364	1172	1230	1391
QAW	ACTUAL STACK FLOWRATE	M3/MIN	1923	1654	1417	1539	1730
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
CAN	PART. LOAD-TTL,STD CN	MG/NM3	15.96	3.33	6.01	4.11	4.45
CAT	PART. LOAD-TTL,STD CN	MG/M3	13.22	2.71	4.97	3.28	3.57
CAW	PARTIC EMIS-TOTAL	KG/HR	1.446	.269	.423	.303	.371

SUMMARY OF RESULTS

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTD	VOL DRY GAS-STD COND	DSCF	21.41	65.54	58.62	61.79	68.96
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
TS	AVG STACK TEMPERATURE	DEG.F	170	180	166	186	180
QS	STK FLOWRATE, DRY,STD CN	DSCFM	53325	47475	41401	43442	49120
QA	ACTUAL STACK FLOWRATE	ACFM	64389	58403	50052	54338	61093
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7

PARTICULATES -- TOTAL CATCH

MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
CAN	PART.LOAD-TTL,STD CN	GR/DSCF	.00698	.00146	.00263	.00179	.00194
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.00578	.00118	.00217	.00143	.00156
CAX	PARTIC EMIS-TOTAL	LB/HR	3.19	.59	.93	.67	.82

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTD	VOLUME DRY GAS-STD COND	NCM	.61	1.86	1.66	1.75	1.95
PMOS	PERCENT MOISTURE BY VOL		2.0	2.0	2.0	2.0	2.0
TS	AVG STACK TEMPERATURE	DEG.C	77	82	74	86	82
QSD	STK FLOWRATE.DRY.STD CN	NM3/MIN	1510	1344	1172	1230	1391
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1823	1654	1417	1539	1730
PERI	PERCENT ISOKINETIC		113.9	100.0	102.6	103.1	101.7

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-IS	2-IS	3-IS	4-IS	5-IS
MT	PARTICULATE WT-TOTAL	MG	9.7	6.2	10.0	7.2	8.7
CAOM	PART. LOAD-TTL.STD CN	MG/NM3	15.96	3.33	6.01	4.11	4.45
CAUM	PART. LOAD-TTL.STD CN	MG/M3	13.22	2.71	4.97	3.28	3.57
CAKM	PARTIC EMIS-TOTAL	KG/HR	1.446	.269	.423	.303	.371

A-2-2 ROTARY DRUM GRANULATOR SCRUBBER OUTLET RESULTS-ENGLISH AND METRIC UNITS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 1-05 03-05-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.18	-.35	18.83	.0	18.2	49.0	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		662.10								
2 01	5.0	665.31	.35	1.40	65	64	2.0	110	55.0	2072
2 02	5.0	668.85	.45	1.40	71	64	2.0	110		2350
2 03	5.0	672.81	.50	1.40	76	65	3.0	100		2455
2 04	5.0	677.23	.57	1.40	78	65	5.0	100		2621
2 05	5.0	681.83	.60	1.40	82	66	5.0	100		2689
2 06	5.0	686.30	.65	2.80	84	68	5.0	100		2799
2 07	5.0	690.62	.70	2.70	84	68	5.0	100		2905
2 08	5.0	695.10	.73	2.90	85	69	6.0	105		2980
2 09	5.0	699.91	.76	3.10	88	70	6.0	100		3027
2 10	5.0	704.50	.73	2.80	92	72	5.0	100		2966
2 11	5.0	709.21	.71	3.00	93	73	5.0	100	65.0	2925
2 12	5.0	714.34	.65	3.50	95	75	5.0	100	65.0	2799

METER -0 FACTOR= 1.000 PITOT COEF= .840 PROBE DIAM.= .2500 IN.
12 POINTS

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.29	-.35	18.83	.0	21.9	74.1	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		714.41								
1 01	5.0	716.82	.35	1.30	62	62	1.0	105		2064
1 02	5.0	719.67	.43	1.60	66	64	1.0	110		2298
1 03	5.0	722.81	.49	1.80	68	64	1.0	122		2479
1 04	5.0	726.12	.51	1.90	70	65	1.0	125		2536
1 05	5.0	729.68	.55	2.10	75	67	1.0	125		2633
1 06	5.0	733.20	.56	2.10	75	68	2.0	125		2657
1 07	5.0	737.14	.53	2.00	76	68	2.0	130	68.0	2596
1 08	5.0	740.63	.51	1.80	78	70	1.0	120	65.0	2525
1 09	5.0	744.61	.51	1.80	78	71	1.0	120	64.0	2525
1 10	5.0	748.79	.58	2.30	80	72	4.0	115	64.0	2681
1 11	5.0	752.56	.55	2.10	80	72	1.0	115	64.0	2611
1 12	5.0	756.36	.48	1.90	82	74	1.0	115	61.0	2439
2 01	5.0	759.52	.35	1.30	70	72	1.0	100		2055
2 02	5.0	763.24	.43	1.60	74	72	4.0	110		2298
2 03	5.0	766.72	.49	1.80	79	74	1.0	120		2475
2 04	5.0	770.27	.54	2.10	79	74	1.0	118		2594
2 05	5.0	774.32	.56	2.20	80	76	2.0	120		2646
2 06	5.0	778.30	.60	2.40	82	76	2.0	116	58.0	2729
2 07	5.0	782.10	.62	2.40	82	76	2.0	115	58.0	2772
2 08	5.0	786.26	.63	2.40	83	76	2.0	112	58.0	2787
2 09	5.0	790.78	.62	2.80	83	76	8.0	115	59.0	2772
2 10	5.0	795.51	.61	2.80	85	77	6.0	115	60.0	2749
2 11	5.0	799.49	.59	2.40	83	76	3.0	117	60.0	2709
2 12	5.0	803.44	.54	2.30	82	78	3.0	115	58.0	2587

METER -0 FACTOR= 1.000 PITOT COFF= .840 PROBE DIAM.= .2500 IN.
24 POINTS

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.10	-.35	18.83	.0	11.0	52.4	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		803.64								
1 01	5.0	806.46	.29	1.20	65	66	4.0	100		1873
1 02	5.0	809.66	.37	1.50	69	66	5.0	100		2116
1 03	5.0	813.19	.40	1.80	71	67	7.0	100		2200
1 04	5.0	816.81	.44	1.80	72	68	7.0	100		2308
1 05	5.0	820.43	.46	1.80	73	68	7.0	100		2360
1 06	5.0	824.05	.47	1.70	74	69	7.0	100		2385
1 07	5.0	827.53	.45	1.80	75	70	7.0	100	62.0	2334
1 08	5.0	831.09	.43	1.80	76	70	7.0	100	63.0	2281
1 09	5.0	834.72	.44	1.90	76	70	7.0	105	62.0	2318
1 10	5.0	838.35	.44	1.80	76	71	7.0	100	64.0	2308
1 11	5.0	841.83	.43	1.70	76	72	7.0	105		2292
1 12	5.0	845.17	.39	1.50	76	72	6.0	100		2173
2 01	5.0	847.89	.26	1.00	72	72	4.0	100		1774
2 02	5.0	850.95	.35	1.40	74	72	5.0	100		2058
2 03	5.0	854.28	.35	1.60	77	72	6.0	100		2058
2 04	5.0	857.66	.39	1.60	78	73	6.0	100		2173
2 05	5.0	860.99	.42	1.60	79	74	6.0	100	66.0	2255
2 06	5.0	864.57	.45	1.90	80	75	7.0	100	63.0	2334
2 07	5.0	868.27	.47	1.90	80	76	7.0	100	63.0	2385
2 08	5.0	872.02	.48	2.00	80	76	7.0	100	65.0	2410
2 09	5.0	875.74	.46	1.90	81	76	8.0	100	64.0	2360
2 10	5.0	879.45	.47	1.90	82	77	7.0	100	62.0	2385
2 11	5.0	882.99	.45	1.80	82	77	7.0	100	60.0	2334
2 12	5.0	886.18	.38	1.40	82	78	6.0	100	63.0	2145

METER -0 FACTOR= 1.000 PITOT COEFF= .840 PROBE DIAM.= .2500 IN.
24 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 4-05 03-07-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.10	-.35	18.83	.0	21.5	69.9	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		887.96								
1 01	5.0	889.96	.31	1.20	77	77	2.0	105		1948
1 02	5.0	893.78	.40	1.80	83	77	2.0	105		2213
1 03	5.0	897.92	.48	2.20	85	78	3.0	110		2435
1 04	5.0	901.84	.50	2.10	88	78	3.0	110		2486
1 05	5.0	905.68	.52	2.10	86	80	3.0	110		2535
1 06	5.0	909.33	.51	1.90	84	78	3.0	110		2510
1 07	5.0	913.09	.49	2.00	84	78	3.0	110	62.0	2461
1 08	5.0	916.83	.52	2.00	85	80	3.0	110		2535
1 09	5.0	920.70	.50	2.10	86	79	3.0	110	64.0	2486
1 10	5.0	924.47	.50	2.00	86	79	3.0	110		2486
1 11	5.0	928.19	.48	2.00	85	80	3.0	110	64.0	2435
1 12	5.0	931.67	.44	1.70	84	78	3.0	110		2332
2 01	5.0	934.58	.30	1.20	79	78	2.0	110		1925
2 02	5.0	937.79	.39	1.60	82	78	2.0	110		2195
2 03	5.0	941.40	.43	1.90	84	78	2.0	110		2305
2 04	5.0	945.09	.48	1.90	84	78	2.0	110		2435
2 05	5.0	948.83	.49	2.00	84	78	2.0	110		2461
2 06	5.0	952.49	.50	1.90	84	77	2.0	105	64.0	2475
2 07	5.0	956.45	.55	2.20	84	77	3.0	110		2607
2 08	5.0	960.49	.56	2.30	84	76	3.0	110	62.0	2630
2 09	5.0	964.42	.56	2.20	83	76	3.0	110	76.0	2630
2 10	5.0	968.45	.54	2.30	83	76	4.0	105		2572
2 11	5.0	972.48	.55	2.30	83	77	4.0	110	80.0	2607
2 12	5.0	976.11	.52	1.90	83	77	3.0	105		2524

METER -0 FACTOR= 1.000 PITOT COEF= .840 PROBE DIAM.= .2500 IN.
24 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 5-05 03-08-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.08	-.35	18.83	.0	25.9	177.0	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		976.65								
1 01	5.0	979.94	.43	1.70	65	62	3.0	105		2314
1 02	5.0	983.69	.50	2.10	70	62	4.0	115		2518
1 03	5.0	987.74	.58	2.40	75	63	5.0	110		2700
1 04	5.0	992.12	.64	2.70	80	64	7.0	110		2836
1 05	5.0	996.91	.69	3.00	85	66	8.0	110		2945
1 06	5.0	1001.33	.67	2.60	90	70	7.0	110		2902
1 07	5.0	1005.45	.64	2.40	91	72	6.0	110	56.0	2836
1 08	5.0	1009.46	.63	2.40	91	74	5.0	112	54.0	2819
1 09	5.0	1013.83	.64	2.60	94	78	6.0	110	54.0	2836
1 10	5.0	1018.21	.63	2.60	94	78	6.0	110	54.0	2814
1 11	5.0	1022.43	.58	2.40	96	80	6.0	115	55.0	2712
1 12	5.0	1026.13	.52	2.00	96	80	4.0	110	55.0	2556
2 01	5.0	1029.26	.39	1.50	78	78	2.0	115		2223
2 02	5.0	1033.03	.47	2.00	82	77	4.0	115		2441
2 03	5.0	1037.09	.55	2.30	89	77	5.0	115		2641
2 04	5.0	1041.12	.57	2.40	92	78	6.0	120		2700
2 05	5.0	1045.32	.61	2.40	96	79	6.0	120		2793
2 06	5.0	1049.42	.62	2.40	95	80	6.0	120		2816
2 07	5.0	1053.81	.67	2.80	98	80	7.0	120	54.0	2927
2 08	5.0	1058.30	.71	2.90	100	82	7.0	120	56.0	3013
2 09	5.0	1062.85	.72	3.00	101	84	7.0	120	57.0	3034
2 10	5.0	1067.30	.70	2.70	101	85	6.0	120	58.0	2992
2 11	5.0	1071.70	.70	2.90	101	84	7.0	120	58.0	2992
2 12	5.0	1076.04	.63	2.60	102	86	6.0	120	59.0	2838

METER -0 FACTOR= 1.000 PITOT COEF= .840 PROBE DIAM.= .2500 IN.
24 POINTS

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DN	PROBE TIP DIAMETER	IN	.250	.250	.250	.250	.250
TT	NET TIME OF RUN	MIN	60	120	120	120	120
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	IN.HG	30.38	30.29	30.10	30.10	30.08
PM	AVG ORIFICE PRES DROP	IN.H2O	2.32	2.05	1.68	1.95	2.45
VM	VOL DRY GAS-METER COND	DCF	52.24	89.03	82.54	88.15	99.39
TM	AVG GAS METER TEMP	DEG.F	76	74	74	81	83
VMSTD	VOL DRY GAS-STD COND	DSCF	52.59	89.49	82.44	87.00	97.75
VW	TOTAL H2O COLLECTED	ML	49.0	74.1	52.4	69.9	177.0
VWV	VOL H2O VAPOR-STD COND	SCF	2.32	3.51	2.48	3.31	8.39
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
MD	MOLE FRACTION DRY GAS		.958	.962	.971	.963	.921
PCO2	PERCENT CO2 BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.38	28.43	28.52	28.44	27.98
CP	PITOT TUBE COEFICIENT		.840	.840	.840	.840	.840
DPS	AVG STACK VELOCITY HEAD	IN.H2O	.62	.53	.41	.48	.60
TS	AVG STACK TEMPERATURE	DEG.F	102	117	100	109	115
NP	NET SAMPLING POINTS		12	24	24	24	24
PST	STATIC PRES OF STACK	IN.HG	-.03	-.03	-.03	-.03	-.03
PS	STACK PRESSURE, ABSOLUTE	IN.HG	30.35	30.26	30.07	30.07	30.05
VS	AVG STACK GAS VELOCITY	FPM	2717	2552	2235	2427	2760
AT	STACK AREA	FT2	18.83	18.83	18.83	18.83	18.83
QS	STK FLOWRATE, DRY,STD CN	DSCFM	46484	42630	38521	40887	43969
QA	ACTUAL STACK FLOWRATE	ACFM	50931	47836	41902	45502	51730
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00
CAN	PART.LOAD-PTL.STD CN	GR/DSCF	.000	.000	.000	.000	.000
CAO	PART.LOAD-TTL.STD CN	GR/DSCF	.00533	.00377	.00205	.00381	.00408
CAT	PART.LOAD-PTL.STK CN	GR/ACF	.000	.000	.000	.000	.000
CAU	PART.LOAD-TTL.STK CN	GR/ACF	.00486	.00336	.00189	.00342	.00347
CAW	PARTIC EMIS-PARTIAL	LB/HR	0	0	0	0	0
CAX	PARTIC EMIS-TOTAL	LB/HR	2.12	1.38	.68	1.33	1.54
FA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

SUMMARY OF RESULTS

NAME	DESCRIPTION	UNITS	1-05	2-05	3-05	4-05	5-05
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTD	VOL DRY GAS-STD COND	DSCF	52.59	89.49	82.44	87.00	97.75
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
TS	AVG STACK TEMPERATURE	DEG.F	102	117	100	109	115
QS	STK FLOWRATE, DRY,STD CN	DSCFM	46484	42630	38521	40887	43969
QA	ACTUAL STACK FLOWRATE	ACFM	50931	47836	41902	45502	51730
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

PARTICULATES -- PARTIAL CATCH

NAME	DESCRIPTION	UNITS	1-05	2-05	3-05	4-05	5-05
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
CAN	PART.LOAD-PTL.STD CN	GR/DSCF	.000	.000	.000	.000	.000
CAT	PART.LOAD-PTL.STK CN	GR/ACF	.000	.000	.000	.000	.000
CAW	PARTIC EMIS-PARTIAL	LB/HR	0	0	0	0	0

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-05	2-05	3-05	4-05	5-05
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
CAO	PART.LOAD-TTL.STD CN	GR/DSCF	.00533	.00377	.00205	.00381	.00408
CAU	PART.LOAD-TTL.STK CN	GR/ACF	.00486	.00336	.00189	.00342	.00347
CAX	PARTIC EMIS-TOTAL	LB/HR	2.12	1.38	.68	1.33	1.54
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DDN	PROBE TIP DIAMETER	MM	6.3	6.3	6.3	6.3	6.3
TT	NET TIME OF RUN	MIN	60	120	120	120	120
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PBM	BAROMETRIC PRESSURE	MM HG	771.7	769.4	764.5	764.5	764.0
PMM	AV ORIFICE PRESSURE DROP	MM H2O	58.8	52.1	42.7	49.5	62.2
VMM	VOL DRY GAS-METER COND	NM3	1.40	2.52	2.34	2.50	2.81
TMM	AVG GAS METER TEMP	DEG.C	24	24	23	27	28
VMSTM	VOLUME DRY GAS-STD COND	NCM	1.49	2.51	2.33	2.46	2.77
VW	TOTAL H2O COLLECTED	ML	49.0	74.1	52.4	69.9	177.0
VWM	VOL H2O VAPOR-STD COND	NM3	.07	.10	.07	.09	.24
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
MD	MOLE FRACTION DRY GAS		.958	.962	.971	.963	.921
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.38	28.43	28.52	28.44	27.98
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPSM	AVG STK VELOCITY HEAD	MM H2O	15.7	13.4	10.5	12.2	15.3
TSM	AVG STACK TEMPERATURE	DEG.C	39	47	38	43	46
NP	NET SAMPLING POINTS		12	24	24	24	24
PSTM	STATIC PRES OF STACK	MM HG	-.65	-.65	-.65	-.65	-.65
PSM	STACK PRESSURE. ABSOLUTE	MM HG	771.0	768.7	763.9	763.9	763.4
VSM	AVG STACK GAS VELOCITY	M/MIN	828	778	681	740	841
ASM	STACK AREA	M2	1.7	1.7	1.7	1.7	1.7
QSM	STK FLOWRATE.DRY.STD CN	NM3/MIN	1316	1207	1091	1158	1245
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1442	1355	1187	1288	1465
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00
CANM	PART. LOAD-PTL.STD CN	MG/NM3	0	0	0	0	0
CAOM	PART. LOAD-TTL.STD CN	MG/NM3	12.19	8.62	4.70	8.71	9.34
CATM	PART. LOAD-PTL.STD CN	MG/M3	0	0	0	0	0
CAUM	PART. LOAD-TTL.STD CN	MG/M3	11.13	7.69	4.32	7.83	7.94
CAWM	PARTIC EMIS-PARTIAL	KG/HR	0	0	0	0	0
CAXM	PARTIC EMIS-TOTAL	KG/HR	.963	.625	.308	.605	.697
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTM	VOLUME DRY GAS-STD COND	NCM	1.49	2.53	2.33	2.46	2.77
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
TSM	AVG STACK TEMPERATURE	DEG.C	39	47	38	43	46
QSM	STK FLOWRATE.DRY.STD CN	NM3/MIN	1316	1207	1091	1158	1245
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1442	1355	1187	1288	1465
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583

PARTICULATES -- PARTIAL CATCH

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0	.0
CANM	PART. LOAD-PTL.STD CN	MG/NM3	0	0	0	0	0
CATM	PART. LOAD-PTL.STD CN	MG/M3	0	0	0	0	0
CAWM	PARTIC EMIS-PARTIAL	KG/HR	0	0	0	0	0

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
CAOM	PART. LOAD-TTL.STD CN	MG/NM3	12.19	8.62	4.70	8.71	9.34
CAUM	PART. LOAD-TTL.STD CN	MG/M3	11.13	7.69	4.32	7.83	7.94
CAXM	PARTIC EMIS-TOTAL	KG/HR	.963	.625	.308	.605	.697
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00	100.00

SOTDAT VALUES

NAME	DESCRIPTION	UNITS	1-05	2-05	3-05	4-05	5-05
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1442	1355	1187	1208	1465
ASM	STACK AREA	M2	1.7	1.7	1.7	1.7	1.7
TSM	AVG STACK TEMPERATURE	DEG.C	39	47	38	43	46
PSCM	STACK PRESSURE, ABSOLUTE	CM HG	77.1	76.9	76.4	76.4	76.3
NP	NET SAMPLING POINTS		12	24	24	24	24
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583	-14583
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
PCO2W	PERCENT CO2 BY VOL, WET		0.0	0.0	0.0	0.0	0.0
PCOW	PERCENT CO BY VOL, WET		0.0	0.0	0.0	0.0	0.0
PO2W	PERCENT O2 BY VOL, WET		21.9	21.8	21.6	21.8	22.8
PN2W	PERCENT N2 BY VOL, WET		82.5	82.1	81.4	82.0	85.8
VSMS	AVG STACK GAS VELOCITY	M/SEC	13.8	13.0	11.4	12.3	14.0
TMM	AVG GAS METER TEMP	DEG.C	24	24	23	27	28

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DN	PROBE TIP DIAMETER	IN	.250	.250	.250	.250	.250
TT	NET TIME OF RUN	MIN	60	120	120	120	120
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	IN.HG	30.38	30.29	30.10	30.10	30.08
PM	AVG ORIFICE PRES DROP	IN.H2O	2.32	2.05	1.68	1.95	2.45
VM	VOL DRY GAS-METER COND	DCF	52.24	89.03	82.54	88.15	99.39
TM	AVG GAS METER TEMP	DEG.F	76	74	74	81	83
VMSTD	VOL DRY GAS-STD COND	DSCF	52.59	89.49	82.44	87.00	97.75
VW	TOTAL H2O COLLECTED	ML	49.0	74.1	52.4	69.9	177.0
VWV	VOL H2O VAPOR-STD COND	SCF	2.32	3.51	2.48	3.31	8.39
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
MD	MOLE FRACTION DRY GAS		.958	.962	.971	.963	.921
PCO2	PERCENT CO2 BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.38	28.43	28.52	28.44	27.98
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPS	AVG STACK VELOCITY HEAD	IN.H2O	.62	.53	.41	.48	.60
TS	AVG STACK TEMPERATURE	DEG.F	102	117	100	109	115
NP	NET SAMPLING POINTS		12	24	24	24	24
PST	STATIC PRES OF STACK	IN.HG	-.03	-.03	-.03	-.03	-.03
PS	STACK PRESSURE, ABSOLUTE	IN.HG	30.35	30.26	30.07	30.07	30.05
VS	AVG STACK GAS VELOCITY	FPM	2717	2552	2235	2427	2760
AT	STACK AREA	FT2	18.83	18.83	18.83	18.83	18.83
QS	STK FLOWRATE, DRY,STD CN	DSCFM	46484	42630	38521	40887	43969
QA	ACTUAL STACK FLOWRATE	ACFM	50931	47836	41902	45502	51730
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
CAO	PART.LOAD-TTL,STD CN	GR/DSCF	.00533	.00377	.00205	.00381	.00408
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.00486	.00336	.00189	.00342	.00347
CAX	PARTIC EMIS-TOTAL	LB/HR	2.12	1.38	.68	1.33	1.54

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
DNO	PROBE TIP DIAMETER	MM	6.3	6.3	6.3	6.3	6.3
TT	NET TIME OF RUN	MIN	60	120	120	120	120
CMETER	METER FACTOR		1.000	1.000	1.000	1.000	1.000
PBM	BAROMETRIC PRESSURE	MM HG	771.7	769.4	764.5	764.5	764.0
PMM	AV ORIFICE PRESSURE DROP	MM H2O	58.8	52.1	42.7	49.5	62.2
VMM	VOL DRY GAS-METER COND	NM3	1.48	2.52	2.34	2.50	2.81
TMM	AVG GAS METER TEMP	DEG.C	24	24	23	27	28
VMSTM	VOLUME DRY GAS-STD COND	NCM	1.49	2.53	2.33	2.46	2.77
VW	TOTAL H2O COLLECTED	ML	49.0	74.1	52.4	69.9	177.0
VWM	VOL H2O VAPOR-STD COND	NM3	.07	.10	.07	.09	.24
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
MD	MOLE FRACTION DRY GAS		.958	.962	.971	.963	.921
PCO2	PERCENT CO2 BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL, DRY		21.0	21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL, DRY		-0.0	-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL, DRY		79.0	79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.38	28.43	28.52	28.44	27.98
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840	.840
DPSM	AVG STK VELOCITY HEAD	MM H2O	15.7	13.4	10.5	12.2	15.3
TSM	AVG STACK TEMPERATURE	DEG.C	39	47	38	43	46
NP	NET SAMPLING POINTS		12	24	24	24	24
PSTM	STATIC PRES OF STACK	MM HG	-.65	-.65	-.65	-.65	-.65
PSM	STACK PRESSURE, ABSOLUTE	MM HG	771.0	768.7	763.9	763.9	763.4
VSM	AVG STACK GAS VELOCITY	M/MIN	828	778	681	740	841
ASM	STACK AREA	M2	1.7	1.7	1.7	1.7	1.7
QSM	STK FLOWRATE,DRY,STD CN	NM3/MIN	1316	1207	1091	1158	1245
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1442	1355	1187	1288	1465
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
CAOM	PART. LOAD-TTL,STD CN	MG/NM3	12.19	8.62	4.70	8.71	9.34
CAUM	PART. LOAD-TTL,STD CN	MG/M3	11.13	7.69	4.32	7.83	7.94
CAXM	PARTIC EMIS-TOTAL	KG/HR	.963	.625	.308	.605	.697

SUMMARY OF RESULTS

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTD	VOL DRY GAS-STD COND	DSCF	52.59	89.49	82.44	87.00	97.75
PMOS	PERCENT MOISTURE BY VOL		4.2	3.9	2.9	3.7	7.9
TS	AVG STACK TEMPERATURE	DEG.F	102	117	100	109	115
QS	STK FLOWRATE, DRY,STD CN	DSCFM	46484	42630	38521	40887	43969
QA	ACTUAL STACK FLOWRATE	ACFM	50931	47836	41902	45502	51730
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
CAO	PART.LOAD-TTL,STD CN	GR/DSCF	.00533	.00377	.00205	.00381	.00408
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.00486	.00336	.00189	.00342	.00347
CAX	PARTIC EMIS-TOTAL	LB/HR	2.12	1.38	.68	1.33	1.54

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
	DATE OF RUN		03-05-79	03-06-79	03-07-79	03-07-79	03-08-79
VMSTM	VOLUME DRY GAS-STD COND	NCM	1.49	2.53	2.33	2.46	2.77
PMOS	PERCENT MOISTURE BY VOL		4.2	3.8	2.9	3.7	7.9
TSM	AVG STACK TEMPERATURE	DEG.C	39	47	38	43	46
QSM	STK FLOWRATE,DRY,STD CN	NM3/MIN	1316	1207	1091	1158	1245
QAM	ACTUAL STACK FLOWRATE	M3/MIN	1442	1355	1187	1288	1465
PERI	PERCENT ISOKINETIC		103.7	96.2	98.1	97.5	101.9

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-OS	2-OS	3-OS	4-OS	5-OS
MT	PARTICULATE WT-TOTAL	MG	18.2	21.9	11.0	21.5	25.9
CAOM	PART. LOAD-TTL,STD CN	MG/NM3	12.19	8.62	4.70	8.71	9.34
CAUM	PART. LOAD-TTL,STD CN	MG/M3	11.13	7.69	4.32	7.83	7.94
CAXM	PARTIC EMIS-TOTAL	KG/HR	.963	.625	.308	.605	.697

A-3 ROTARY DRUM COOLER UNCONTROLLED OUTLET RESULTS

A-3-1 ROTARY DRUM COOLER UNCONTROLLED OUTLET RESULTS - ENGLISH AND METRIC UNITS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 1-OPDC 03-08-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.08	-2.60	4.10	.0	8.7	2.3	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		27.63								
1 01	1.0	28.10	.15	.65	75	75		80		1325
1 02	1.0	28.67	.17	.75	76	75		80		1410
1 03	1.0	29.13	.14	.62	78	78		80		1280
1 04	1.0	29.53	.05	.22	80	79		90		772
1 05	1.0	30.00	.70	3.00	80	78		90		2889
1 06	1.0	30.60	.86	3.50	80	78		90		3202
1 07	1.0	31.70	.95	4.00	85	83		90		3366
1 08	1.0	33.00	1.50	6.20	90	88		90		4229

METER -D FACTOR= 1.000 PITOT COFF= .840 PROBE DIAM.= .2500 IN.
8 POINTS

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
60	30.08	-2.60	4.10	.0	61.2	16.3	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		33.00								
1 09	1.0	34.10	2.85	3.50	82	80		95		5857
1 10	1.0	35.10	3.10	4.00	85	80		100		6136
1 11	1.0	36.10	3.10	3.80	90	80		100		6136
1 12	1.0	37.20	3.00	3.80	92	82		100		6036
1 13	1.0	38.40	3.40	4.30	94	82		100		6426
1 14	1.0	39.45	3.50	4.40	96	82		105		6549
1 15	1.0	40.70	3.70	4.60	100	83		105		6733
1 16	1.0	41.80	3.80	4.70	102	84		105		6824
1 17	1.0	43.00	3.70	4.60	104	84		105		6733
1 18	1.0	44.20	3.60	4.50	106	84		105		6642
1 19	1.0	45.45	3.50	4.40	106	84	5.0	105		6549
1 20	1.0	46.50	3.70	4.60	110	85	6.0	105		6733
1 21	1.0	47.70	3.70	4.60	110	85	6.0	105		6733
1 22	1.0	48.80	3.70	4.60	111	85	6.0	105		6733
1 23	1.0	49.90	2.50	3.10	112	86	6.0	105		5535
1 24	1.0	50.83	2.50	3.10	112	88	4.0	105		5535
2 01	1.0	51.60	2.50	3.10	100	90	5.0	100		5510
2 02	1.0	52.60	2.50	3.20	101	90	5.0	85		5436
2 03	1.0	53.60	2.50	3.10	102	90	5.0	85		5436
2 04	1.0	54.50	2.50	3.10	102	90	5.0	85		5436
2 05	1.0	55.50	2.50	3.10	105	90	5.0	100		5510
2 06	1.0	56.50	2.70	3.30	106	90	5.0	105		5752
2 07	1.0	57.60	2.80	3.50	108	90	5.0	105		5857
2 08	1.0	58.20	1.10	1.30	110	90	2.0	105		3671
2 09	1.0	58.90	1.10	1.30	110	90	6.0	105		3671
2 10	1.0	59.40	2.20	1.80	110	90	6.0	105		5192
2 11	1.0	60.50	2.80	3.50	105	92	5.0	100		5831
2 12	1.0	61.50	2.90	3.60	108	92	4.0	100		5934
2 13	1.0	62.70	3.50	4.50	109	93	6.0	100		6520
2 14	1.0	63.80	3.40	4.20	110	94	6.0	100		6426
2 15	1.0	65.00	3.50	4.30	112	94	6.0	100		6520
2 16	1.0	66.10	3.50	4.40	112	94	6.0	100		6520
2 17	1.0	67.30	3.60	4.50	112	94	6.5	100		6612
2 18	1.0	68.40	3.40	4.20	115	94	6.0	100		6426
2 19	1.0	69.50	3.00	4.00	115	94		100		6036
2 20	1.0	70.10	1.20	1.60	115	94		100		3817
2 21	1.0	70.70	1.10	1.30	115	94		100		3655

METER -0 FACTOR= 1.000 PITOT COFF= .840 PROBE DIAM.= .1875 IN.
37 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 2-OPDC 03-09-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
80	30.06	-2.60	4.01	.0	43.1	14.0	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		71.77								
1 01	1.0	72.15	.28	.42	72	72	3.0	80		1809
1 02	1.0	72.55	.45	.60	73	73	3.0	80		2294
1 03	1.0	72.95	.20	.29	75	74	3.0	80		1529
1 04	1.0	73.30	.25	.35	76	74	3.0	100		1741
1 05	1.0	73.68	.10	.15	78	75	3.0	100		1101
1 06	1.0	73.82	.10	.15	79	75	3.0	110		1111
1 07	1.0	74.50	.80	1.10	80	75	5.0	110		3142
1 08	1.0	75.20	1.50	2.00	82	75	6.0	110		4303
1 09	1.0	76.30	2.90	4.00	85	76	8.0	110		5983
1 10	1.0	77.50	3.20	4.50	88	76	10.0	110		6285
1 11	1.0	78.60	3.30	4.50	93	76	10.0	110		6382
1 12	1.0	79.75	3.10	4.10	95	77	8.5	110		6186
1 13	1.0	80.99	3.20	4.30	98	78	9.5	110		6285
1 14	1.0	82.00	3.20	4.30	100	78	9.5	110		6285
1 15	1.0	83.20	3.60	4.80	102	79	10.5	110		6666
1 16	1.0	84.37	3.60	4.80	105	80	10.5	110		6666
1 17	1.0	85.60	3.70	4.80	106	80	10.5	110		6758
1 18	1.0	86.80	3.60	4.80	108	80	10.5	110		6666
1 19	1.0	88.10	4.40	5.90	110	81	11.5	110		7370
1 20	1.0	89.40	4.30	5.80	112	83	12.5	110		7286
1 21	1.0	90.75	4.00	5.50	112	83	12.5	110		7027
1 22	1.0	92.05	3.80	5.00	115	84	11.5	110		6849
1 23	1.0	93.26	3.30	4.50	116	85	10.0	110		6382
1 24	1.0	94.25	3.20	4.20	116	86	9.0	110		6285
2 01	1.0	95.25	2.50	3.40	100	86	8.0	80		5407
2 02	1.0	96.26	2.50	3.40	104	86	8.0	80		5407
2 03	1.0	97.30	2.80	3.70	105	88	8.0	100		5827
2 04	1.0	98.40	2.80	3.70	106	89	8.0	115		5905
2 05	1.0	99.40	2.60	3.50	108	88	8.0	115		5690
2 06	1.0	100.40	2.50	3.40	108	88	8.0	115		5579
2 07	1.0	101.45	2.50	3.40	110	88	8.0	115		5579
2 08	1.0	102.45	2.50	3.40	111	88	8.0	115		5579
2 09	1.0	103.20	1.00	1.30	112	88	4.0	115		3529
2 10	1.0	104.03	2.50	3.40	112	90	9.0	115		5579
2 11	1.0	105.28	3.50	4.70	113	90	9.0	115		6602
2 12	1.0	106.36	3.10	4.10	115	91	9.0	115		6213
2 13	1.0	107.59	3.80	5.00	115	91	11.0	115		6879
2 14	1.0	108.79	3.80	5.00	116	91	11.0	110		6849
2 15	1.0	110.02	3.80	5.00	118	92	11.0	110		6849
2 16	1.0	111.25	3.80	5.00	119	92	11.0	110		6849

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 2-ORDC 03-09-79

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
2 17	1.0	112.50	3.50	4.70	120	93	10.0	115		6849
2 18	1.0	113.61	3.50	4.70	121	94	10.0	115		6602
2 19	1.0	114.80	3.20	4.10	121	95	10.0	110		6285
2 20	1.0	115.62	1.20	1.80	121	95	6.0	110		3849

METER -0 FACTOR= 1.000 PITOT COFF= .840 PROBE DIAM.= .1875 IN.
44 POINTS

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 3-ORDC 03-09-79

ATMOSPHERIC TEMP (F)	ATMOSPHERIC PRES (I.HG)	STACK PRES(G) (I.H2O)	STACK AREA (FT2)	PARTICULATE PARTIAL (MG)	PARTICULATE TOTAL (MG)	H2O COND (ML)	DRY GAS O2 (=)	DRY GAS CO2 (=)	DRY GAS CO (=)
80	30.06	-2.60	4.01	.0	15.5	16.2	21.0	-0.0	0.0

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
		115.94								
1 01	1.0	116.30	.25	.35	76	76	0.0	95		1734
1 02	1.0	116.68	.25	.35	76	76	1.0	95		1734
1 03	1.0	117.05	.25	.35	77	76	1.0	95		1734
1 04	1.0	117.41	.27	.36	78	76	1.0	80		1777
1 05	1.0	117.76	.27	.36	79	77	1.0	80		1777
1 06	1.0	118.10	.10	.20	80	78	0.0	90		1092
1 07	1.0	118.64	1.10	1.30	82	78	2.0	100		3654
1 08	1.0	119.60	2.50	3.30	84	78	5.0	110		5558
1 09	1.0	120.70	3.00	3.95	87	78	5.0	120		6142
1 10	1.0	121.80	3.30	4.40	90	78	6.0	120		6441
1 11	1.0	122.98	3.20	4.20	93	79	6.0	120		6343
1 12	1.0	124.10	3.20	4.20	95	80	6.0	120		6343
1 13	1.0	125.25	3.30	4.20	98	80	6.0	115		6414
1 14	1.0	126.40	3.50	4.60	100	80	6.5	115		6605
1 15	1.0	127.60	3.50	4.60	102	81	6.0	115		6605
1 16	1.0	128.80	3.70	4.80	104	82	7.0	115		6791
1 17	1.0	130.00	3.70	4.80	106	82	6.0	115		6791
1 18	1.0	131.18	3.70	4.70	108	83	6.0	115		6791
1 19	1.0	132.44	3.90	5.10	109	83	6.0	115		6972
1 20	1.0	133.65	3.80	4.90	110	84	7.0	115		6882
1 21	1.0	134.87	3.80	4.90	111	85	7.0	115		6882
1 22	1.0	135.90	2.50	3.30	112	86	4.5	115		5582
1 23	1.0	136.85	2.00	2.60	112	86	4.0	115		4993
1 24	1.0	137.74	2.00	2.60	112	87	4.0	115		4993
2 01	1.0	138.61	2.50	3.20	114	88	5.0	90		5460
2 02	1.0	139.50	2.50	3.20	110	88	5.0	90		5460
2 03	1.0	140.55	2.50	3.20	106	89	5.0	95		5484
2 04	1.0	141.52	2.30	3.00	106	89	4.5	110		5331
2 05	1.0	142.55	2.50	3.20	106	89	5.0	125		5631
2 06	1.0	143.56	2.60	3.40	107	90	5.0	125		5742
2 07	1.0	144.61	2.60	3.50	108	90	5.0	125		5742
2 08	1.0	145.61	2.40	3.30	108	91	4.5	125		5517
2 09	1.0	146.57	2.00	2.70	108	92	4.0	120		5015
2 10	1.0	147.56	2.50	3.40	108	92	6.0	120		5607
2 11	1.0	148.69	2.90	4.10	109	92	7.0	120		6038
2 12	1.0	149.86	3.20	4.20	110	93	6.0	120		6343
2 13	1.0	151.10	3.90	5.10	110	93	7.0	115		6972
2 14	1.0	152.34	4.00	5.20	113	94	7.5	115		7061
2 15	1.0	153.60	3.80	5.00	113	94	7.0	115		6882
2 16	1.0	154.80	3.60	4.70	114	94	6.5	115		6699

PARTICULATE DATA AND CALCULATED VALUES FOR RUN 3-ORDC 03-09-79

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTAS P (I.H2O)	DELTAS H (I.H2O)	TEMP IN (F)	TEMP OUT (F)	TRAIN VAC (I.HG)	STACK TEMP (F)	S.G. TEMP (F)	STACK VEL (FPM)
2 17	1.0	155.90	2.60	3.40	115	95	6.0	115		6699
2 18	1.0	156.88	2.50	3.20	115	96	5.0	120		5607
2 19	1.0	158.02	3.20	4.20	115	96	6.5	120		6343
2 20	1.0	159.02	2.20	2.90	115	96	5.0	120		5259

METER -O FACTOR= 1.000 PITOT COFF= .840 PROBE DIAM.= .1875 IN.
44 POINTS

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
DN	PROBE TIP DIAMETER	IN	.250	.188	.188	.188
TT	NET TIME OF RUN	MIN	8	37	44	44
CMETER	METER FACTOR		1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	IN.HG	30.08	30.08	30.06	30.06
PM	AVG ORIFICE PRES DROP	IN.H2O	2.37	3.61	3.58	3.38
VM	VOL DRY GAS-METER COND	DCF	5.37	37.70	43.85	43.08
TM	AVG GAS METER TEMP	DEG.F	80	97	93	94
VMSTD	VOL DRY GAS-STD COND	DSCF	5.31	36.26	42.41	41.60
VW	TOTAL H2O COLLECTED	ML	2.3	16.3	14.0	16.2
VWV	VOL H2O VAPOR-STD COND	SCF	.11	.77	.66	.77
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
MD	MOLE FRACTION DRY GAS		.980	.979	.985	.982
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.61	28.67	28.64
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840
DPS	AVG STACK VELOCITY HEAD	IN.H2O	.56	2.91	2.67	2.58
TS	AVG STACK TEMPERATURE	DEG.F	86	101	107	111
NP	NET SAMPLING POINTS		8	37	44	44
PST	STATIC PRES OF STACK	IN.HG	-.19	-.19	-.19	-.19
PS	STACK PRESSURE, ABSOLUTE	IN.HG	29.89	29.89	29.87	29.87
VS	AVG STACK GAS VELOCITY	FPM	2310	5885	5458	5423
AT	STACK AREA	FT2	4.10	4.10	4.01	4.01
QS	STK FLOWRATE, DRY,STD CN	DSCFM	8916	22109	19948	19620
QA	ACTUAL STACK FLOWRATE	ACFM	9425	24007	21804	21665
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00
CAN	PART.LOAD-PTL.STD CN	GR/DSCF	.000	.000	.000	.000
CAO	PART.LOAD-TTL.STD CN	GR/DSCF	.02523	.02599	.01565	.00574
CAT	PART.LOAD-PTL.STK CN	GR/ACF	.000	.000	.000	.000
CAU	PART.LOAD-TTL.STK CN	GR/ACF	.02387	.02393	.01432	.00520
CAW	PARTIC EMIS-PARTIAL	LB/HR	0	0	0	0
CAX	PARTIC EMIS-TOTAL	LB/HR	1.93	4.92	2.68	.96
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583

SUMMARY OF RESULTS

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
VMSTD	VOL DRY GAS-STD COND	DSCF	5.31	36.26	42.41	41.60
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
TS	AVG STACK TEMPERATURE	DEG.F	86	101	107	111
QS	STK FLOWRATE, DRY,STD CN	DSCFM	8916	22109	19948	19620
QA	ACTUAL STACK FLOWRATE	ACFM	9425	24007	21804	21665
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583

PARTICULATES -- PARTIAL CATCH

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0
CAN	PART.LOAD-PTL,STD CN	GR/DSCF	.000	.000	.000	.000
CAT	PART.LOAD-PTL,STK CN	GR/ACF	.000	.000	.000	.000
CAW	PARTIC EMIS-PARTIAL	LB/HR	0	0	0	0

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
CAO	PART.LOAD-TTL,STD CN	GR/DSCF	.02523	.02599	.01565	.00574
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.02387	.02393	.01432	.00520
CAX	PARTIC EMIS-TOTAL	LB/HR	1.93	4.92	2.68	.96
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
DNM	PROBE TIP DIAMETER	MM	6.3	4.8	4.8	4.8
TT	NET TIME OF RUN	MIN	8	37	44	44
CMETER	METER FACTOR		1.000	1.000	1.000	1.000
PBM	BAROMETRIC PRESSURE	MM HG	764.0	764.0	763.5	763.5
PMM	AV ORIFICE PRESSURE DROP	MM H2O	60.1	91.6	91.0	85.7
VMM	VOL DRY GAS-METER COND	NM3	.15	1.07	1.24	1.22
TMM	AVG GAS METER TEMP	DEG.C	27	36	34	34
VMSTM	VOLUME DRY GAS-STD COND	NCM	.15	1.03	1.20	1.18
VW	TOTAL H2O COLLECTED	ML	2.3	16.3	14.0	16.2
VWM	VOL H2O VAPOR-STD COND	NM3	.00	.02	.02	.02
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
MD	MOLE FRACTION DRY GAS		.980	.979	.985	.982
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.61	28.67	28.64
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840
DPSM	AVG STK VELOCITY HEAD	MM H2O	14.4	73.9	67.8	65.5
TSM	AVG STACK TEMPERATURE	DEG.C	30	38	42	44
NP	NET SAMPLING POINTS		8	37	44	44
PSTM	STATIC PRES OF STACK	MM HG	-4.86	-4.86	-4.86	-4.86
PSM	STACK PRESSURE. ABSOLUTE	MM HG	759.2	759.2	758.7	758.7
VSM	AVG STACK GAS VELOCITY	M/MIN	704	1794	1664	1653
ASM	STACK AREA	M2	.4	.4	.4	.4
QSM	STK FLOWRATE.DRY.STD CN	NM3/MIN	252	626	565	556
QAM	ACTUAL STACK FLOWRATE	M3/MIN	267	680	617	613
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00
CANM	PART. LOAD-PTL.STD CN	MG/NM3	0	0	0	0
CAOM	PART. LOAD-TTL.STD CN	MG/NM3	57.73	59.47	35.81	13.13
CATM	PART. LOAD-PTL.STD CN	MG/M3	0	0	0	0
CAUM	PART. LOAD-TTL.STD CN	MG/M3	54.61	54.77	32.76	11.89
CAWM	PARTIC EMIS-PARTIAL	KG/HR	0	0	0	0
CAXM	PARTIC EMIS-TOTAL	KG/HR	.874	2.234	1.214	.438
FA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
VMSTM	VOLUME DRY GAS-STD COND	NCM	.15	1.03	1.20	1.18
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
TSM	AVG STACK TEMPERATURE	DEG.C	30	38	42	44
QSM	STK FLOWRATE,DRY,STD CN	NM3/MIN	252	626	565	556
QAM	ACTUAL STACK FLOWRATE	M3/MIN	267	680	617	613
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583

PARTICULATES -- PARTIAL CATCH

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
MF	PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0
CANM	PART. LOAD-PTL,STD CN	MG/NM3	0	0	0	0
CATM	PART. LOAD-PTL,STD CN	MG/M3	0	0	0	0
CAWM	PARTIC EMIS-PARTIAL	KG/HR	0	0	0	0

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
CAOM	PART. LOAD-TTL,STD CN	MG/NM3	57.73	59.47	35.81	13.13
CAUM	PART. LOAD-TTL,STD CN	MG/M3	54.61	54.77	32.76	11.89
CAXM	PARTIC EMIS-TOTAL	KG/HR	.874	2.234	1.214	.438
IC	PERC IMPINGER CATCH		100.00	100.00	100.00	100.00

SOTDAT VALUES

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
QAM	ACTUAL STACK FLOWRATE	M3/MIN	267	680	617	613
ASQ	STACK AREA	M2	.4	.4	.4	.4
TSM	AVG STACK TEMPERATURE	DEG.C	30	38	42	44
PSCM	STACK PRESSURE, ABSOLUTE	CM HG	75.9	75.9	75.9	75.9
NP	NET SAMPLING POINTS		8	37	44	44
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84
EA	PERCENT EXCESS AIR		-14583	-14583	-14583	-14583
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
PCO2W	PERCENT CO2 BY VOL, WET		0.0	0.0	0.0	0.0
PCOW	PERCENT CO BY VOL, WET		0.0	0.0	0.0	0.0
PO2W	PERCENT O2 BY VOL, WET		21.4	21.4	21.3	21.4
PN2W	PERCENT N2 BY VOL, WET		80.6	80.7	80.2	80.5
VSMS	AVG STACK GAS VELOCITY	M/SEC	11.7	29.9	27.7	27.5
TMM	AVG GAS METER TEMP	DEG.C	27	36	34	34

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
DN	PROBE TIP DIAMETER	IN	.250	.188	.188	.188
TT	NET TIME OF RUN	MIN	8	37	44	44
CMETER	METER FACTOR		1.000	1.000	1.000	1.000
PB	BAROMETRIC PRESSURE	IN.HG	30.08	30.08	30.06	30.06
PM	AVG ORIFICE PRES DROP	IN.H2O	2.37	3.61	3.58	3.38
VM	VOL DRY GAS-METER COND	DCF	5.37	37.70	43.85	43.08
TM	AVG GAS METER TEMP	DEG.F	80	97	93	94
VMSTD	VOL DRY GAS-STD COND	DSCF	5.31	36.26	42.41	41.60
VW	TOTAL H2O COLLECTED	ML	2.3	16.3	14.0	16.2
VWV	VOL H2O VAPOR-STD COND	SCF	.11	.77	.66	.77
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
MD	MOLE FRACTION DRY GAS		.980	.979	.985	.982
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.61	28.67	28.64
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840
DPS	AVG STACK VELOCITY HEAD	IN.H2O	.56	2.91	2.67	2.58
TS	AVG STACK TEMPERATURE	DEG.F	86	101	107	111
NP	NET SAMPLING POINTS		8	37	44	44
PST	STATIC PRES OF STACK	IN.HG	-.19	-.19	-.19	-.19
PS	STACK PRESSURE. ABSOLUTE	IN.HG	29.89	29.89	29.87	29.87
VS	AVG STACK GAS VELOCITY	FPM	2310	5885	5458	5423
AT	STACK AREA	FT2	4.10	4.10	4.01	4.01
QS	STK FLOWRATE. DRY.STD CN	DSCFM	8916	22109	19948	19620
QA	ACTUAL STACK FLOWRATE	ACFM	9425	24007	21804	21665
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
CAO	PART.LOAD-TTL.STD CN	GR/DSCF	.02523	.02599	.01565	.00574
CAU	PART.LOAD-TTL.STK CN	GR/ACF	.02387	.02393	.01432	.00520
CAX	PARTIC EMIS-TOTAL	LB/HR	1.93	4.92	2.68	.96

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
DND	PROBE TIP DIAMETER	MM	6.3	4.8	4.8	4.8
TT	NET TIME OF RUN	MIN	8	37	44	44
CMETER	METER FACTOR		1.000	1.000	1.000	1.000
PBM	BAROMETRIC PRESSURE	MM HG	764.0	764.0	763.5	763.5
PMM	AV ORIFICE PRESSURE DROP	MM H2O	60.1	91.6	91.0	85.7
VMM	VOL DRY GAS-METER COND	NM3	.15	1.07	1.24	1.22
TMM	AVG GAS METER TEMP	DEG.C	27	36	34	34
VMSTM	VOLUME DRY GAS-STD COND	NCM	.15	1.03	1.20	1.18
VW	TOTAL H2O COLLECTED	ML	2.3	16.3	14.0	16.2
VWM	VOL H2O VAPOR-STD COND	NM3	.00	.02	.02	.02
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
MD	MOLE FRACTION DRY GAS		.980	.979	.985	.982
PCO2	PERCENT CO2 BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PO2	PERCENT O2 BY VOL. DRY		21.0	21.0	21.0	21.0
PCO	PERCENT CO BY VOL. DRY		-0.0	-0.0	-0.0	-0.0
PN2	PERCENT N2 BY VOL. DRY		79.0	79.0	79.0	79.0
MWD	MOLECULAR WT-DRY STK GAS		28.84	28.84	28.84	28.84
MW	MOLECULAR WT-STK GAS		28.62	28.61	28.67	28.64
CP	PITOT TUBE COEFFICIENT		.840	.840	.840	.840
DPSM	AVG STK VELOCITY HEAD	MM H2O	14.4	73.9	67.8	65.5
TSM	AVG STACK TEMPERATURE	DEG.C	30	38	42	44
NP	NET SAMPLING POINTS		8	37	44	44
PSTM	STATIC PRES OF STACK	MM HG	-4.86	-4.86	-4.86	-4.86
PSM	STACK PRESSURE. ABSOLUTE	MM HG	759.2	759.2	758.7	758.7
VSM	AVG STACK GAS VELOCITY	M/MIN	704	1794	1664	1653
ASM	STACK AREA	M2	.4	.4	.4	.4
QSM	STK FLOWRATE.DRY.STD CN	NM3/MIN	252	626	565	556
QAM	ACTUAL STACK FLOWRATE	M3/MIN	267	680	617	613
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
CAUM	PART. LOAD-TTL.STD CN	MG/NM3	57.73	59.47	35.81	13.13
CAUM	PART. LOAD-TTL.STD CN	MG/M3	54.61	54.77	32.76	11.89
CAXM	PARTIC EMIS-TOTAL	KG/HR	.874	2.234	1.214	.438

SUMMARY OF RESULTS

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
VMSTD	VOL DRY GAS-STD COND	DSCF	5.31	36.26	42.41	41.60
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
TS	AVG STACK TEMPERATURE	DEG.F	86	101	107	111
QS	STK FLOWRATE, DRY,STD CN	DSCFM	8916	22109	19948	19620
QA	ACTUAL STACK FLOWRATE	ACFM	9425	24007	21804	21665
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
CAU	PART.LOAD-TTL,STD CN	GR/DSCF	.02523	.02599	.01565	.00574
CAU	PART.LOAD-TTL,STK CN	GR/ACF	.02387	.02393	.01432	.00520
CAX	PARTIC EMIS-TOTAL	LB/HR	1.93	4.92	2.68	.96

PARTICULATE EMISSION DATA
(METRIC UNITS)

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
	DATE OF RUN		03-08-79	03-08-79	03-09-79	03-09-79
VMSTM	VOLUME DRY GAS-STD COND	NCM	.15	1.03	1.20	1.18
PMOS	PERCENT MOISTURE BY VOL		2.0	2.1	1.5	1.8
TSM	AVG STACK TEMPERATURE	DEG.C	30	38	42	44
QSM	STK FLOWRATE,DRY,STD CN	NM3/MIN	252	626	565	556
QAM	ACTUAL STACK FLOWRATE	M3/MIN	267	680	617	613
PERI	PERCENT ISOKINETIC		89.1	94.3	100.7	100.4

PARTICULATES -- TOTAL CATCH

NAME	DESCRIPTION	UNITS	1-ORDC	1-ORDC	2-ORDC	3-ORDC
MT	PARTICULATE WT-TOTAL	MG	8.7	61.2	43.1	15.5
CANM	PART. LOAD-TTL,STD CN	MG/NM3	57.73	59.47	35.81	13.13
CAUM	PART. LOAD-TTL,STD CN	MG/M3	54.61	54.77	32.76	11.89
CAXM	PARTIC EMIS-TOTAL	KG/HR	.874	2.234	1.214	.438

APPENDIX B SAMPLE EQUATIONS AND EXAMPLE CALCULATIONS

B-1 MODIFIED EPA METHOD 5 RUN NO. 3, ROTARY DRUM COOLER OUTLET

B-2 EQUATIONS FOR CONVERTING NITRATE AND AMMONIA RESULTS TO AMMONIUM NITRATE

B-3 CALCULATION TO DETERMINE OBSTRUCTED AREA OF THE INLET DUCT TO THE ROTARY DRUM GRANULATOR SCRUBBER

B-1 MODIFIED EPA METHOD 5 RUN NO. 3, ROTARY DRUM COOLER UNCONTROLLED OUTLET

EXAMPLE PARTICULATE CALCULATIONS
USING RUN .3-OPDC DATA

```
1.  VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS    (1)

              17.65*VM*(PB + PM/13.6)
   VMSTD =  --------------------------
                    TM+460.

              17.65* 43.08*(30.06+ 3.375/13.6)
          =  ---------------------------------  =     41.60 DSCF
                      93.9+460.

   VMSTM =  VMSTD*0.028317=   41.60*0.028317=      1.18 DNM3

2.  VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

   VWV   =  0.0474*VW   = 0.0474*  16.2       =        .77 SCF
   VWM   =  VWV*0.028317 =   .768*0.028317   =      .0217 NM3

3.  PERCENT MOISTURE IN STACK GAS

              100.*VWV       100.*   .77
   PMOS  =  ----------- =  -------------     =        1.8 PERCENT
             VMSTD+VWV       41.60+   .77

4.  MOLE FRACTION OF DRY STACK GAS

             100.-PMOS       100.-    1.8
   MD    =  -----------  =  --------------   =      .982
               100.             100.

5.  AVERAGE MOLECULAR WEIGHT OF DRY STACK GAS

   MWD   =  (PCO2 * 44/100) + (PO2 * 32/100)
               +(PN2+PCO * 28/100)

         =  (-0.0 * 44/100) + (21.0 * 32/100)
               +(79.0 * 28/100)
                                              =     28.84

6.  MOLECULAR WEIGHT OF STACK GAS

   MW    =  MWD*MD + 18*(1-MD)

         =   28.8* .982 + 18*(1- .982)       =      28.64
```

```
7.  STACK GAS VELOCITY AT STACK CONDITIONS

    VS    =  5129*CP*ASQRT(DPS*(TS+460))*
               SQRT(1/(PS*MW))

          =  5129*  .840 * 36.818
               *SQRT(1/(29.87*   28.64))     =      5423 FPM

    VSM   =  VS*0.3048  =     5423*0.3048    =      1653 METERS/MIN

8.  STACK GAS VOLUMETRIC FLOW AT STANDARD CONDITIONS, DRY BASIS     (1)

             0.000847*VS*AT*MD*PS
    QS    =  ------------------
                 TS+460

             0.122*  5423*     4* .982*29.87
          =  --------------------------------
                    111.5 +460
                                             =      19620 DSCFM

    QSM   =  QS*0.028317 =   19620*0.028317  =      556 NM3/MIN

9.  STACK GAS VOLUMETRIC FLOW AT STACK CONDITIONS

              QS * (TS+460)
    QA    =  ---------------
              17.65 * PS * MD

               19620*( 111.5+460)
          =  ---------------------           =      21665 ACFM
              17.65*29.87* .982

    QAM   =  QA*0.028317 =   21665*0.028317  =      613 NM3/MIN

10.  PERCENT ISOKINETIC

              1039*(TS+460)*VMSTD
    PERI  =  ---------------------
              VS*TT*PS*MD*(DN*DN)

              1039*( 111.5+460)*   41.60
          =  ------------------------------  =      100.4 PERCENT
              5423*  44.0*29.87* .982* .188
                                     * .188
```

```
11.  PARTICULATE LOADING -- PROBE, CYCLONE, AND FILTER
                    (AT STANDARD CONDITIONS)

     CAN   =  0.0154 * (MF/VMSTD)

           =  0.0154*(    .00/   41.60)          =    .00000 GR/DSCF

     CANM  =  CAN*2288.34 =   .00000*2288.34    =        .00 MG/NM3

12.  PARTICULATE LOADING -- TOTAL
                    (AT STANDARD CONDITIONS)      (1)

     CAO   =  0.0154 * (MT/VMSTD)

           =  0.0154*(  15.50/   41.60)          =    .00574 GR/DSCF

     CAOM  =  CAO*2288.34 =   .00574*2288.34    =     13.13 MG/NM3

13.  PARTICULATE LOADING -- PROBE, CYCLONE, AND FILTER
                    (AT STACK CONDITIONS)

                  17.65*CAN*PS*MD
     CAT   =  -----------------
                     TS+460

                  17.65*  .0000*29.87* .982
           =  ---------------------------          =    .00000 GR/ACF
                        111.5+460

     CATM  =  CAT*2288.34 =   .00000*2288.34    =        .00 MG/M3

14.  PARTICULATE LOADING -- TOTAL
                    (AT STACK CONDITIONS)

                  17.65*CAO*PS*MD
     CAU   =  -----------------
                     TS+460

                  17.65*  .0057*29.87* .982
           =  ---------------------------          =    .00520 GR/ACF
                        111.5+460

     CAUM  =  CAU*2288.34 =   .00520*2288.34    =     11.89 MG/M3
```

```
15.  PARTICULATE EMISSION RATE
               -- PROBE, CYCLONE, AND FILTER

     CAW   =  0.00857*CAN*QS

           =  0.00857*   .0000*   19620         =        .00 LB/HR

     CAWM  =  CAW*0.45359 =      .00*0.45359    =        .00 KG/HR

16.  PARTICULATE EMISSION RATE
               -- TOTAL

     CAX   =  0.00857*CAO*QS

           =  0.00857*   .0057*   19620         =        .96 LB/HR

     CAXM  =  CAX*0.45359 =      .96*0.45359    =        .44 KG/HR

17.  PERCENT EXCESS AIR AT SAMPLING POINT

              100. * (PO2-0.5*PCO)
     EA    =  ----------------------
              0.264*PN2-PO2+0.5*PCO

              100. *(21.0-0.5*-0.0)
           =  ------------------------          =  -14583.3 PERCENT
              0.264*79.0-21.0+0.5*-0.0

-----

(1)  STANDARD CONDITIONS-   68 DEG F, 29.92 IN HG
                            20 DEG C,  760. MM HG.
```

B-2 EQUATIONS FOR CONVERTING NITRATE AND AMMONIA RESULTS TO AMMONIUM NITRATE

1. Nitrate conversion to ammonium nitrate equation:

$$\frac{\text{mg nitrate x 80.05 g/mole of ammonium nitrate}}{\text{62.0 g/mole of nitrate}} = \text{mg ammonium nitrate}$$

2. Ammonia conversion to ammonium nitrate equation:

$$\frac{\text{Moles of Ammonia}}{17} \text{ X 80 g ammonium nitrate/mole} = \text{g ammonium nitrate}$$

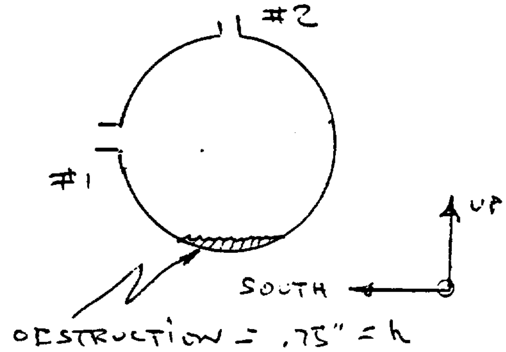
B-3 CALCULATION TO DETERMINE OBSTRUCTED AREA OF THE INLET DUCT TO THE ROTARY DRUM GRANULATOR SCRUBBER

TITLE Scrubber Inlet - Swift / Beaumont, TX.

PROJECT NO. 4468-L-18 DRAWN [signature] APPR. DATE 3-79

Port 1 = 49.875"
Port 2 = 49.500"

$$\frac{\pi \left(\frac{49.875 + 49.5}{4}\right)^2}{144} = 13.464 \text{ ft}^2$$



Calculation to correct for obstruction in duct:

Segment of circle ratio $h/D = .75/49.875 = .015$

∴ C/D ratio from table = (.02) = .2800

∴ $C/D \times D = .28 \times 49.875 = 13.965$ = length of C (chord)

$$\frac{\text{area}}{D^2} = .0037$$

$$\text{area} = D^2 \times (\text{area}/D^2)$$

$$= (49.875)^2 \times .0037$$

$$= .063 \text{ ft}^2$$

Corrected area of duct:

$$13.465 - .063 = 13.402 \text{ ft}^2$$

STANDARD HANDBOOK FOR MECHANICAL ENGINEERS

Revised by a Staff of Specialists

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Seventh Edition

McGRAW-HILL BOOK COMPANY

New York San Francisco Toronto London Sydney

$s = \frac{1}{2}(a + b + c)$, $t = \frac{1}{2}(m_1 + m_2 + m_3)$.
$r = \sqrt{(s - a)(s - b)(s - c)/s}$ = radius inscribed circle.
$R = \frac{1}{2}a/\sin A = \frac{1}{2}b/\sin B = \frac{1}{2}c/\sin C$ = radius circumscribed circle.
Area $= \frac{1}{2}$ base $\times$ altitude $= \frac{1}{2}ah = \frac{1}{2}ab \sin C = rs = abc/4R$,
$= \sqrt{s(s - a)(s - b)(s - c)} = \frac{4}{3}\sqrt{t(t - m_1)(t - m_2)(t - m_3)}$,
$= r^2 \cot \frac{1}{2}A \cot \frac{1}{2}B \cot \frac{1}{2}C = 2R^2 \sin A \sin B \sin C$,
$= \pm\frac{1}{2}\{(x_1y_2 - x_2y_1) + (x_2y_3 - x_3y_2) + (x_3y_1 - x_1y_3)\}$, where (x_1,y_1), (x_2,y_2), (x_3,y_3) are coordinates of vertices. See also p. 2–45.

Rectangle (Fig. 48). Area $= ab = \frac{1}{2}D^2 \sin u$, where u = angle between diagonals D, D.

Rhombus (Fig. 49). Area $= a^2 \sin C = \frac{1}{2}D_1D_2$, where C = angle between two adjacent sides; D_1, D_2 = diagonals.

Parallelogram (Fig. 50). Area $= bh = ab \sin C = \frac{1}{2}D_1D_2 \sin u$, where u = angle between diagonals D_1 and D_2; $D_1^2 = 2(a^2 + b^2)$.

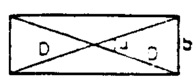


FIG. 48

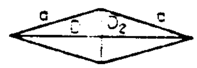


FIG. 49

FIG. 50

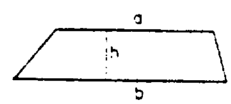


FIG. 51

Trapezoid (Fig. 51). Area $= \frac{1}{2}(a + b)h = \frac{1}{2}D_1D_2 \sin u$, where bases a and b are parallel; u = angle between diagonals D_1 and D_2.

Quadrilateral Inscribed in a Circle (Fig. 52).

Area $= \frac{1}{2}D_1D_2 \sin u = \sqrt{(s - a)(s - b)(s - c)(s - d)} = \frac{1}{2}(ac + bd) \sin u$, where $s = \frac{1}{2}(a + b + c + d)$.

Any Quadrilateral (Fig. 53). Area $= \frac{1}{2}D_1D_2 \sin u$.

NOTE. $a^2 + b^2 + c^2 + d^2 = D_1^2 + D_2^2 + 4m^2$, where m = distance between midpoints of D_1 and D_2.

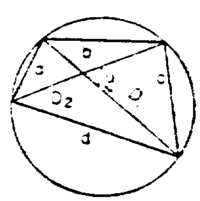


FIG. 52

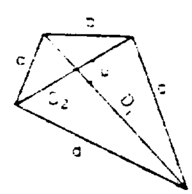


FIG. 53

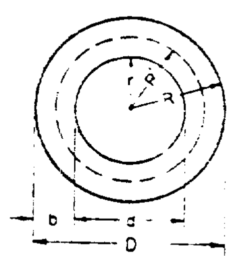


FIG. 54

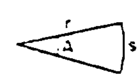


FIG. 55

Polygons. See table p. 1–39.

Circle. Area $= \pi r^2 = \frac{1}{2}Cr = \frac{1}{4}Cd = \frac{1}{4}\pi d^2 = 0.785398d^2$ (table, p. 1–30), where r = radius, d = diameter, C = circumference $= 2\pi r = \pi d$ (table, p. 1–28).

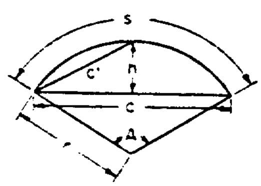
Annulus (Fig. 54). Area $= \pi(R^2 - r^2) = \pi(D^2 - d^2)/4 = 2\pi R'b$, where R' = mean radius $= \frac{1}{2}(R + r)$, and $b = R - r$.

Sector (Fig. 55). Area $= \frac{1}{2}rs = \pi r^2 A/360° = \frac{1}{2}r^2$ rad A, where rad A = radian measure of angle A, and s = length of arc $= r$ rad A (table, p. 1–44).

X **Segment** (Fig. 56). Area $= \frac{1}{2}r^2(\text{rad } A - \sin A) = \frac{1}{2}[r(s - c) + ch]$, where rad A = radian measure of angle A (table, pp. 1–34 to 1–35, 1–44). For small arcs, $s = \frac{1}{3}(8c' - c)$, where c' = chord of half of the arc (Huygen's approximation).

NOTE. $c = 2\sqrt{h(d - h)}$; $c' = \sqrt{dh}$ or $d = c'^2/h$, where d = diameter of circle; $h = r(1 - \cos \frac{1}{2}A)$, $s = 2r$ rad $\frac{1}{2}A$.

Ribbon bounded by two parallel curves (Fig. 57). If a straight line AB moves so that it is always perpendicular to the path traced by its middle point G, then the area of the ribbon or strip thus generated is equal to the length of AB times the length of the path traced by G. (It is assumed that the radius of curvature of G's path is never less than $\frac{1}{2}AB$, so that successive positions of the generating line will not intersect.)



X Fig. 56

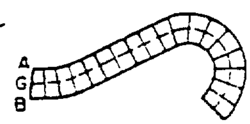


Fig. 57

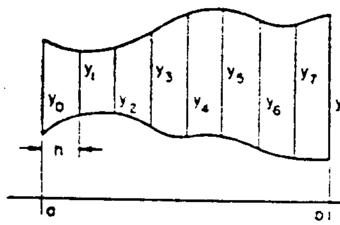


Fig. 58

Simpson's Rule (Fig. 58). Divide the given area into n panels (where n is some even number) by means of $n + 1$ parallel lines, called ordinates, drawn at constant distance h apart; and denote the lengths of these ordinates by $y_0, y_1, y_2, \ldots, y_n$. (Note that y_0 or y_n may be zero.) Area $= \frac{1}{3}h[(y_0 + y_n) + 4(y_1 + y_3 + y_5 \ldots) + 2(y_2 + y_4 + y_6 \cdots)]$, approx. The greater the number of divisions, the more accurate the result.

Note. Taking $y = f(x)$, where x varies from $x = a$ to $x = b$, and $h = (b - a)/n$, then the error $= -\frac{1}{180}\frac{(b-a)^5}{n^4}f''''(X)$, where $f''''(X)$ is the value of the fourth derivative of $f(x)$ for some (unknown) value $x = X$, between a and b.

Ellipse (Fig. 59; see also p. 2-51). Area of ellipse $= \pi ab$. Area of shaded segment $= xy + ab \sin^{-1}(x/a)$. Length of perimeter of ellipse $= \pi(a + b)K$, where $K = (1 + \frac{1}{4}m^2 + \frac{1}{64}m^4 + \frac{1}{256}m^6 + \cdots)$, $m = (a - b)/(a + b)$.

For m =	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
K =	1.002	1.010	1.023	1.040	1.064	1.092	1.127	1.168	1.216	1.273

Hyperbola (Fig. 60; see also p. 2-53). In any hyperbola, shaded area $A = ab \ln\left(\frac{x}{a} + \frac{y}{b}\right)$. In an equilateral hyperbola $(a = b)$, area $A = a^2 \sinh^{-1}(y/a) = a^2 \cosh^{-1}(x/a)$. For tables of hyperbolic functions, see p. 1-60. Here x and y are co-ordinates of point P.

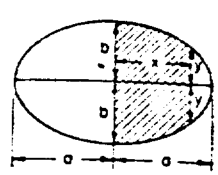


Fig. 59

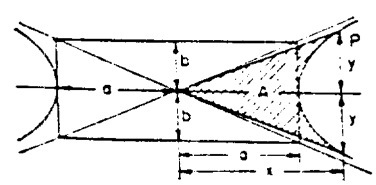


Fig. 60

Parabola (Fig. 61; see also p. 2-49). Shaded area $A = \frac{2}{3}ch$. In Fig. 62, length of arc $OP = s = \frac{1}{2}PT + \frac{1}{2}p \ln \cot \frac{1}{2}u$. Here c = any chord; p = semilatus rectum; PT = tangent at P.

Note. $OT = OM = x$.

For lengths and areas of **other curves** see pp. 2-56 to 2-63.

Segments of Circles, Given h/D

Given: h = height; D = diameter of circle. (For explanation of this table, see p. 1–38)

$\frac{h}{D}$	$\frac{\text{Arc}}{D}$	Diff	$\frac{\text{Area}}{D^2}$	Diff	Central angle, v	Diff	$\frac{\text{Chord}}{D}$	Diff	$\frac{\text{Arc}}{\text{Circum}}$	Diff	$\frac{\text{Area}}{\text{Circle}}$	Diff
.00	0.000	2003	.0000	13	0.00°	2296	.0000	*1990	.0000	*638	.0000	17
1	.2003	*835	.0013	24	22.96	*956	.1990	*810	.0638	*265	.0017	31
2	.2838	*644	.0037	32	32.52	*738	.2800	*612	.0903	*205	.0048	39
3	.3482	*545	.0069	36	39.90	*625	.3412	*507	.1108	*174	.0087	47
4	.4027	*483	.0105	42	46.15	*553	.3919	*440	.1282	*154	.0134	53
.05	.4510	*439	.0147	45	51.68°	*504	.4359	*391	.1436	*139	.0187	58
6	.4949	*406	.0192	50	56.72	*465	.4750	*353	.1575	*130	.0245	63
7	.5355	*380	.0242	52	61.37	*435	.5103	*323	.1705	121	.0308	67
8	.5735	*359	.0294	56	65.72	*411	.5426	*298	.1826	114	.0375	71
9	.6094	*341	.0350	59	69.83	*391	.5724	*276	.1940	108	.0446	74
.10	.6435	*326	.0409	61	73.74°	*374	.6000	*258	.2048	104	.0520	78
1	.6761	*314	.0470	64	77.46	*359	.6258	*241	.2152	100	.0598	82
2	.7075	*302	.0534	66	81.07	*347	.6499	*227	.2252	96	.0680	84
3	.7377	*293	.0600	68	84.54	*335	.6726	*214	.2348	93	.0764	87
4	.7670	*284	.0668	71	87.89	*326	.6940	*201	.2441	91	.0851	90
.15	.7954	276	.0739	72	91.15°	316	.7141	*191	.2532	88	.0941	92
6	.8230	270	.0811	74	94.31	309	.7332	*181	.2620	86	.1033	94
7	.8500	263	.0885	76	97.40	302	.7513	*171	.2706	83	.1127	97
8	.8763	258	.0961	78	100.42	295	.7684	162	.2789	82	.1224	99
9	.9021	252	.1039	79	103.37	289	.7846	154	.2871	81	.1323	101
.20	0.9273	248	.1118	81	106.26°	284	.8000	146	.2952	79	.1424	103
1	0.9521	243	.1199	82	109.10	279	.8146	139	.3031	77	.1527	104
2	0.9764	240	.1281	84	111.89	274	.8285	132	.3108	76	.1631	107
3	1.0004	235	.1365	84	114.63	271	.8417	125	.3184	75	.1738	108
4	1.0239	233	.1449	86	117.34	266	.8542	118	.3259	74	.1846	109
.25	1.0472	229	.1535	88	120.00°	263	.8660	113	.3333	73	.1955	111
6	1.0701	227	.1623	88	122.63	260	.8773	106	.3406	72	.2066	112
7	1.0928	224	.1711	89	125.23	256	.8879	101	.3478	72	.2178	114
8	1.1152	222	.1800	90	127.79	254	.8980	95	.3550	70	.2292	115
9	1.1374	219	.1890	92	130.33	251	.9075	90	.3620	70	.2407	116
.30	1.1593	217	.1982	92	132.84°	249	.9165	85	.3690	69	.2523	117
1	1.1810	215	.2074	93	135.33	247	.9250	80	.3759	69	.2640	119
2	1.2025	214	.2167	93	137.80	245	.9330	74	.3828	68	.2759	119
3	1.2239	212	.2260	95	140.25	242	.9404	70	.3896	67	.2878	120
4	1.2451	210	.2355	95	142.67	241	.9474	65	.3963	67	.2998	121
.35	1.2661	209	.2450	96	145.08°	240	.9539	61	.4030	67	.3119	122
6	1.2870	208	.2546	96	147.48	238	.9600	56	.4097	66	.3241	123
7	1.3078	206	.2642	97	149.86	237	.9656	52	.4163	66	.3364	123
8	1.3284	206	.2739	97	152.23	235	.9708	47	.4229	65	.3487	124
9	1.3490	204	.2836	98	154.58	235	.9755	43	.4294	65	.3611	124
.40	1.3694	204	.2934	98	156.93°	233	.9798	39	.4359	65	.3735	125
1	1.3898	203	.3032	98	159.26	233	.9837	34	.4424	65	.3860	126
2	1.4101	202	.3130	99	161.59	231	.9871	31	.4489	64	.3986	126
3	1.4303	202	.3229	99	163.90	232	.9902	26	.4553	64	.4112	126
4	1.4505	201	.3328	100	166.22	230	.9928	22	.4617	64	.4238	126
.45	1.4706	201	.3428	99	168.52°	230	.9950	18	.4681	64	.4364	127
6	1.4907	201	.3527	100	170.82	230	.9968	14	.4745	64	.4491	127
7	1.5108	200	.3627	100	173.12	229	.9982	10	.4809	64	.4618	127
8	1.5308	200	.3727	100	175.41	230	.9992	6	.4873	63	.4745	128
9	1.5508	200	.3827	100	177.71	229	.9998	2	.4936	64	.4873	127
.50	1.5708		.3927		180.00°		1.0000		.5000		.5000	

* Interpolation may be inaccurate at these points.

Segments of Spheres

(h = height of segment; D = diam of sphere)

$\frac{h}{D}$	$\frac{\text{Vol segm}}{D^3}$	Diff	$\frac{\text{Vol segm}}{\text{Vol sphere}}$	Diff
0.00	0.0000		0.0000	
1	0.0002	2	0.0003	3
2	0.0006	4	0.0012	9
3	0.0014	8	0.0026	14
4	0.0024	10	0.0047	21
0.05	0.0038	14	0.0073	26
6	0.0054	16	0.0104	31
7	0.0073	19	0.0140	36
8	0.0095	22	0.0182	42
9	0.0120	25	0.0228	46
0.10	0.0147	27	0.0280	52
1	0.0176	29	0.0336	56
2	0.0208	32	0.0397	61
3	0.0242	34	0.0463	66
4	0.0279	37	0.0533	70
0.15	0.0318	39	0.0607	74
6	0.0359	41	0.0686	79
7	0.0403	44	0.0769	83
8	0.0448	45	0.0855	86
9	0.0495	47	0.0946	91
0.20	0.0545	50	0.1040	94
1	0.0596	51	0.1138	98
2	0.0649	53	0.1239	101
3	0.0704	55	0.1344	105
4	0.0760	56	0.1452	108
0.25	0.0818	58	0.1562	110
6	0.0878	60	0.1676	114
7	0.0939	61	0.1793	117
8	0.1002	63	0.1913	120
9	0.1066	64	0.2035	122
0.30	0.1131	65	0.2160	125
1	0.1198	67	0.2287	127
2	0.1265	67	0.2417	130
3	0.1334	69	0.2548	131
4	0.1404	70	0.2682	134
0.35	0.1475	71	0.2817	135
6	0.1547	72	0.2955	138
7	0.1620	73	0.3094	139
8	0.1694	74	0.3235	141
9	0.1768	74	0.3377	142
0.40	0.1843	75	0.3520	143
1	0.1919	76	0.3665	145
2	0.1995	76	0.3810	145
3	0.2072	77	0.3957	147
4	0.2149	77	0.4104	147
0.45	0.2227	78	0.4252	148
6	0.2305	78	0.4401	149
7	0.2383	78	0.4551	150
8	0.2461	78	0.4700	149
9	0.2539	78	0.4850	150
0.50	0.2618	79	0.5000	150

NOTE. Vol segm = $\frac{1}{6}\pi h^2(3D - 2h)$.

Explanation of Table on this page

Given, h = height of segment,
D = diameter of sphere.

To find the volume of the segment, form the ratio h/D and find from the table the value of (vol/D^3); then, by a simple multiplication,

volume segment = $D^3 \times$ (vol/D^3).

The table gives also the ratio of the volume of the segment to the entire volume of the sphere.

NOTE. Area of zone = $\pi \times h \times D$.
(Use Table of Multiples of π, p. 1-28)

Explanation of Table on p. 1-34

Given, h = height of segment,
c = chord.

To find the diameter of the circle, the length of arc, or the area of the segment, form the ratio h/c, and find from the table the value of (diam/c), (arc/c), or (area/hc); then, by a simple multiplication,

diam = $c \times$ (diam/c),
arc = $c \times$ (arc/c),
area = $h \times c \times$ (area/hc).

The table gives also the angle subtended at the center, and the ratio of h to D. See p. 2-17.

Explanation of Table on p. 1-35

Given, h = height of segment,
D = diameter of circle.

To find the chord, the length of arc, or the area of the segment, form the ratio h/D, and find from the table the value of (chord/D), (arc/D), or (area/D^2); then, by a simple multiplication,

chord = $D \times$ (chord/D),
arc = $D \times$ (arc/D),
area = $D^2 \times$ (area/D^2).

The table gives also the angle subtended at the center, the ratio of the arc of the segment to the whole circumference, and the ratio of the area of the segment to the area of the whole circle. See p. 2-17.

APPENDIX C MODIFIED EPA METHOD 5 FIELD DATA

C-1 ROTARY DRUM GRANULATOR SCRUBBER TESTS

C-1-1 ROTARY DRUM GRANULATOR SCRUBBER INLET TESTS

C-1-2 ROTARY DRUM GRANULATOR SCRUBBER OUTLET TESTS

C-2 ROTARY DRUM COOLER TESTS

C-2-1 ROTARY DRUM COOLER UNCONTROLLED OUTLET TESTS

C-1 ROTARY DRUM GRANULATOR SCRUBBER TESTS

C-1-1 ROTARY DRUM GRANULATOR SCRUBBER INLET TESTS

MIDWEST RESEARCH INSTITUTE

RUN 1

MRI Project Number 4468-L(18)
Field Dates MARCH 4, 9 - 1979
Plant SWIFT CHEM. BEAUMONT, TX.
Sampling Location SCRUBBER INLET
Sampling Date 3-5-79

FIELD CREW

Crew Chief B.C. DuRos

Testing Engineer
1 R. C. STULTZ
2
3

Engr. Technician
1 D. VOGEL
2
3

Lab Technician
1 R. JONES
2 C. COLE
3

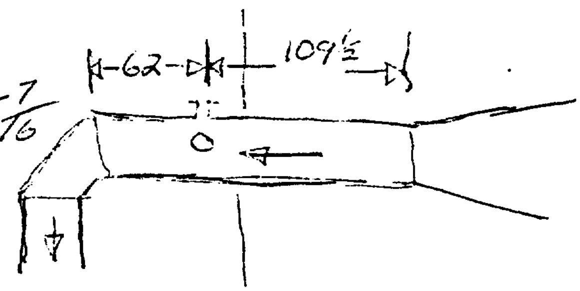
Process Engineer
1 T. CURTIN
2

Other
1 G. SCHEIL (ANALYSIS)
2

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Swift Chemical Plant
DATE 3-4-79
SAMPLING LOCATION Scrubber inlet
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) [(55 3/4) + (55 1/8)] ÷ 2 = 55 7/16
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) (5 7/8 + 5 5/8) ÷ 2 = 5 3/4
STACK I.D., (DISTANCE A - DISTANCE B) 49 11/16 (49.6875)
NEAREST UPSTREAM DISTURBANCE 109 1/2 = 2.2 dia.
NEAREST DOWNSTREAM DISTURBANCE 62 = 1.2 dia.
CALCULATOR STOLTZ / VOGEL



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.011	49.6875	0.55 > 1.00	5 3/4	6 3/4
2	.032		1.59		7 3/8
3	.055		2.73		8 1/2
4	.079		3.93		9 5/8
5	.105		5.22		11
6	.132		6.56		12 1/4
7	.161		8.00		13 3/4
8	.194		9.64		15 3/8
9	.230		11.43		17 1/4
10	.272		13.52		19 1/4
11	.323		16.05		22 1/4
12	.398		19.78		25 1/2
13	.602		29.91		35 5/8
14	.677		33.64		39 3/8
15	.728		36.17		42
16	.77		38.26		44
17	.806		40.05		45 3/4
18	.839		41.69		47 1/2
19	.868		43.13		48 7/8
20	.895		44.47		50 1/4
21	.921		45.76		51 1/2
22	.945		46.95		52 3/4
23	.968		48.10		53 7/8
24	.989		49.14 > 48.69		54 1/2

EPA (Dur) 232
4-72

Corrected sample points

Use stack dia. = 49 1/2"
Use port length of 5 5/8"

Point #	Stack Fraction of ID	Stack ID	Product of Colums 2+3	Distance B	Sample Point Location
1	.011	49.5	.54 = 1	5 5/8	6 5/8
2	.032		1.58		7 1/4
3	.055		2.72		8 3/8
4	.079		3.91		9 1/2
5	.105		5.20		10 7/8
6	~~.102~~ .132		6.53		12 1/8
7	~~.104~~ .161		7.97		13 5/8
8	.194		9.60		15 1/4
9	.230		11.39		17
10	.272		13.46		19 1/8
11	.323		15.99		21 5/8
12	.398		19.70		25 3/8
13	.602		29.80		35 3/8
14	.677		33.51		39 1/8
15	.728		36.04		41 5/8
16	.77		38.12		43 3/4
17	.806		39.90		45 1/2
18	.839		41.53		47 1/8
19	.868		42.97		48 5/8
20	.895		44.30		49 7/8
21	.921		45.59		51 1/4
22	.945		46.78		52 3/8
23	.968		47.92		53 1/2
24	.989		45.5 = 48.96		54 5/8 = ≫ 54 1/8

Inlet to scrubber

Port #1 (Horizontal)

Flange to ~~[illegible]~~ Near wall = $5\frac{7}{8}$"

Flange to Far wall = $55\frac{3}{4}$"

Port #2 (Vertical)

Flange to near wall = $5\frac{5}{8}$"

Flange to Far wall (Top of muck) = $54\frac{3}{8}$"

(Bottom of muck) = $55\frac{1}{8}$"

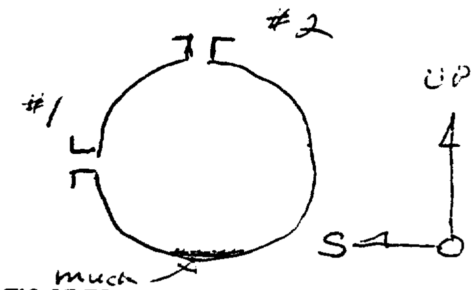
Downstream disturbance = 62"

Upstream = $85 + 24\frac{1}{2} = 109\frac{1}{2}$"

$55\frac{1}{8} - 5\frac{5}{8} = 49\frac{1}{2}$

PRELIMINARY VELOCITY TRAVERSE

PLANT Swift Chemical Plant
DATE 3-4-79
LOCATION Scrubber Inlet
STACK I.D. 49.67
BAROMETRIC PRESSURE, in. Hg ~~[illegible]~~ 30.15
STACK GAUGE PRESSURE, in. H_2O -3.1" H_2O @ 1-13
OPERATORS Stultz - Vogel



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1-1	0.98	144
1-2	1.80	161
1-3	1.70	162
1-4	1.90	162
1-5	1.90	162
1-6	1.90	162
1-7	1.90	162
1-8	1.90	162
1-9	1.92	162
1-10	1.85	162
1-11	1.91	162
1-12	1.95	162
1-13	1.90	155
1-14	1.98	155
1-15	1.92	155
1-16	2.00	157
1-17	1.96	158
1-18	2.00	158
1-19	2.07	158
1-20	2.00	158
1-21	1.90	158
1-22	1.92	158
1-23	1.95	158
1-24	1.80	156
AVERAGE	1.875	158.7

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
2-1	0.85	144
2-2	1.00	146
2-3	1.20	157
2-4	1.40	160
2-5	1.43	163
2-6	1.50	164
2-7	1.50	164
2-8	1.50	164
2-9	1.50	164
2-10	1.51	165
2-11	1.47	165
2-12	1.40	165
2-13	1.90 ~~1.10~~	163
2-14	1.75 ~~[illegible]~~	163
2-15	1.75 ~~[illegible]~~	162
2-16	1.55 ~~1.20~~	156
2-17	0.11 ~~0.55~~	125
2-18	0.04	123
2-19	0.04	123
2-20	0.03	125
2-21	0.03	125
2-22	0.05	129
2-23	0.09	131
2-24	0.11	137
AVERAGE	0.988	149.4

EPA (Dur) 233
4 72

ΔP avg. = 1.43
Temp avg. = 154°F

Run Number Prelim.
Date 3-4-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY MOISTURE DETERMINATION

Recorded by RCS
Assisted by Vogel

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = 30.15 in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx Pm$ = ______ in. Hg
Average Meter Temperature, Tm = ______ oF
Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = \underline{\qquad\qquad} \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = 183 °F
Wet Bulb Temperature = 115 °F } 68° diff

Moisture Content (from Ref. Table) = 6.5 % by Volume

C. Predetermined Value

% Moisture ______ Basis ______

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical Plant

DATE 3-4-79

SAMPLING LOCATION Inlet to Scrubber

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\ avg.}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6.5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.15
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_b = .23 P_s	29.92
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.992
AVERAGE STACK TEMPERATURE, °F	$T_{s\ avg.}$	154
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.43
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	2.07
C FACTOR		.97
CALCULATED NOZZLE DIAMETER, in.		~~0.346~~ 0.141
ACTUAL NOZZLE DIAMETER, in.		~~0.375~~ 0.125
REFERENCE Δp, in. H_2O		~~0.11~~ 3.4

EPA (Dur) 234
4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical - Beaumont

Sampling Location Scrubber Inlet

Test Number ______

Date 3-4-79

Initial ______

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

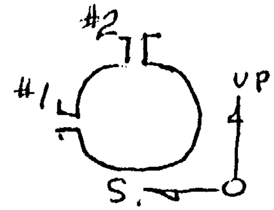
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	100
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	~~22.24~~ ~~0.958~~ 0.935
Nozzle diameter, inches	Dn	0.125
Barometric pressure, inches Hg	Pb	
$\frac{5.168\ (100 + 460)\ (.84)\ (3)\ (.935)\ (.125^2)}{\sqrt{30.15}}$	K	~~106.55~~ 19.40

FIELD DATA

PLANT Swift Chemical - Beaumont
DATE 3-5-79
SAMPLING LOCATION Scrubber Inlet
SAMPLE TYPE Part.
RUN NUMBER 1
OPERATOR RCS
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 30.40
STATIC PRESSURE, (P_s) -3.1" H_2O
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 4', TFE Liner
NOZZLE I.D. 0.123
ASSUMED MOISTURE, % 6.5
SAMPLE BOX NUMBER
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.97
PROBE HEATER SETTING
HEATER BOX SETTING None
REFERENCE Δp 8.4

Leak CK: Initial at 15" Hg, CFM .014
Final at Hg, CFM

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = \frac{~~106.55~~}{19.40} \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

	TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	~~SAMPLE BOX TEMPERATURE~~ Ambient Wet/Dry	~~IMPINGER TEMPERATURE~~ Scrubber ΔP in H_2O
		0	1535		743.33									
	1-1	3		748.25	744.65	0.92	0.21		100					
	1-2	6		748.71	745.40	0.79	0.18		85	68	68	0		
	1-3	9		749.50	746.27	0.95	0.22		182	70	69	2	48.4/	8.0-8.45
	1-4	12		750.62	747.08	0.95	0.22		109	72	69	6		
Stop 1553 Start 1554	1-5	15		752.39	748.15	1.60	0.38		185	73	70	1	47.6/69.3	
	1-6	18				2.18	0.50		184	74	71	2		8.0
	1-8	21			750.85	~~2.80~~ 2.30	0.57		185	78	72	3		
Stop 1605	1-9	24			752.32	3.1	0.7		184	80	72	3	47.8/69.3	
Start 1609	1-10	27			753.54	2.1	0.49		185					
Stop 1611	1-11	30	1624		754.75	1.8	0.42		183	76	73	2	47.7/69.0	
Start 1621	1-12	33	1627		756.08	1.9	0.44		181	79	75	2		
Stop 1624	1-13	36	1633		757.15	1.6	0.38		181	81	76	2		
Start 1632	1-14	39	1636		758.32	1.9	0.44		181	81	76	2		
Stop 1631	1-15	42	1639		759.45	1.6	0.38		182	82	77	2		
Start 1633	1-16	45	1642		760.59	1.7	0.41		183	84	77	2	48.0/69.2	7.1
	1-17	48			761.78	1.9	0.44		185	86	78	2		
	1-18	51			762.95	1.8	0.42		180	88	79			
	1-19	54	1650		764.13	1.9	0.44		187	88	79	2		
Stop 1654	1-20	57	1654		765.31	1.8	0.42		187	88	80	2	47.7/69.4	
	1-21													
	1-22													
	1-23													
	1-24													

COMMENTS
Test terminated at end of Point 1-20 because of plant process problems.
Note: Point 1-7 not sampled

C-12

EPA (Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical - Beaumont Date 3-5-79

Sampling Location Scrubber Inlet Initial RCS

Test Number 1

Isokinetic equation:

$$\% \ I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	170 ~~161.5~~
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	21.38
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	.935 (assumed)
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.14
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	30.17
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps x Ms}}$	Vs	~~4771~~ 4928
Total sample time, minutes	θ	57
Nozzle diameter, inches	Dn	0.123
$\frac{1{,}039\ (170 + 460)(21.38)}{(4928)(57)(30.17)(.935)(.123^2)}$	% I	116.7

ANALYTICAL DATA

Bar. Pressure = 30.23 " Hg

PLANT Swift

DATE 3-5-79

SAMPLING LOCATION Inlet

SAMPLE TYPE AN

RUN NUMBER 1

SAMPLE BOX NUMBER 3

CLEAN-UP MAN KJ

COMMENTS: only 1/2 a run completed

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

FILTER NUMBER ______ ______ — CONTAINER ______ ______ mg

FRONT HALF SUBTOTAL ______ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

ETHER-CHLOROFORM EXTRACTION ______ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

BACK HALF SUBTOTAL ______ mg

TOTAL WEIGHT ______ mg

MOISTURE

Front Half

wt of jar and imp. H_2O = 626.2

wt. of jar = 448.9

wt. of Imp H_2O = 177.3

wt. of jar + Imp. H_2O + filter + rinse (Front half) = 1,289.5g

Back Half

wt of jar = 93.3g

wt of jar + Imp. H_2SO_4 = 297.0

" " " " " + rinse H_2SO_4 = 323.6g

77.8g (circled)

IMPINGERS

FINAL VOLUME	346.7	ml
INITIAL VOLUME	200	ml
NET VOLUME	146.7	ml

SILICA GEL

FINAL WEIGHT	713.3 g	______ g	______ g
INITIAL WEIGHT	708.2 g	______ g	______ g
NET WEIGHT	5.1 g	______ g	______ g

TOTAL MOISTURE 146.7 g

EPA (Dur) 231
4/72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift - Beaumont Tx.
Sample Location Inlet
Sample Box No. 3
Sample Type Ammonium Nitrate

Run No. (1) ✓
Sample Date 3/5/79
Recovery Date 3/5/79
Cleanup Person Jones

Filter No. ______
Sample No. ______
Sample Material Description ______

MOISTURE AND/OR SAMPLE

	1	2	3	4	5	SILICA GEL
Impinger Type[a]	M	S	M	S	M	
Impinger Solution	H_2O	H_2O	$1N H_2SO_4$	$1N H_2SO_4$	MT	
combined Final Volume (wt) gm	346.7					713.3
combined Initial Volume (wt) gm	200					708.2
combined Net Volume (wt) gm	146.7					5.1
Sample No.(s)						

Silica Gel Color ______

Combined impinger contents, Sample No. ______
Liquid Level Marked ______ Container(s) Sealed ______
Description of Impinger Solution ______
Total Moisture, gm ______

a/ S = Greenburg-Smith standard, M = Modified, O = Other ______
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ______
Liquid Level Marked ______
Sealed ______

Impinger Rinse: Sample No. ______
Liquid Level Marked ______
Sealed ______

Water Blank: Sample No. ______
Liquid Level Marked ______

Dry Catch: Sample No. ______
Description ______
Sealed ______

Acetone Blank: Sample No. ______
Liquid Level Marked ______
Sealed ______

Filter Blank: Sample No. ______
Sealed ______

Sample Disposition ______
Carrier ______ Date Shipped: ______
Remarks: ______

Date of laboratory custody ______ Seal(s) broken by ______
Personnel accepting custody ______ Date broken ______
Remarks: ______

✓ only 1/2 a run completed

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-5-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test 1	1	Port #1 Inlet	Particulate	1535	1553		
Stop Test				1553	1554		
Resume Test	1	Port #1	Particulate	1554	1605		
Stop Test				1605	1609		
Resume Test	1	Port #1	Particulate	1609	1611		
Stop Test				1611	1621		
Resume Test	1	Port #1	Particulate	1621	1629		
Stop Test				1629	1631		
Resume Test	1	Port #1	Particulate	1631	1632		
Stop Test				1632	1633		
Resume Test	1	Port #1	Particulate	1633	1654		
Stop Test - Incomplete, Plant Process Problems	1	Port #1	Particulate	1654			

MIDWEST RESEARCH INSTITUTE

RUN 2

MRI Project Number 4468-L18
Field Dates March 4-
Plant Swift Chemical - Beaumont
Sampling Location Scrubber Inlet
Sampling Date 3-6-79

FIELD CREW

Crew Chief: DaRos

Testing Engineer
1 Stultz
2
3

Engr. Technician
1 Vogel
2
3

Lab Technician
1 COLE
2 JONES
3

Process Engineer
1 T. L. CURTIN (GCA)
2

Other
1 G. SCHEIL (ANALYSIS)
2

MRI - Form PO (10/72)

Run Number 2

Date 3-6-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by RCS

Assisted by Vogel

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ____________ in. Hg

☐ Barometer Location ____________

Reading Time ________ by ______

☐ Elevation ____________

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx Pm$ = ____________ in. Hg

Average Meter Temperature, Tm = ____________ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ____________ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{PmVm}{(Tm+460)\,Wm}\right]} = \text{\_\_\_\_\_\_\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ________ °F

Wet Bulb Temperature = ________ °F

Moisture Content (from Ref. Table) = ________ % by Volume

C. Predetermined Value

% Moisture 4 Basis assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical - Beaumont

DATE 3-6-79

SAMPLING LOCATION Scrubber Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	85
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	(30.30)
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	Pb -0.23 P_s	(30.07)
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	(.992)
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	175
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.43
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	2.07
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	.193	
ACTUAL NOZZLE DIAMETER, in.	.1875	
REFERENCE Δp. in. H_2O	1.7	

EPA (Dur) 234
4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical, Beaumont
Sampling Location Scrubber Inlet
Test Number 2

Date 3-6-79
Initial RCS

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

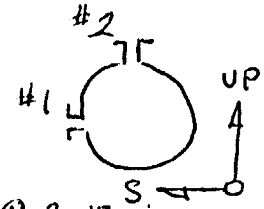
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	85 ~~175~~
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	2
Mole fraction dry gas	Mf	.96
Nozzle diameter, inches	Dn	.1875
Barometric pressure, inches Hg	Pb	30.30
$\frac{5.168\ (85 + 460)\ (.84)\ (2)\ (.96)\ (.1875^2)}{\sqrt{30.30}}$	K	~~159.70~~ 29.01

FIELD DATA

PLANT Swift Chemical - Beaumont
DATE 3-6-79
SAMPLING LOCATION Scrubber-Inlet
SAMPLE TYPE Particulate
RUN NUMBER 2
OPERATOR RCS
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE ~~30.40~~ 30.30
STATIC PRESSURE, (P_s) ~~[illegible]~~ -3.20 @ 2-13
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 4', TFE Liner
NOZZLE I.D. .1875
ASSUMED MOISTURE, % 4
SAMPLE BOX NUMBER
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING
HEATER BOX SETTING None
REFERENCE Δp 1.7

Leak CK: Initial at 15" Hg, CFM .005 SCHEMATIC OF TRAVERSE POINT LAYOUT
Final at 12 Hg, CFM .005 READ AND RECORD ALL DATA EVERY 2 MINUTES

$VM = 29.01 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$ 1.37 avg.

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER TEMPERATURE~~, °F Probe
	0	0940		765.442									
1-1	2	0942		766.48	0.55	.60		109	57	57	0		
1-2	4	0944		767.47	0.92	1.00		175	59	57	2		
1-3	6	0946		768.64	1.10	1.1		183	61	57	2		
1-4	8	0948		770.01	1.50	1.75		184	62	57	3		
1-5	10	0950		771.48	1.60	1.85		184	67	58	3		
1-6	12	0952		773.02	1.80	1.95		185	69	59	3		
1-7	14	0954			1.9	2.05		184	72	60	3		
1-8	16	0956		776.11	1.75	1.9		184	75	60	3		
1-9	18	0958		777.63	1.80	1.95		184	77	61	3		
1-10	20	1000		779.16	1.70	1.85		183	78	62	3		
1-11	22	1002		780.67	1.75	1.90		183	80	63	3		
1-12	24	1004		782.18	1.75	1.90		184	82	64	3		
1-13	26	1006		783.84	2.20	2.3		184	83	65	4		
1-14	28	1008		785.49	2.0	2.2		184	85	66	3.5		
1-15	30	1010		787.04	1.75	1.90		187	87	67	3		
1-16	32	1012		788.67	2.0	2.2		187	88	68	3.5		
1-17	34	1014		790.25	1.9	2.05		187	90	69	3		
1-18	36	1016		791.80	1.80	1.95		187	90	70	3.5		180
1-19	38	1018		793.34	1.9	2.05		187	91	71	3.5		
1-20	40	1020		794.96	1.80	1.95		187	92	72	3.5		
1-21	42	1022		796.48	1.75	1.90		187	92	73	3		
1-22	44	1024		798.03	1.80	1.95		186	93	74	3		
1-23	46	1026		799.62	1.95	2.1		186	94	75	3.5		187
1-24	48	1028		801.174	1.80	1.95		185	94	76	3.5		

COMMENTS:

40.77/24 = 1.699

173.7 ave. temp °F

EPA (Dur) 235

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER TEMPERATURE~~ °F Probe	
	48	1104		801.174										
2-1	50	1106		802.14	0.7	0.8		69	68	72	6			
2-2	52			803.08	.95	1.0					12			Stop 1107
2-3	54	1127		804.29	1.1	1.2		180	69	70	2			Start 1124
2-4	56	1129		805.66	1.4	1.5		185	72	70	3			
2-5	58	1131		807.11	1.6	1.75		185	75	70	3			
2-6	60	1133		808.64	1.8	1.9		186	79	71	3.5		147	
2-7	62	1135		810.18	1.8	1.9		186	81	71	3.5		158	
2-8	64	1137		811.74	1.85	2.0		186	84	72	3.5			
2-9	66	1139		813.28	1.80	1.9		187	85	72	3.5			
2-10	68	1141		814.82	1.80	1.9		187	86	72	3.5		164	
2-11	70	1143		816.39	1.85	2.0		185	88	73	3.5			
2-12	72	1145		817.98	1.90	2.05		185	90	74	3.5		165	
2-13	74	1147		819.57	1.90	2.05		183	92	74	4			
2-14	76	1149		820.95	1.4	1.5		183	94	75	3			
2-15	78	1151		822.29	1.3	1.4		182	94	76	3			
2-16	80	1153		823.58	1.2	1.3		181	93	76	3		170	
2-17	82	1155		824.82	1.1	1.2		182	93	77	3		174	
2-18	84	1157		826.02	1.00	1.1		182	93	78	3			
2-19	86	1159		827.05	0.7	0.8		181	92	78	2.5			
2-20	88	1201		827.99	0.57	0.62		182	92	79	2		174	
2-21	90	1203		828.84	0.45	0.50		180	90	79	2			
2-22	92	1205		829.49	0.23	0.26		178	89	79	2			
2-23	94	1207		830.22	0.35	0.38		175	88	79	2			
2-24	96	1209		830.901	0.25	0.28		174	87	79	2			

29/24 = 1.208 avg: 174.4

Run Number 2 Date 3-6-79 Sampling Location Scrubber Inlet

Comments: Probe stopped up on point # 2-2. Stopped sampling, cleaned out with DDW and continued.

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant *Swift Chemical - Beaumont* Date *3-6-79*
Sampling Location *Scrubber Inlet* Initial *BCS*
Test Number *2*

Isokinetic equation:

$$\% \ I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	*174.05*	
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	*67.282*	
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	*.96*	** .98*
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	*28.84*	
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	*28.41*	
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	*30.06*	
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ *1.454*	Vs	*4476*	
Total sample time, minutes	θ	*96*	
Nozzle diameter, inches	Dn	*.1875*	
$\frac{1{,}039\ (174.05 + 460)(67.282)}{(4476)(96)(30.06)(.96)(.1875^2)}$	% I	*101.7*	

** .98* ** 99.6*

** Calculation for assumed moisture of 2%*

Meter Volume = 67.459 cf

ΔH avg. = 1.57
Tm avg = 77.9

$$V_{m\,std.} = \frac{17.64\,(67.459)\left(30.30 + \frac{1.57}{13.6}\right)}{77.9 + 460}$$

$V_{m\,std} = 67.282$

Ts avg. 174.05

$$V_s = 5128.8\,(.84)\sqrt{1.454}\sqrt{\frac{174.05 + 460}{30.06 \times 28.41}}$$

$V_s = 4476$ fpm

SAMPLING TASK LOG

Plant Swift Chemical - Beaumont
Date 3-6-79
Project No. 4468-L18

Plant Location Beaumont, Texas
Recorded by

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Probe heater on at 0900	2	Inlet, Port 1		0900			
Begin Test 2	2	Inlet, Port #1	Particulate	0940	1028		
Change Ports				1028	1104		
Resume Test	2	Inlet, Port #2	Particulate	1104	1209		
				12	09		

PARTICULATE SAMPLE R COVERY AND INTEGRITY

Plant Swift - Beaumont Tx.
Sample Location Inlet
Sample Box No. 3
Sample Type Ammonium Nitrate

Run No. (2)
Sample Date 3/6/79
Recovery Date 3/6/79
Cleanup Person Cole

Filter No. ____
Sample No. ____
Sample Material Description ____

MOISTURE AND/OR SAMPLE

						SILICA GEL
Impinger Sequence	1	2	3	4	5	
Impinger Type a/	M	S	M	S	M	
Impinger Solution	H_2O	H_2O	$1N\ H_2SO_4$	$1N\ H_2SO_4$	MT	
combined Final Volume (wt) b/	515.3					723.8
combined Initial Volume (wt) b/	200					713.3
combined Net Volume (wt) b/	315.3 1/					10.5
Sample No.(s)						

Combined impinger contents, Sample No. ____
Liquid Level Marked ____ Container(s) Sealed ____
Silica Gel Color ____
Description of Impinger Solution ____
Total Moisture, gm ____

a/ S = Greenburg-Smith standard, M = Modified, O = other ____
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ____
Liquid Level Marked ____
Sealed ____
Impinger Rinse: Sample No. ____
Liquid Level Marked ____
Sealed ____
Water Blank: Sample No. ____
Liquid Level Marked ____

Dry Catch: Sample No. ____
Description ____
Sealed ____
Acetone Blank: Sample No. ____
Liquid Level Marked ____
Sealed ____
Filter Blank: Sample No. ____
Sealed ____

Sample Disposition ____
Carrier ____ Date Shipped: ____
Remarks: ____

Date of laboratory custody ____ Seal(s) broken by ____
Personnel accepting custody ____ Date broken ____
Remarks: ____

1/ Rinsed probe during test

ANAL 'TICAL DATA

PLANT Swift

DATE 3/6/79

SAMPLING LOCATION Inlet

SAMPLE TYPE

RUN NUMBER 2

SAMPLE BOX NUMBER 3

CLEAN-UP MAN

COMMENTS:

FRONT HALF

LABORATORY RESULT:

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER		CONTAINER	m
FILTER NUMBER		CONTAINER	m
		FRONT HALF SUBTOTAL	

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER	
	ETHER-CHLOROFORM EXTRACTION	
ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER	
	BACK HALF SUBTOTAL	
	TOTAL WEIGHT	

MOISTURE

✓ Combined Combined

IMPINGERS

FINAL VOLUME	515.3	ml
INITIAL VOLUME	200	ml
NET VOLUME	315.3	ml ✓

SILICA GEL

FINAL WEIGHT	723.8	g		g		g
INITIAL WEIGHT	713.3	g		g		g
NET WEIGHT	10.5	g		g		g

TOTAL MOISTURE

EPA (Dur) 231
4-72

✓ combined = 1st & 2nd impinger volumes
✓ probe was rinsed half-way thru first run.

Pb 30,10

MIDWEST RESEARCH INSTITUTE

RUN 3

MRI Project Number 4468-L18
Field Dates
Plant Swift Chemical - Beaumont
Sampling Location Scrubber Inlet
Sampling Date 3-7-79

FIELD CREW

Crew Chief		Da Ros
Testing Engineer	1	Stultz
	2	
	3	
Engr. Technician	1	Vogel
	2	
	3	
Lab Technician	1	C. Cole
	2	P. Jones
	3	
Process Engineer	1	T.L. Curtin (G.C.A.)
	2	
Other	1	G. Scheil (Analysis)
	2	

MRI - Form PO (10/72)

Run Number 3

Date 3-7-79

MIDWEST RESEARCH INSTITUTE

PRELIMINARY

MOISTURE DETERMINATION

Recorded by RCS

Assisted by ______

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx Pm$ = ______ in. Hg

Average Meter Temperature, Tm = ______ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = \text{\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 2 Basis Assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical - Beaumont

DATE 3-7-79

SAMPLING LOCATION Scrubber Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	T_m avg.	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.10
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.86
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.99
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	174
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.45
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	2.2
C FACTOR		1.03
CALCULATED NOZZLE DIAMETER, in.		0.193
ACTUAL NOZZLE DIAMETER, in.		0.1875
REFERENCE Δp, in. H_2O		1.6

EPA (Dur) 234
4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical - Beaumont Date 3-7-79
Sampling Location Scrubber Inlet Initial RCS
Test Number 3

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

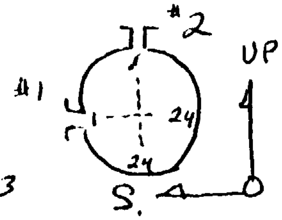
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	80
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	2
Mole fraction dry gas	Mf	.96
Nozzle diameter, inches	Dn	.1875
Barometric pressure, inches Hg	Pb	30.10
$\frac{5.168\ (80 + 460)\ (.84)\ (2)\ (.96)\ (.1875^2)}{\sqrt{30.10}}$	K	28.84

FIELD DATA

PLANT Swift Chemical - Beaumont
DATE 3-7-79
SAMPLING LOCATION Scrubber Inlet
SAMPLE TYPE Particulate
RUN NUMBER 3
OPERATOR RCS
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 30.10
STATIC PRESSURE, (P_s) -2.4" H_2O @ C2-13
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 4' TFE Lined
NOZZLE I.D. .1875"
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 1.03
PROBE HEATER SETTING Max
HEATER BOX SETTING None
REFERENCE Δp 1.6

Leak CK: Initial at 15" Hg, CFM .0075
Final at 12" Hg, CFM .017

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 2 MINUTES

$VM = 28.84 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET $(T_{m\,in})$, °F	DRY GAS METER TEMPERATURE OUTLET $(T_{m\,out})$, °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER TEMPERATURE~~, °F Probe
	0	1030		831.355									
1-1	2	1033		832.33	0.60	0.7		129	64	64	2		
1-2	4	1035		833.43	0.80	0.95		165	66	65	2		
1-3	6	1037		834.60	0.89	1.00		165	68	65	2		162
1-4	8	1039		835.98	1.20	1.40		167	71	65	2		
1-5	10	1041		837.28	1.40	1.6		167	74	66	2.5		
1-6	12	1043		838.70	1.45	1.65		169	76	66	2.5		156
1-7	14	1045		840.16	1.50	1.70		168	79	67	2.5		
1-8	16	1047		841.59	1.45	1.65		168	80	67	2.5		
1-9	18	1049		843.04	1.50	1.70		168	82	68	2.5		156
1-10	20	1051		844.48	1.45	1.65		169	83	69	2.5		
1-11	22	1053		846.2	1.55	1.75		168	84	70	2.5		
1-12	24	1055		847.43	1.50	1.70		169	85	71	2.5		158
1-13	26	1057		849.00	1.80	2.05		170	87	72	3		
1-14	28	1059		850.52	1.60	1.84		170	89	72	2.5		
1-15	30	1101		852.01	1.60	1.84		170	89	73	2.5		164
1-16	32	1103		853.51	1.56	1.70		170	91	74	2.5		
1-17	34	1105		854.98	1.55	1.75		170	91	75	2.5		
1-18	36	1107		856.48	1.30	1.50		169	91	75	2.5		172
1-19	38	1109		857.90	1.60	1.84		171	91	76	3		
1-20	40	1111		859.34	1.45	1.65		169	92	77	2.5		173
1-21	42	1113		860.81	1.50	1.70		170	92	77	2.5		
1-22	44	1115		862.35	1.45	1.65		170	92	78	2.5		
1-23	46	1117		863.65	1.35	1.55		170	92	79	3		
COMMENTS 1-24	48	1119		865.103	1.50	1.70		170	93	80	4		177

33.49/24 = 1.395   4011/24 = 167.1   Tm avg = 77.35

EPA (Dur) 235
1/7?

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER TEMPERATURE~~, °F Probe
	[illegible]	1139		865.103									
2-1	50	1141		865.90	0.60	0.70		140	75	76			
2-2	52	1150		866.35	0.65	0.72		165	75	75			
2-3	54	1152		867.96	0.80	0.92		168	76	76			
2-4	56	1154		869.12	0.83	0.95		168	78	77	2		
2-5	58	1156		870.35	1.00	1.2		170	80	77	2		
2-6	60	1158		871.62	1.10	1.3		170	82	77	2		160
2-7	62	1200		872.96	1.22	1.4		170	84	78	2		
2-8	64	1202		874.34	1.30	1.5		171	86	78	2.5		
2-9	66	1204 ~~1205~~		875.72	1.30	1.5		170	88	78	2		
2-10	68	1206		877.13	1.35	1.55		170	89	79	2.5		
2-11	70	1208		878.50	1.25	1.45		170	90	79	2.0		
2-12	72	1210		879.88	1.30	1.5		170	91	79	2.5		
2-13	74	1212		881.35	1.50	1.7		169	92	80	2.5		161
2-14	76	1214		882.60	1.0	1.2		167	92	81	2		
2-15	78	1216		883.76	0.80	0.95		163	92	81	2		
2-16	80	1218		884.89	0.76	0.90		164	92	82	2		166
2-17	82	1220		886.03	0.80	0.95		169	92	82	2		
2-18	84	1222		887.11	0.71	0.85		165	91	82	2		
2-19	86	1224		887.99	0.43	0.50		150	90	83	1		
2-20	88	1226		888.71	0.27	0.32		165	89	83	1		169
2-21	90	1228		889.31	0.18	0.22		166	88	83	1		
2-22	92	1230		889.79	0.11	0.14		155	87	83	<1		
2-23	94	1232		890.19	0.06	.075		153	86	83	<1		174
2-24	96	1234		890.830	0.28	0.32		148	86	84	<1		
					19.6/24 = 0.817			3936/24 = 164					
									$T_{m\,avg}$ = 83.06				

Stop 1142
Start ~~1150~~ 1149

Run Number 3

Date 3-7-79

Sampling Location Scrubber Inlet

Comments: Probe stopped up on point 2-2

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical - Beaumont Date 3-7-79
Sampling Location Scrubber Inlet Initial RCS
Test Number 3

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	165.55
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	58.639
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	.98
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.62
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.92
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	3872
Total sample time, minutes	θ	96
Nozzle diameter, inches	Dn	.1875
$\frac{1{,}039\ (165.55 + 460)(58.639)}{(3872)(96)(29.92)(.98)(.1875^2)}$	% I	99.5

Test #B   3-7-79   RCS

$\Delta P_{s\,avg} = 1.106$ $\Delta H_{avg} = 1.27$

$T_{m\,avg} = 80.2$

$T_{s\,avg.} = 165.55$

Meter Volume = 59.475 (actual)

Quick ck: $\left(\sqrt{\frac{1.106}{165.55+460}} \times 28.84\right) \times 48 = 58.21$ cf design

$P_s = (30.10) - (2.4 \times .074) = 29.92$

$$V_{m_{std}} = \frac{17.64\,(59.475)\left(30.1 + \frac{1.27}{13.6}\right)}{80.2 + 460}$$

$V_{m\,std} = 58.639$

$$M_s = (28.84)(.98) + 18\,(1 - .98)$$
$$= 28.62$$

$$V_m = 5128.8\,(.84)\left(\sqrt{1.106}\right)\sqrt{\frac{165.55+460}{29.92 \times 28.62}}$$
$$= 3872$$

ANAL 'TICAL DATA

PLANT Swift Beaumont Tx.

DATE 3/7/79

SAMPLING LOCATION Inlet

SAMPLE TYPE Ammonium nitrate

RUN NUMBER 3

SAMPLE BOX NUMBER 3

CLEAN-UP MAN ______

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

FILTER NUMBER ______ ______ — CONTAINER ______ ______ mg

FRONT HALF SUBTOTAL ______ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

ETHER-CHLOROFORM EXTRACTION ______ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

BACK HALF SUBTOTAL ______ mg

TOTAL WEIGHT ______ mg

MOISTURE

	#1	#2	#3	#4	#5
IMPINGERS					
FINAL VOLUME (ml)	788.1	586.1	592.0	598.3	482.2
100ml + INITIAL VOLUME (ml)	578.2	592.1	589.2	591.3	480.1
NET VOLUME (ml)	109.9	-6.0	2.8	7.0	2.1
SILICA GEL					
FINAL WEIGHT (g)	737.0				
INITIAL WEIGHT (g)	723.8				
NET WEIGHT (g)	13.2				

109.9
2.8
7.0
2.1
121.8
-6.0
115.8

TOTAL MOISTURE 115.8

EPA (Dur) 231
4 72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift Beaumont Tx. Run No. (3)
Sample Location Inlet Sample Date 3/7/79
Sample Box No. 3 Recovery Date ______
Sample Type Ammonium Nitrate Cleanup Person ______

Filter No. ______ ______ ______
Sample No. ______ ______ ______
Sample Material Description ______

MOISTURE AND/OR SAMPLE | SILICA GEL

Impinger Sequence	1	2	3	4	5		
Impinger Type a/	M	S	M	S	M		
Impinger Solution	H_2O	H_2O	1N H_2SO_4	1N H_2SO_4	MT		
Final Volume (wt) gm							
Initial Volume (wt) gm	100	100	100	100	100	723.8	
Net Volume (wt) gm							
Sample No.(s)							

Combined impinger contents, Sample No. ______ Silica Gel Color ______
Liquid Level Marked ______ Container(s) Sealed ______
Description of Impinger Solution ______
Total Moisture, gm ______

a/ S = Greenburg-Smith standard, M = Modified, O = Other ______
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ______
Liquid Level Marked ______
Sealed ______

Impinger Rinse: Sample No. ______
Liquid Level Marked ______
Sealed ______

Water Blank: Sample No. ______
Liquid Level Marked ______

Dry Catch: Sample No. ______
Description ______
Sealed ______

Acetone Blank: Sample No. ______
Liquid Level Marked ______
Sealed ______

Filter Blank: Sample No. ______
Sealed ______

Sample Disposition ______
Carrier ______ Date Shipped: ______
Remarks: ______

Date of laboratory custody ______ Seal(s) broken by ______
Personnel accepting custody ______ Date broken ______
Remarks: ______

SAMPLE HANDLING LOG

Project Number 4468-L18

Source Identification Inlet to Scrubber

Test Run Number #3

Pollutant(s) in Sample AN

Task	Date	Time	Personnel	Remarks
Sampling	3/7/79	11:42 start 1:00 stop	Vogel Stoltz	
Probe Technician	3/7/79	-	Vogel	
Meter Technician	3/7/79	-	Stoltz	
Other	3/7/79	-		
Transport of Train to Cleanup Site	3/7/79	1245	Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test	3	Inlet Port #1	Particulate	1031	1119		
Change Ports				1119	1139		
Resume Test	3	Inlet Port #2	Particulate	1139	1142		
Stop Test - Unplug Probe				1142	1149		
Resume Test	3	Inlet Port #2	Particulate	1149	1234		
Test Complete				12	34		

MIDWEST RESEARCH INSTITUTE

RUN 4

MRI Project Number 4468-L18
Field Dates March 3–
Plant Swift Chemical - Beaumont
Sampling Location Scrubber Inlet
Sampling Date 3-7-79

FIELD CREW

Crew Chief DaRos

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Vogel
2
3

Lab Technician 1 C. Cole
2 R Jones
3

Process Engineer 1 T. L. Curtin (GCA)
2

Other 1 G. Schiel (Analysis)
2

MRI - Form PO (10/72)

Run Number 4

Date 3-7-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by RCS

Assisted by

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = ______ in. Hg

Average Meter Temperature, T_m = ______ °F

Total Weight of Moisture Collected, $W_c + W_a = W_m$ = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{P_m V_m}{(T_m + 460)\, W_m}\right]} = \text{\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 2 Basis Assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical – Beaumont

DATE 3-7-79

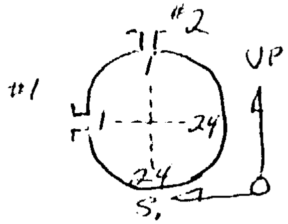
SAMPLING LOCATION Scrubber Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	85
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.10
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.87
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.99
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	165.5
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.106
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	2.05
C FACTOR	1.03	
CALCULATED NOZZLE DIAMETER, in.	0.193	
ACTUAL NOZZLE DIAMETER, in.	0.1875	
REFERENCE Δp, in. H_2O	1.6	

EPA (Dur) 234
4/72

FIELD DATA

PLANT Swift Chemical - Beaumont
DATE 3-7-79
SAMPLING LOCATION Scrubber Inlet
SAMPLE TYPE Particulate
RUN NUMBER 4
OPERATOR RCS
AMBIENT TEMPERATURE 75
BAROMETRIC PRESSURE 30.10
STATIC PRESSURE, (P_s) -3.1" H_2O @ 1-13
FILTER NUMBER (s)



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4'
NOZZLE I.D. 0.1875
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 1.03
PROBE HEATER SETTING Max
HEATER BOX SETTING None
REFERENCE Δp 1.6

Leak CK: Initial at 15" Hg, CFM .006
Final at Hg 16 CFM .005

READ AND RECORD ALL DATA EVERY 2 MINUTES

$$VM = 28.84 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER TEMPERATURE~~, °F Probe
	0	1500		891.503									
1-1	2	1502		892.80	1.10	1.3		175	77	78	3.5		
1-2	4	1504		894.00	0.90	1.05		186	79	78	3		170
1-3	6	1506		895.39	1.35	1.55		190	80	78	4		
1-4	8	1508		896.81	1.40	1.60		188	83	78	4		
1-5	10	1510		898.26	1.50	1.70		187	86	78	4.5		160
1-6	12	1512		899.74	1.55	1.80		188	88	79	4.5		
1-7	14	1514		901.24	1.55	1.80		187	90	79	4.5		
1-8	16	1516		902.77	1.60	1.85		186	93	80	5		165
1-9	18	1518		904.28	1.55	1.80		189	94	81	4.5		
1-10	20	1520		905.76	1.50	1.70		188	97	82	4.5		
1-11	22	1522		907.25	1.55	1.80		187	98	82	4.5		170
1-12	24	1524		908.73	1.50	1.70		189	98	83	4.5		
1-13	26	1526		910.34	1.85	2.10		190	97	84	5		
1-14	28	1528		911.87	1.60	1.85		192	97	84	4.5		170
1-15	30	1530		913.40	1.60	1.85		191	98	84	4.5		
1-16	32	1532		914.97	1.70	1.90		191	98	85	5		
1-17	34	1534		916.48	1.55	1.80		190	98	85	4.5		
1-18	36	1536		917.99	1.55	1.86		190	99	85	4.5		179
1-19	38	1538		919.52	1.60	1.85		193	100	86	5		
1-20	40	1540		921.07	1.60	1.85		192	100	86	5		
1-21	42	1542		922.60	1.60	1.85		193	100	87	5		183
1-22	44	1544		924.14	1.60	1.85		192	101	88	5		
1-23	46	1546		925.69	1.65	1.90		192	102	88	5		190
COMMENTS: 1-24	48	1548		927.233	1.60	1.85		191	103	89	5		

EPA (Dur) 235

Stop 1613
Start 1617

Stop 1625
Start 1630

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER~~ TEMPERATURE, °F Probe
	48	1610		927.233									
2-1	50	1612		928.29	0.75	.90		84	82	85	4		
2-2	52	1618		929.30	0.80	5/5		183	83	85	10		
2-3	54	1620		930.56	1.00	1.2		~~181~~	83	84	3.5		
2-4	56	1622		931.85	1.15	1.3		~~180~~	85	85	4		
2-5	58	1624		933.28	1.40	1.6		~~179~~	88	85	4.5		~~176~~
2-6	60	1631		934.51	1.40	1.6							
2-7	62	1633		935.92	1.40	1.6		194	86	84	4.5		
2-8	64	1635		937.38	1.45	1.7		192	88	85	4.5		
2-9	66	1637		938.86	1.45	1.7		191	90	85	4.5		166
2-10	68	1639		940.35	1.50	1.75		192	92	85	4.5		
2-11	70	1641		941.78	1.40	1.6		194	94	86	4		
2-12	72	1643		943.28	1.50	1.75		193	94	86	4.5		
2-13	74	1645		944.77	1.50	1.75		191	95	86	4.5		172
2-14	76	1647		946.09	1.10	1.30		190	95	85	4		
2-15	78	1649		947.39	1.10	1.30		188	95	86	4		
2-16	80	1651		948.58	0.85	1.00		187	94	86	3.5		177
2-17	82	1653		949.69	0.78	0.90		188	94	86	3.5		
2-18	84	1655		950.79	0.78	0.90		187	93	86	3.5		
2-19	86	1657		951.85	0.68	0.80		185	93	86	3		184
2-20	88	1659		952.59	0.28	0.33		183	92	86	2.5		
2-21	90	1701		953.17	0.16	0.20		183	90	86	2		
2-22	92	1703		953.77	0.22	0.26		185	88	86	2		
2-23	94	1705		954.31	0.15	0.18		177	88	86	2		
2-24	96	1707		955.020	0.32	0.38		180	87	86	2.5		190

Run Number 4 Date 3-7-79 Sampling Location Scrubber Inlet

Comments: Probe stopped up on Point 2-2 - cleaned out with H_2O
Did not plug T.C. wires back in - missed temperatures for Points 2-3 thru 2-6
Probe stopped again on 2-5 - cleaned out, with H_2O

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical - Beaumont Date 3-7-79
Sampling Location Scrubber Inlet Initial RCS
Test Number 4

Isokinetic equation:

$$\% \ I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	185.2
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	61.752
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	.98
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.62
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.87
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	4173
Total sample time, minutes	θ	96
Nozzle diameter, inches	Dn	.1875
$\frac{1{,}039\ (185.2 + 460)(61.752)}{(4173)(96)(29.87)(.98)(.1875^2)}$	% I	100.4

Test #4 3-7-79 RCS

$\Delta Ps_{avg} = 1.243$

$Ts_{avg} = 185.2$

$\Delta H_{avg} = 1.44$

$Tm_{avg} = 88.06$

$V_m = 63.517$

$Ps = 30.10 - (3.1 \times .074)$
$= 29.87$

$$V_{m\,std} = \frac{17.64\,(63.517)\left(30.10 + \frac{1.44}{13.6}\right)}{88.06 + 460}$$

$V_{m\,std} = 61.752$

$$V_s = 5128.8\,(.84)\left(\sqrt{1.243}\right)\sqrt{\frac{185.2 + 460}{29.87 \times 28.62}}$$

$= 4173$ fpm

ANALYTICAL DATA

PLANT Swift Beaumont Tx.
DATE 3/7/79
SAMPLING LOCATION Inlet
SAMPLE TYPE ~~Outlet~~ Ammonium Nitrate
RUN NUMBER 4
SAMPLE BOX NUMBER #4
CLEAN-UP MAN RG

COMMENTS:

LABORATORY RESULTS

FRONT HALF

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

FILTER NUMBER ______ ______ — CONTAINER ______ ______ mg

FRONT HALF SUBTOTAL ______

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______
ETHER-CHLOROFORM EXTRACTION ______

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

BACK HALF SUBTOTAL ______

TOTAL WEIGHT ______

MOISTURE

798.3
581.6
16.7

IMPINGERS	#1	#2	#3	#4	#5
FINAL VOLUME	798.3 ml	614.7	577.6	587.8	497.9
INITIAL VOLUME (+100)	[illegible]	611.2	576.2	585.0	496.8
NET VOLUME	581.6 ml	3.5	0.9	2.8	1.1

SILICA GEL			
FINAL WEIGHT	[illegible] g	726.7 g	______ g
INITIAL WEIGHT	[illegible] g	711.5 g	______ g
NET WEIGHT	______ g	15.2 g	______ g

16.7
3.5
0.9
2.8
1.1
25.0

TOTAL MOISTURE 25.0

EPA (Dur) 231
4 72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Sesift Beaumont Tx. Run No. (4)
Sample Location Inlet. Sample Date 3/7/79
Sample Box No. 7 Recovery Date
Sample Type Ammonium Nitrate Cleanup Person

Filter No.
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE						SILICA GEL	
Impinger Sequence	1	2	3	4	5		
Impinger Type[a]	M	S	M	S	M		
Impinger Solution	H_2O	H_2O	1N H_2SO_4	1N H_2SO_4	MT		
Tare Final Volume (wt)[b]	798.3	614.7	577.6	587.8	447.9		
Tare Initial Volume (wt)[b]	581.6	611.2	576.7	585.0	446.8	711.5	
Net Volume (wt)[b]	16.7	3.5	0.9	2.8	1.1		
Sample No.(s)							

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Silica Gel Color
Description of Impinger Solution
Total Moisture, gm

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No.
Liquid Level Marked
Sealed
Impinger Rinse: Sample No.
Liquid Level Marked
Sealed
Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed
Acetone Blank: Sample No.
Liquid Level Marked
Sealed
Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

Date of laboratory custody Seal(s) broken by
Personnel accepting custody Date broken
Remarks:

SAMPLE HANDLING LOG

Project Number 4468-L(19)

Source Identification Inlet to scrubber

Test Run Number 4

Pollutant(s) in Sample A N

Task	Date	Time	Personnel	Remarks
Sampling	3-7-77	3:00 start 5:[illegible] stop	BOB STULTZ DAN VOGEL	
Probe Technician	"		D. VOGEL	
Meter Technician	"		B. Stults	
Other	"			
Transport of Train to Cleanup Site	"	5:25	VOGEL	
Train Disassembly		1907		
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468 -L(8)

Plant Location Beaumont, Texas
Recorded by

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test	4	Inlet Port #1	Particulate	1500	1548		
Change Ports				1548	1610		
Resume Test	4	Inlet Port #2	Particulate	1610	1613		
Stop Test - unplug Probe				1613	1617		
Resume Test	4	Inlet Port #2	Particulate	1617	1625		
Stop Test - unplug Probe				1625	1630		
Resume Test	4	Inlet Port #2	Particulate	1630	1707		
Test Complete				17	07		

MIDWEST RESEARCH INSTITUTE

RUN 5

MRI Project Number 4468-L18
Field Dates March 3-
Plant Swift Chemical - Beaumont
Sampling Location Scrubber Inlet
Sampling Date 3-8-79

FIELD CREW

Crew Chief		DaRos
Testing Engineer	1	Stultz
	2	
	3	
Engr. Technician	1	Vogel
	2	
	3	
Lab Technician	1	R. Jones
	2	C. Cole
	3	
Process Engineer	1	T. Curtin (GSA)
	2	
Other	1	G. Scheil
	2	

MRI - Form PO (10/72)

Run Number 5

Date 3-8-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY MOISTURE DETERMINATION

Recorded by RCr

Assisted by ________

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ____________ in. Hg

☐ Barometer Location ____________

Reading Time ________ by ______

☐ Elevation ____________

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = ____________ in. Hg

Average Meter Temperature, Tm = ____________ oF

Total Weight of Moisture Collected, Wc + Wa = Wm = ____________ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{P_m V_m}{(T_m + 460) W_m}\right]} = \text{\_\_\_\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ________ °F

Wet Bulb Temperature = ________ °F

Moisture Content (from Ref. Table) = ________ % by Volume

C. Predetermined Value

% Moisture 2 Basis Assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical - Beaumont

DATE 3-8-79

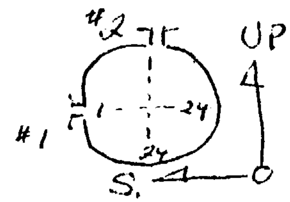
SAMPLING LOCATION Scrubber Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	85
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.08
STATIC PRESSURE IN STACK, in. Hg (P_m ± 0.074 STACK GAUGE PRESSURE in in. H_2O) -3.1	P_s	29.84
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.99
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	185
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.243
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	1.85
C FACTOR	1.03	
CALCULATED NOZZLE DIAMETER, in.	0.193	
ACTUAL NOZZLE DIAMETER, in.	0.1875	
REFERENCE Δp, in. H_2O	1.6	

EPA (Dur) 234
4/72

FIELD DATA

PLANT Swift Chemical - Beaumont
DATE 3-8-79
SAMPLING LOCATION Scrubber Inlet
SAMPLE TYPE Particulate
RUN NUMBER 5
OPERATOR RCS
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 30.08
STATIC PRESSURE, (P_s) -4.1 @ 1-13
FILTER NUMBER (s)



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' TFE Lined
NOZZLE I.D. 0.1875
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 1.03
PROBE HEATER SETTING Max
HEATER BOX SETTING None
REFERENCE Δp 1.6

Leak CK: Initial at 15" Hg, CFM .01
Final at 10" Hg, CFM .008

READ AND RECORD ALL DATA EVERY 2 MINUTES

$VM = \_\_\_ \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER~~ TEMPERATURE, °F Probe
	0	0919		956.629									
1-1	2	0921		958.05	1.20	1.50		176	64	63	4		
1-2	4	0923		959.40	1.30	1.50		155	68	64	4		168
1-3	6	0925		960.79	1.40	1.60		177	72	64	4.5		
1-4	8	0927		962.33	1.75	2.0		180	76	64	5.5		
1-5	10	0929		963.93	1.85	2.1		182	79	65	6		170
1-6	12	0931		965.54	2.00	2.3		183	83	66	6.5		
1-7	14	0933		967.29	2.05	2.35		181	86	67	6.5		
1-8	16	0935		968.89	1.90	2.1		182	88	68	6		
1-9	18	0937		970.53	2.0	2.2		184	90	69	6		173
1-10	20	0939		972.23	2.1	2.4		185	92	70	6.5		
1-11	22	0941		973.92	2.05	2.3		184	92	71	6.5		
1-12	24	0943		975.60	2.05	2.3		183	93	72	6.5		175
1-13	26	0945		977.44	2.50	2.8		183	94	74	8		
1-14	28	0947		979.29	2.10	2.4		182	95	74	7		
1-15	30	0949		980.92	2.10	2.4		184	95	75	7		176
1-16	32	0951		982.65	2.15	2.45		183	95	76	7		
1-17	34	0953		984.37	2.10	2.4		185	96	77	7		
1-18	36	0955		986.07	2.00	2.3		184	97	78	6.5		180
1-19	38	0957		987.79	2.10	2.4		185	98	78	7		
1-20	40	0959		989.51	2.15	2.45		185	99	79	7		
1-21	42	1001		991.14	1.85	2.10		183	98	79	6		176
1-22	44	1003		992.83	2.00	2.3		185	98	80	7		
1-23	46	1005		994.46	1.85	2.10		185	99	81	7		
1-24	48	1007		995.860	1.30	1.5		184	98	82	4.5		176

COMMENTS

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1/72

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	~~IMPINGER TEMPERATURE~~, °F Probe
	48	1028		995.868									
2-1	50	1030		997.02	0.95	1.10		125	76	78	3.5		
2-2	52	1032		998.12	1.40	1.6		180	78	78	4.5		
2-3	54	1034		999.86	1.45	1.65		174	82	79	4.5		
2-4	56	1036		001.44	1.70	2.0		185	87	79	5.5		174
2-5	58	1038		003.03	1.75	2.0		185	90	79	5.5		
2-6	60	1040		004.64	1.8	2.1		185	93	79	6		
2-7	62	1042		006.26	1.8	2.1		185	96	80	5.5		175
2-8	64	1044		007.90	1.9	2.2		185	98	80	6		
2-9	66	1046		009.57	1.95	2.25		185	100	81	6		
2-10	68	1048		011.25	1.95	2.25		187	102	82	6		178
2-11	70	1050		012.92	1.95	2.25		186	102	82	6.5		
2-12	72	1052		014.63	2.05	2.35		186	104	82	7		
2-13	74	1054		016.32	2.05	2.35		182	106	83	7.5		
2-14	76	1056		017.72	1.40	1.6		182	107	84	7		179
2-15	78	1058		019.44	1.05	1.2		178	106	84	6.5		
2-16	80	1100		020.24	1.15	1.3		181	106	85	7		
2-17	82	1102		021.55	1.20	1.4		182	104	85	10		
2-18	84	1104		022.78	0.98	1.10		182	104	86	9		184
2-19	86	1106		023.97	0.90	1.05		183	103	86	7.5		
2-20	88	1108		024.89	0.44	0.52		183	101	86	4.5		
2-21	90	1110		025.53	0.20	0.25		180	100	86	2.5		180
2-22	92	1112		026.05	0.15	0.18		176	98	86	2		
2-23	94	1114		026.61	0.17	0.20		173	96	86	2		
2-24	96	1116		027.172	0.16	0.19		173	94	86	2		190

Run Number 5 Date 3-8-79 Sampling Location Scrubber Inlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical - Beaumont　　Date 3-9-79

Sampling Location Scrubber Inlet　　Initial BCS

Test Number 5

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	180.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	68.94
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	.98
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.62
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.78
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	4714
Total sample time, minutes	θ	96
Nozzle diameter, inches	Dn	.1875
$\frac{1{,}039\ (180.5 + 460)(68.94)}{(4714)(96)(29.78)(.98)(.1875^2)}$	% I	98.8

Test #5 Scrubber Outlet

$\Delta P_{s\,avg.} = 1.593$

$T_{m\,avg} = 85.4$

$T_{s\,avg} = 180.5°$

$V_{m\,actual} = 70.543$ CF

$\Delta H_{avg} = 1.82$

$$V_{m\,std} = \frac{17.64\,(70.543)\left(30.08 + \frac{1.82}{13.6}\right)}{85.4 + 460}$$

$V_{m\,std} = 68.94$ CF

$M_s = (28.84 \times .98) + 18(1 - .98)$
$= 28.62$

$P_s = 30.08 - (4.1 \times .074)$
$= 29.78$

$$V_s = 5128.8\,(.84)(\sqrt{1.593})\sqrt{\frac{180.5 + 460}{29.78 \times 28.62}}$$

$= 4714$ fpm

ANAL 'TICAL DATA

PLANT Swift Beaumont Tx.

DATE [crossed out] 3/8/79

SAMPLING LOCATION Inlet

SAMPLE TYPE AN

RUN NUMBER 5

SAMPLE BOX NUMBER 3

CLEAN-UP MAN Rg

COMMENTS: Train disassembly 1333

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ ml

FILTER NUMBER ______ ______ ______ ______ ______ ______ — CONTAINER ______ ______ m.

FRONT HALF SUBTOTAL ______

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

ETHER-CHLOROFORM EXTRACTION ______

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

BACK HALF SUBTOTAL ______

TOTAL WEIGHT ______

MOISTURE

	#1	#2	#3	#4	#5
IMPINGERS					
FINAL VOLUME	717.3 g ~~ml~~	590.1	592.1	593.8	481.2
INITIAL VOLUME (tare + 10 cc)	578.8 g ml	591.6	589.2	588.5	~~[illegible]~~ 480.4
NET VOLUME	148.5 g ml	−1.5	2.9	5.3	0.8
SILICA GEL					
FINAL WEIGHT	683.8 g	g	g		
INITIAL WEIGHT	670.2 g	g	g		
NET WEIGHT	g	g	g		

148.5
−1.5
2.9
5.3
0.8

TOTAL MOISTURE 156.0 ml

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4-72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift

Sample Location Inlet

Sample Box No. 3

Sample Type AN

Run No. 5

Sample Date 3-8-79

Recovery Date 3-8-79

Cleanup Person RJ

Filter No.

Sample No.

Sample Material Description

MOISTURE AND/OR SAMPLE

						SILICA GEL
Impinger Sequence	1	2	3	4	5	
Impinger Type[a]	M	S	M	S	M	
Impinger Solution	H_2O	H_2O	1N H_2SO_4	1N H_2SO_4	MT	
Tare + Final Volume (wt)[b]	727.3	590.1	592.1	593.8	481.2	683.8
Tare + Initial Volume (wt)[b]	578.8	591.6	589.2	588.5	480.4	670.2
Net Volume (wt)[b]	148.5	-1.5	2.9	5.3	0.8	13.6
Sample No.(s)						

Silica Gel Color

Combined impinger contents, Sample No.

Liquid Level Marked

Container(s) Sealed

Description of Impinger Solution

Total Moisture, gm

a/ S = Greenburg-Smith standard, M = Modified, O = Other

b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No.

Liquid Level Marked

Sealed

Impinger Rinse: Sample No.

Liquid Level Marked

Sealed

Water Blank: Sample No.

Liquid Level Marked

Dry Catch: Sample No.

Description

Sealed

Acetone Blank: Sample No.

Liquid Level Marked

Sealed

Filter Blank: Sample No.

Sealed

Sample Disposition

Carrier

Date Shipped:

Remarks:

Date of laboratory custody

Personnel accepting custody

Remarks:

Seal(s) broken by

Date broken

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-8-79
Project No. 4468-LC(8)

Plant Location Beaumont, Texas
Recorded by

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test	5	Inlet Port #1	Particulate	0919	1007		
Change Ports				1007	1028		
Resume Test	5	Inlet Port #2	Particulate	1028	1116		
Test Complete				11	16		

SAMPLE HANDLING LOG

Project Number 4468-4(10)

Source Identification INLET - SCRUBBER

Test Run Number 5

Pollutant(s) in Sample AN NH_4^-

Task	Date	Time	Personnel	Remarks
Sampling	3-8-79		VOGEL / STULTZ	
Probe Technician	VOGEL			
Meter Technician	STULTZ			
Other				
Transport of Train to Cleanup Site	VOGEL	1130		
Train Disassembly	COLE			
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

C-1-2 ROTARY DRUM GRANULATOR SCRUBBER OUTLET TESTS

MIDWEST RESEARCH INSTITUTE

PROJECT DEVELOPMENT SKETCH

MRI-18

TITLE Scrubber Outlet - Swift / Beaumont, TX.

PROJECT NO. 4468-L(18) DRAWN BJ APPR. DATE 3-79

I.D. = 58.75"

$$A.S. = \frac{\pi\left(\frac{I.D.}{2}\right)^2}{144} = \frac{\pi\left(\frac{58.75}{2}\right)^2}{144} = 18.83\ ft^2$$

MIDWEST RESEARCH INSTITUTE

RUN 1

MRI Project Number 4468 L(18)
Field Dates 3-4 → 3-10
Plant SWIFT CHEMICAL
Sampling Location Scrubber Outlet
Sampling Date 3-5-79

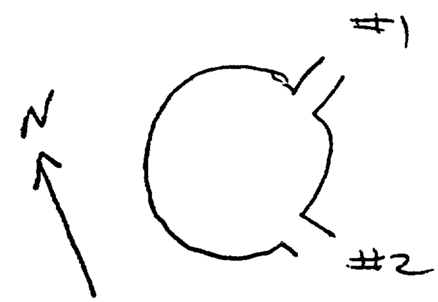
FIELD CREW

Crew Chief		Bruce DaRos
Testing Engineer	1	JEFF THOMAS
	2	
	3	
Engr. Technician	1	Mark Hansen
	2	
	3	
Lab Technician	1	RON JAMES
	2	CHRIS COLE
	3	
Process Engineer	1	
	2	
Other	1	C. SCHEIL (ANALYSIS)
	2	

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Swift Chemical
DATE 3-5-79
SAMPLING LOCATION Scrubber Outlet
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 67 1/4
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 8 1/2
STACK I.D., (DISTANCE A - DISTANCE B) 58 3/4
NEAREST UPSTREAM DISTURBANCE 72 dia
NEAREST DOWNSTREAM DISTURBANCE 7.1 dia
CALCULATOR J. Thomas



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.021	58 3/4	1 1/4	8.50	9 3/4
2	.067	↓	3 7/8	↓	12 3/8
3	.118		6 7/8		15 3/8
4	.177		10 3/8		18 7/8
5	.250		14 5/8		23 1/8
6	.356		20 7/8		29 3/8
7	.644		37 7/8		46 3/8
8	.750		44		52 1/2
9	.823		48 3/8		56 7/8
10	.882		51 7/8		60 3/8
11	.933		54 7/8		63 3/8
12	.979		57 1/2		66

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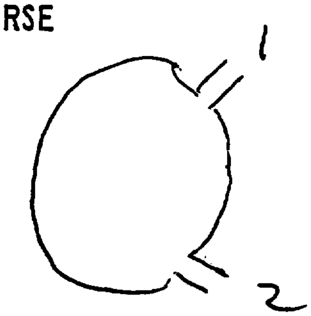
4-72

PRELIMINARY VELOCITY TRAVERSE

PLANT Swift Chemical
DATE 3-5-79
LOCATION Outlet Scrubber
STACK I.D. 58 3/4
BAROMETRIC PRESSURE, in. Hg 30.38
STACK GAUGE PRESSURE, in. H_2O
OPERATORS Thomas, Hansen

Static P = -.35



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1-1	.33	100
1-2	.39	100
1-3	.49	105
1-4	.54	105
1-5	.57	105
1-6	.56	105
1-7	.54	105
1-8	.54	105
1-9	.50	105
1-10	.49	105
1-11	.50	100
1-12	.48	105
AVERAGE	.494	103.75

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
2-1	.29	100
2-2	.39	100
2-3	.45	105
2-4	.50	105
2-5	.52	105
2-6	.52	105
2-7	.55	105
2-8	.57	105
2-9	.56	105
2-10	.55	105
2-11	.54	105
2-12	.51	105
AVERAGE	.495	104.2

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4/72

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-5-79

SAMPLING LOCATION Scrubber Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m\ avg.}$	~~80~~ ~~100~~ 80 ~~100~~
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	~~4.15~~ 7.17
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.38
STATIC PRESSURE IN STACK, in. Hg (P_m ± 0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	30.35 ~~30.12~~
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999 ~~.991~~
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	104
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.495 ~~.5~~
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.57
C FACTOR		~~1.05~~ 1.0
CALCULATED NOZZLE DIAMETER, in.		0.248
ACTUAL NOZZLE DIAMETER, in.		0.25
REFERENCE Δp, in. H_2O		~~0.46~~ 0.48

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4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical	Date 3-5-79
Sampling Location Scrubber Outlet	Initial JT
Test Number Run 1	

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	100
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.9585
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	30.38
$\frac{5.168\ (100 + 460)\ (.84)\ (5)\ (.9585)\ (.25^2)}{\sqrt{30.35}}$	K	132.11

127.39

Run Number 1	MIDWEST RESEARCH INSTITUTE	Recorded by JT
Date 3-5-79	PRELIMINARY MOISTURE DETERMINATION	Assisted by MH

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = ______ in. Hg

Average Meter Temperature, Tm = ______ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{P_m V_m}{(T_m + 460) W_m}\right]} = \text{\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

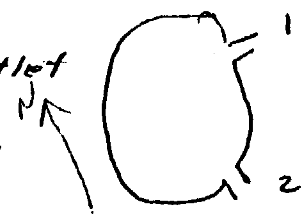
% Moisture 7.17 Basis $\% H_2O = \frac{(\text{Vapor Pres. at stack T})(\text{Rel. Humidity})}{\text{Barometric Pressure}}$

$= \frac{(2.178)(100)}{30.38}$

MRI - Form P4 (10/72)

FIELD DATA

PLANT Swift Chemical
DATE 3-5-79
SAMPLING LOCATION Scrubber Outlet
SAMPLE TYPE Particulate
RUN NUMBER 1
OPERATOR J. Thomas Darcs
AMBIENT TEMPERATURE 60°F
BAROMETRIC PRESSURE 30.38
STATIC PRESSURE, (P_s) − 0.35
FILTER NUMBER (s)



PROBE LENGTH AND TYPE
NOZZLE I.D. .25
ASSUMED MOISTURE, % 7.17
SAMPLE BOX NUMBER
METER BOX NUMBER 6
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 0.48

Leak CK: Initial at 15" Hg, CFM 0 SCHEMATIC OF TRAVERSE POINT LAYOUT
Final at Hg, CFM

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 132.11 \times \sqrt{\frac{\Delta P_x}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
1-1													
1-2													
1-3													
1-4													
1-5													
1-6													
1-7													
1-8													
1-9													
1-10													
1-11													
1-12													
Initial	0	1535	← 662.10 →		—			~~110~~	64	64		315	55
2-1	5	665.3	~~678.70~~	665.31	.35	1.4	1.4	110	65	64	2	145	
2-2	10		669.00	668.85	.45			110	71	64	2	170	
2-3	15		672.95	672.81	.50			100	76	65	3	—	
2-4	20		677.16	677.23	.57			100	78	66	5	150	
2-5	25		681.49	681.83	.60			100	82	66	5	—	
2-6	30		685.99	686.30	.65		2.8	100	84	68	5	170	
2-7	35		690.66	690.62	.70		2.7	100	84	68	5	—	
2-8	40		695.41	695.10	.73		2.9	105	85	69	6	200	
2-9	45		700.28	699.91	.76		3.1	100	88	70	6	—	
2-10	50		705.14	704.5	.73		2.8	100	92	72	5	205	

COMMENTS:

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1/72

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3		VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
		Desired	Actual		DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
2-11	55	709.84	709.21	.71		3.0	100	93	73		—	65
2-12	60	714.34	714.34	.65		3.5	102	95	75		170	65

Run Number 1 Date 3-5-79 Sampling Location Scrubber Outlet

Comments:

EPA (Dur) 236
4 72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Swift - Beaumont
Run No. (1) 3✓
Sample Location: Outlet
Sample Date: 3/5/79
Sample Box No.: 1
Recovery Date: 3/5/79
Sample Type: Ammonium Nitrate
Cleanup Person: Cole

Filter No. ____
Sample No. ____
Sample Material Description ____

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type[a]	M	S	M	S	M
Impinger Solution	H_2O	H_2O	1N H_2SO_4	1N H_2SO_4	MT
Combined Final Volume (wt) gm	224.6				
Combined Initial Volume (wt) gm	200				
Combined Net Volume (wt) gm	24.6				
Sample No.(s)					

Combined impinger contents, Sample No. ____
Liquid Level Marked ____ Container(s) Sealed ____
Description of Impinger Solution ____
Total Moisture, gm ____

SILICA GEL

722.5 ✓
777.1
?
Silica Gel Color ____

a/ S = Greenburg-Smith standard, M = Modified, O = Other ____
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ____ Liquid Level Marked ____ Sealed ____
Impinger Rinse: Sample No. ____ Liquid Level Marked ____ Sealed ____
Water Blank: Sample No. ____ Liquid Level Marked ____
Dry Catch: Sample No. ____ Description ____ Sealed ____
Acetone Blank: Sample No. ____ Liquid Level Marked ____ Sealed ____
Filter Blank: Sample No. ____ Sealed ____
Sample Disposition ____
Carrier ____ Date Shipped: ____
Remarks: ____

Date of laboratory custody ____ Seal(s) broken by ____
Personnel accepting custody ____ Date broken ____
Remarks: ____

✓ probably misread initial reading
3✓ only ½ a run completed

ANALYTICAL DATA

PLANT Swift

DATE 3/5/79

SAMPLING LOCATION Outlet

SAMPLE TYPE

RUN NUMBER 1-~~2~~

SAMPLE BOX NUMBER 1

CLEAN-UP MAN Cole

COMMENTS:

only 1/2 a run completed before.

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

~~volume~~ ~~FILTER NUMBER~~ ~~Initial~~ — CONTAINER ______ ______ mg

Initial ~~Impinger 225.~~ ~~g~~

FRONT HALF SUBTOTAL ______ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

ETHER-CHLOROFORM EXTRACTION ______ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

BACK HALF SUBTOTAL ______ mg

TOTAL WEIGHT ______ mg

MOISTURE

IMPINGERS

FINAL VOLUME	~~225~~ ml	225
INITIAL VOLUME	~~200~~ 200 ml	200
NET VOLUME	~~25~~ ml	25

SILICA GEL

FINAL WEIGHT	~~[illegible]~~ g	722.5 g	g
INITIAL WEIGHT	~~[illegible]~~ g	777.1 g	g
NET WEIGHT	g	g	g.

49 ml. extrapolated from 2-05 data run

TOTAL MOISTURE ______ g

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4/72

Initial weight of silica Gel probably misread

SAMPLING TASK LOG

Plant Swift Chemical
Date 3-5-79
Project No. 4468L-(18)

Plant Location Beaumont, TX
Recorded by J. Thomas

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Iced down & Prepared sample Box	1	Scrubber Outlet-S4	NH_4 NH_4NO_3	1430			1
Start run				1535			
Stop - inlet probe plugged				1537			
Start				1540			
Stop - Port 2				1640			
Only Port 2 was sampled							
due to upset in process.							

MIDWEST RESEARCH INSTITUTE

RUN 2

MRI Project Number 4488-L(18)
Field Dates 3-4 → 3-10
Plant Swift Chemical
Sampling Location Scrubber Outlet
Sampling Date 3-6-78

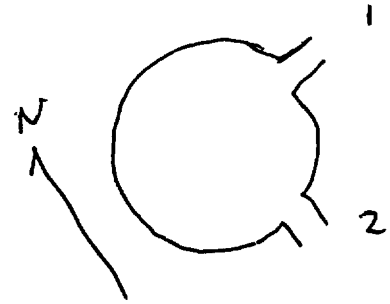
FIELD CREW

Crew Chief		Bruce DaRos
Testing Engineer	1	Jeff Thomas
	2	
	3	
Engr. Technician	1	Mark Hansen
	2	
	3	
Lab Technician	1	Ron Jones
	2	Chris Cole
	3	
Process Engineer	1	
	2	
Other	1	Scheil (Analysis)
	2	

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Swift Chemical
DATE 3-6-79
SAMPLING LOCATION Scrubber Outlet
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 67 1/4
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 8 1/2
STACK I.D., (DISTANCE A - DISTANCE B) 58 3/4
NEAREST UPSTREAM DISTURBANCE 7.2 dia.
NEAREST DOWNSTREAM DISTURBANCE 7.1 dia
CALCULATOR J. Thomas



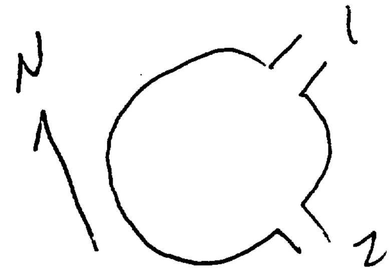
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.021	58 3/4	1 1/4	8 1/2	9 3/4
2	.067	↓	3 7/8	↓	12 3/8
3	.118		6 7/8		15 3/8
4	.177		10 3/8		18 7/8
5	.250		14 5/8		23 1/8
6	.356		20 7/8		29 3/8
7	.644		37 7/8		46 3/8
8	.750		44		52 1/2
9	.823		48 3/8		56 7/8
10	.882		51 7/8		60 3/8
11	933		54 7/8		63 3/8
12	.979		57 1/2		66

A (Dur) 232
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT Swift Chemical
DATE 3-6-79
LOCATION Scrubber Outlet
STACK I.D. 58 3/4
BAROMETRIC PRESSURE, in. Hg 30.29
STACK GAUGE PRESSURE, in. H_2O
OPERATORS J. Thomas, M. Hansen



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1-1	.35	110
-2	.45	110
3	.50	100
4	.57	100
5	.60	100
6	.65	100
7	.70	100
8	.73	105
9	.76	106
10	.73	100
11	.71	100
12	.65	100
AVERAGE	.62	100

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

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4/72

Run Number 2

Date 3-6-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by JT

Assisted by MH

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = ______ in. Hg

Average Meter Temperature, Tm = ______ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{P_m V_m}{(T_m+460)\, W_m}\right]} = \_\_\_\_\_\_ \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 6% Basis assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-6-79

SAMPLING LOCATION Scrubber Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\ avg.}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	assumed 6.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.29
STATIC PRESSURE IN STACK, in. Hg (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	30.26
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999
AVERAGE STACK TEMPERATURE, °F	$T_{s\ avg.}$	100.
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.62
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.76
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	.22	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	.32	

EPA (Dur) 234
4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical Date 3-6-79
Sampling Location Scrubber Outlet Initial JT
Test Number Run 2

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

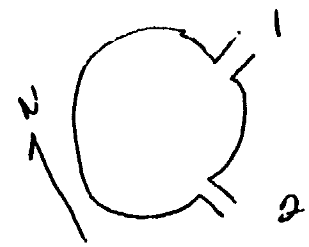
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	80
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	30.29
$\frac{5.168\ (80 + 460)\ (.84)\ (5)\ (.94)\ (.25^2)}{\sqrt{30.29}}$	K	125.12

FIELD DATA

PLANT: Swift Chemical
DATE: 3-6-79
SAMPLING LOCATION: Scrubber Outlet
SAMPLE TYPE: Particulate
RUN NUMBER: 2
OPERATOR: JT · MH
AMBIENT TEMPERATURE:
BAROMETRIC PRESSURE: 30.29
STATIC PRESSURE, (P_s): − 0.35
FILTER NUMBER (s):



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE:
NOZZLE I.D.: .25
ASSUMED MOISTURE, %: 6
SAMPLE BOX NUMBER:
METER BOX NUMBER: 6
METER $\Delta H_@$: 1.84
C FACTOR: 1.0
PROBE HEATER SETTING:
HEATER BOX SETTING:
REFERENCE Δp: .32

Leak CK: Initial at 15" Hg, CFM .003
Final at Hg, CFM .003

READ AND RECORD ALL DATA EVERY 5 MINUTES

$$VM = 1251.2 \times \sqrt{\frac{\Delta P_s}{T_s + 460}}$$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0939.44		714.41					60	62		200	
1-1	5	0944 49	717.52	716.82	.35	.71 1.3	.71 1.3	105	62	62	<1	190	
1-2	10	0949 54	720.26	719.67	.43	.88 1.6	.88 1.6	110	66	64	<1	200	
1-3	15	09 59	723.30	722.81	.49	.98 1.9	1.0 1.9	122	68	64	<1	210	
1-4	20	1004	726.50	726.12	.51	1.0 1.9	1.3 1.9	125	70	65	1	200	
1-5	25	1009	729.96	729.68	.55	1.1 2.1	1.4 2.1	125	75	67	1	210	
1-6	30	1014	733.55	733.20	.56	1.2 2.1	1.3 2.1	125	75	68	2	210	
1-7	35	1019	736.95	737.14	.53	1.0 2.0	1.3 2.0	130	76	68	2	220	68
1-8	40	1024	740.85	740.63	.51	1.0 1.9	1.0 1.9	120	78	70	1	225	65
1-9	45	1029	744.56	744.61	.51	1.0 1.9	1.3 1.9	120	78	71	1	215	64
1-10	50	1034	748.58	748.79	.58	1.2 2.3	1.4 2.3	115	80	72	1	180	64
1-11	55	1039	752.66	752.56	.55	1.1 2.1	1.3 2.1	115	80	72	1	190	64
1-12	60	1044	756.18	756.36	.48	.98 1.9	1.3 1.9	115	82	74	1	175	61
INIT.	0	1104		756.36					72	72			
2-1	5	1109	760.82	759.52	.35 .68	.71 1.3	.71 1.3	100	70	72	<1	150	
2-2	10	1114	762.96	763.24	.43	.88 1.6	1.4 1.6	110	74	72	1	160	
2-3	15	1119	766.88	766.72	.49	.98 1.8	1.4 1.8	120	79	74	1		
2-4	20	1124	770.54	770.27	.54	1.1 2.1	1.3 2.1	118	79	74	1		
2-5	25	1129	774.16	774.32	.56	1.2 2.2	1.5 2.2	120	80	76	2		
2-6	30	1134	778.30	778.30	.60	1.2 2.4	1.5 2.4	116	82	76	2	180	58
2-7	35	1139	782.41	782.10	.62	1.2 2.4	1.5 2.4	115	82	76	2		58
2-8	40	1144	786.25	786.26	.63	1.2 2.4	1.4 2.4	112			2		58
2-9	45	1149	790.93	790.78	.62	2.8	2.8	115	83	70	8		59
2-10	50	1154	794.86	795.51	.61	2.6	2.8	115	85	77	6		60

NOTE

COMMENTS:

EPA (Dur) 235

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3		VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
			Desired	Actual		DESIRED	ACTUAL		INLET $(T_{m\,in})$, °F	OUTLET $(T_{m\,out})$, °F			
2-11	55	1159	799.51	799.49	.59	2.4	2.4	117	83	76	3		60
2-12	60	1204	803.32	803.44	.54	2.1	2.3	115	82	78	3		58
					.53		2.05	117					

Run Number 2

Date 3-6-79

Sampling Location Scrubber Outlet

Comments:

EPA (Dur) 236
4/72

ISOKINETIC PERFORMANCE WORKSHEET

Plant SWIFT CHEMICAL Date 3-6-79
Sampling Location Scrubber Outlet Initial JT
Test Number Run 2

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	117
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	88.53
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.19
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	30.26
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	~~2121.51~~ 2120.21
Total sample time, minutes	θ	120
Nozzle diameter, inches	Dn	.25
$\frac{1{,}039\ (117 + 460)(88.53)}{(\text{~~2121.51~~ } 2120.21)(120)(30.26)(.94)(.25^2)}$	% I	117.33

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift Beaumont Tx. Run No. (2)
Sample Location Outlet Sample Date 3/6/79
Sample Box No. 1 Recovery Date 3/6/79
Sample Type Ammonium Nitrate Cleanup Person Cole

Filter No. ________
Sample No. ________
Sample Material Description ________

MOISTURE AND/OR SAMPLE — SILICA GEL

						Silica Gel
Impinger Sequence	1	2	3	4	5	
Impinger Type[a]	M	S	M	S	M	
Impinger Solution	H_2O	H_2O	$1N\ H_2SO_4$	$1N\ H_2SO_4$	$1N\ H_2SO_4$	
Combined Final Volume (wt)[b]	255.3					741.3
Combined Initial Volume (wt)[b]	200					722.5
Combined Net Volume (wt)[b]	55.3					18.8
Sample No.(s)						

Silica Gel Color ________

Combined impinger contents, Sample No. ________
Liquid Level Marked ________ Container(s) Sealed ________
Description of Impinger Solution ________
Total Moisture, gm 74.1

a/ S = Greenburg-Smith standard, M = Modified, O = Other ________
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ________
Liquid Level Marked ________
Sealed ________

Impinger Rinse: Sample No. ________
Liquid Level Marked ________
Sealed ________

Water Blank: Sample No. ________
Liquid Level Marked ________

Dry Catch: Sample No. ________
Description ________
Sealed ________

Acetone Blank: Sample No. ________
Liquid Level Marked ________
Sealed ________

Filter Blank: Sample No. ________
Sealed ________

Sample Disposition ________
Carrier ________ Date Shipped: ________
Remarks: ________

Date of laboratory custody ________ Seal(s) broken by ________
Personnel accepting custody ________ Date broken ________
Remarks: ________

ANAL 'TICAL DATA

PLANT Swift

DATE 3/6/79

SAMPLING LOCATION ~~Beaumont Tx~~ Outlet

SAMPLE TYPE Ammonium Nitrate

RUN NUMBER 2

SAMPLE BOX NUMBER 1

CLEAN-UP MAN C. Cole

COMMENTS:

FRONT HALF

LABORATORY [illegible]

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______

FILTER NUMBER ______ ______ — CONTAINER ______ ______ m

______ ______

______ ______

FRONT HALF SUBTOTAL ______

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

ETHER-CHLOROFORM EXTRACTION ______

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

BACK HALF SUBTOTAL ______

TOTAL WEIGHT ______

MOISTURE

IMPINGERS

FINAL VOLUME ______ ml

INITIAL VOLUME ______ ml

NET VOLUME ______ ml

SILICA GEL			
FINAL WEIGHT	~~[illegible]~~ g	741.3 g	______ g
INITIAL WEIGHT	~~[illegible]~~ g	722.5 g	______ g
NET WEIGHT	~~[illegible]~~ g	18.8 g	______ g

TOTAL MOISTURE ______

EPA (Dur) 231
4-72

SAMPLING TASK LOG

Plant Swift Chemical Company

Date 3-6-79

Project No. 4468-L(18)

Plant Location Beaumont, Texas

Recorded by

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Pre-Test Leak Check	2	Scrubber Outlet		0930			
Begin Test (Probe thermocouple doesn't function)	2	Scrubber Outlet Port #1	NH_4, NH_3, NO_2	0944	1044		
Change Ports	2			1044	1104		
Resume Test (Sample box thermocouple doesn't function)	2	Scrubber Outlet Port #2	NH_4, NH_3, NO_2	1104	1204		
Test Complete	2			12	04		
Post Test Leak check	2			1215			
(Meter leak test was performed using field lab console)							

MIDWEST RESEARCH INSTITUTE

RUN 3

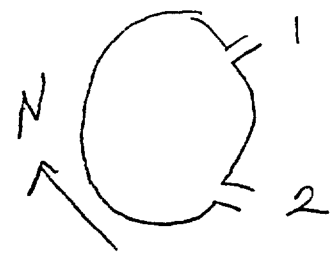
MRI Project Number 4468-C(18)
Field Dates 3-4,9-1979
Plant SWIFT CHEM.
Sampling Location SCRUBBER-OUT
Sampling Date 3-7-79

FIELD CREW

Crew Chief		R.C. DaRos
Testing Engineer	1	J. THOMAS
	2	
	3	
Engr. Technician	1	R.C. DaRos
	2	C. COLE
	3	
Lab Technician	1	C COLE
	2	R. JONES
	3	
Process Engineer	1	T. CURTIN (GCA)
	2	
Other	1	G. SCHEIL (ANALYSIS)
	2	

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Swift Chemical
DATE 3-7-79
SAMPLING LOCATION Scrubber Outlet
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 67 1/4
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 8 1/2
STACK I.D., (DISTANCE A - DISTANCE B) 58 3/4
NEAREST UPSTREAM DISTURBANCE 7 2 dia
NEAREST DOWNSTREAM DISTURBANCE 7.1 dia
CALCULATOR JT



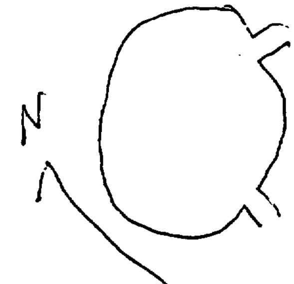
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1 8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
	— SEE RUN 2 DATA —				

PA (Dur) 232
4 72

PRELIMINARY VELOCITY TRAVERSE

PLANT Swift Chemical
DATE 3-7-79
LOCATION Scrubber Outlet
STACK I.D. 58¾
BAROMETRIC PRESSURE, in. Hg 30.10
STACK GAUGE PRESSURE, in. H_2O
OPERATORS JT BD



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
		T_s
Avg.	ΔP &	
		from
	taken	
		DATA
	RUN 2	
AVERAGE	.53	117

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4 72

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Run Number 3
Date 3-7-79

Recorded by JT
Assisted by MH

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = ______ in. Hg

Average Meter Temperature, Tm = ______ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{P_m V_m}{(T_m+460)\, W_m}\right]} = \text{\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 5 Basis ASSUMED

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-7-79

SAMPLING LOCATION Scrubber Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m\,avg.}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	50 assumed
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.10
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	~~29.84~~ 30.07
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	~~.991~~ 1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	117
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.53
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.63
C FACTOR		1.0
CALCULATED NOZZLE DIAMETER, in.		.24
ACTUAL NOZZLE DIAMETER, in.		.25
REFERENCE Δp, in. H_2O		~~.45~~ .48

EPA (Dur) 234
4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical Date 3-7-79
Sampling Location Scrubber Outlet Initial JT
Test Number Run 3

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

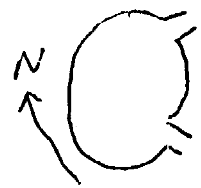
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	80
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	30.10
$\frac{5.168\ (80 + 460)\ (.84)\ (5)\ (.95)\ (.25^2)}{\sqrt{30.10}}$	K	126.85

FIELD DATA

PLANT Swift Chemical
DATE 3-7-79
SAMPLING LOCATION Scrubber Outlet
SAMPLE TYPE Particulate
RUN NUMBER 3
OPERATOR JT
AMBIENT TEMPERATURE 60°
BAROMETRIC PRESSURE 30.10
STATIC PRESSURE, (P_s) -0.35
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 7'
NOZZLE I.D. .25
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER
METER BOX NUMBER 6
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING 8
HEATER BOX SETTING
REFERENCE Δp .45

Leak CK: Initial at 15" Hg, CFM .001
Final at Hg, CFM .001

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 126.85 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1030	803.64						64	64		195	
1-1	5	1035	806.53	806.46	.29	1.2	1.2	100	65	66	4	225	
1-2	10	1040	809.79	809.66	.39	1.4	1.5	100	69	66	5	210	
1-3	15	1045	813.18	813.19	.40	1.6	1.8	100	71	67	7	225	
1-4	20	1050	816.74	816.81	.44	1.7	1.8	100	72	68	7	225	
1-5	25	1055	820.38	820.43	.46	1.8	1.8	100	73	68	7	240	
1-6	30	1100	824.05	824.05	.47	1.8	1.7	100	74	69	7	230	
1-7	35	1105	827.65	827.53	.45	1.8	1.8	100	75	70	7	210	62
1-8	40	1110	831.17	831.09	.43	1.7	1.8	100	74	70	7	245	63
1-9	45	1115	834.71	834.72	.44	1.7	1.9	105	76	70	7	235	62
1-10	50	1120	838.21	838.35	.44	1.7	1.8	100	76	71	7	220	64
1-11	55	1125	841.71	841.83	.43	1.7	1.7	105	76	72	7	185	
1-12	60	1130	845.06	845.17	.39	1.5	1.5	100	76	72	6	180	
Initial	0	1138	845.17						73	70			
2-1	5	1143	847.90	847.89	.26	1.0	1.0	100	72	72	4	120	
2-2	10	1148	851.07	850.95	.35	1.4	1.4	100	74	72	5	140	
2-3	15	1153	854.24	854.28	.35	1.4	1.6	100	77	72	6	140	
2-4	20	1158	857.59	857.66	.39	1.5	1.6	100	78	73	6	140	
2-5	25	1203	861.06	860.99	.42	1.7	1.6	100	79	74	6	145	66
2-6	30	1208	864.66	864.57	.45	1.8	1.9	100	80	75	7	140	63
2-7	35	1213	868.33	868.27	.47	1.8	1.9	100	80	76	7	140	63
2-8	40	1218	872.04	872.02	.45	1.9	2.0	100	80	76	7	145	65
2-9	45	1223	875.68	875.74	.46	1.8	1.9	100	81	76	8	140	64

COMMENTS:

EPA (Dur) 235
1/72

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3		VELOCITY HEAD (Δp_s), in H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
			Desired	Actual		DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F			
2-10	50	1228	879.35	874.45	.47	1.8	1.9	100	82	77	7	62	
2-11	55	1233	882.95	882.97	.45	1.9	1.8	100	82	77	7	60	
2-12	60	1238	886.25	886.18	.38	1.5	1.4	100	82	78	6	63	
LEAK CHECK													
					.41		1.68	100					

Run Number 3

Date 3-7-79

Sampling Location Scrubber Outlet

Comments:

EPA (Dur) 236
4 72

~~875.68~~

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical

Date 3-7-79

Sampling Location Scrubber Outlet

Initial JT

Test Number Run 3

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	100
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	81.49
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.95
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.30
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	30.07
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2237.2
Total sample time, minutes	θ	120
Nozzle diameter, inches	Dn	.25
1,039 (100 + 460)(81.49) / (~~.95~~)(~~28.84~~)(~~28.30~~)(~~30.07~~)(²) (2237.2)(120)(30.07)(.95)(.25²)	% I	98.9

ANAL 'TICAL DATA

PLANT Swift Beaumont Tx.

DATE 3/6/79

SAMPLING LOCATION Outlet

SAMPLE TYPE

RUN NUMBER 3

SAMPLE BOX NUMBER 1

CLEAN-UP MAN Cole

COMMENTS:

Time began cleanup 2:50

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

FILTER NUMBER ______ ______ — CONTAINER ______ ______ mg

FRONT HALF SUBTOTAL ______

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

ETHER-CHLOROFORM EXTRACTION ______

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______

BACK HALF SUBTOTAL ______

TOTAL WEIGHT ______

MOISTURE

	#1	#2	#3	#4	#5	
IMPINGERS						
FINAL ~~VOLUME~~ wt	640.7 g	596.2	580.1	591.8	482.8	33.2
100ml + INITIAL ~~VOLUME~~ wt	607.5 g	589.0	577.2	588.2	479.3	7.2
NET VOLUME	33.2 g	7.2g	2.9	3.6	3.5	2.9
						3.6
						5.5
SILICA GEL						
FINAL WEIGHT	~~[illegible]~~ g	743.5 g	g			
INITIAL WEIGHT	~~[illegible]~~ g	719.3 g	g			
NET WEIGHT	~~[illegible]~~ g	24.2 g	g			

TOTAL MOISTURE 52.4

EPA (Dur) 231
4/72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift Beaumont, Tx. | Run No. (3)
Sample Location Outlet | Sample Date 3/7/79
Sample Box No. 1 | Recovery Date
Sample Type Ammonium Nitrate | Cleanup Person

Filter No.
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type[a]	M	S	M	S	M
Impinger Solution	H_2O	H_2O	1N H_2SO_4	1N H_2SO_4	MT
Final Volume (wt)[b] gm					
Initial Volume (wt)[b] gm	100	100	100	100	100
Net Volume (wt)[b] gm					
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm

SILICA GEL

719.3

Silica Gel Color

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No.
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

Acetone Blank: Sample No.
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier
Remarks: Date Shipped:

Date of laboratory custody
Personnel accepting custody Seal(s) broken by
Remarks: Date broken

SAMPLING TASK LOG

Plant SWIFT CHEMICAL
Date 3-7-79
Project No. 4468 L(18)

Plant Location Beaumont, TX
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Leak Check Initial	3	Scrubber Outlet	NH_4 NH_3NO_3	1010			
	3	Port 1 - Scrubber Outlet	"	1030	1130	60	Run 3
Port Change	3	Port 2 - Scrubber Outlet	"	1138	1238	60	Run 3
Therm. in sample box does	3		"				
not seem to be funct. properly							
on port II. Box does feel							
hot and is probably actually							
at a higher temp. than							
indicated on data sheet.							
Leak Check - final	3	Scrubber outlet	"	1245			

SAMPLE HANDLING LOG

Project Number 4468 L (18)

Source Identification Scrubber Outlet

Test Run Number 3

Pollutant(s) in Sample NH_4 NH_3NO_3

Task	Date	Time	Personnel	Remarks
Sampling	3-7-79	1030 - 1238	Thomas, DaRos Cole	
Probe Technician			DaRos, ~~Riley~~ Cole	
Meter Technician			Thomas	
Other				
Transport of Train to Cleanup Site	3-7-79	1250	Thomas	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN 4

MRI Project Number 4468 L-(18)
Field Dates
Plant Swift Chemical
Sampling Location Scrubber Outlet
Sampling Date 3-7-79

FIELD CREW

Crew Chief		DaRos
Testing Engineer	1	Thomas
	2	
	3	
Engr. Technician	1	Daros, Riley
	2	
	3	
Lab Technician	1	COLE
	2	JONES
	3	
Process Engineer	1	
	2	
Other	1	SCHEIL (ANALYSIS)
	2	

MRI - Form PO (10/72)

Run Number 4

Date 3-7-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by JT

Assisted by BD GR

NOTE: Same as Run No. _____

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = _____ in. Hg

☐ Barometer Location _____

Reading Time _____ by _____

☐ Elevation _____

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = _____ in. Hg

Average Meter Temperature, T_m = _____ °F

Total Weight of Moisture Collected, $W_c + W_a = W_m$ = _____ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \dfrac{P_m V_m}{(T_m + 460) W_m}\right]} = \_\_\_\_\_ \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = _____ °F

Wet Bulb Temperature = _____ °F

Moisture Content (from Ref. Table) = _____ % by Volume

C. Predetermined Value

% Moisture 5 Basis ASSUMED

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-7-79

SAMPLING LOCATION Scrubber Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5.0 Assumed
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.10
STATIC PRESSURE IN STACK, in. Hg (P_m±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	30.07
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	117
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.53
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.63
C FACTOR		1.0
CALCULATED NOZZLE DIAMETER, in.		.24
ACTUAL NOZZLE DIAMETER, in.		.25
REFERENCE Δp, in. H_2O		.48

EPA (Dur) 234
4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical Date 3-7-79
Sampling Location Scrubber Outlet Initial JT
Test Number Run 4

Isokinetic sampling equation:

$$Vm_i = K\sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where: $$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

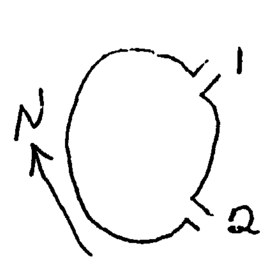
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	80
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	30.10
$\frac{5.168\ (80 + 460)\ (.84)\ (5)\ (.95)\ (.25^2)}{\sqrt{30.10}}$	K	126.85

FIELD DATA

PLANT Swift Chemical
DATE 3-1-79
SAMPLING LOCATION Scrubber Outlet
SAMPLE TYPE Particulate
RUN NUMBER 4
OPERATOR JT
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 30.10
STATIC PRESSURE, (P_s) − 0.35
FILTER NUMBER (s) ~



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 7'
NOZZLE I.D. .25
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER
METER BOX NUMBER 6
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp .48

Leak CK: Initial at 15" Hg, CFM .002
Final at Hg, CFM ~~.018~~ .023

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 1.2685 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ — 887.96 — Desired	Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1501											
1-1	5	1506	890.93	889.96	~~.35~~ [.31]	~~1.4~~ [1.2]	~~1.4~~ [1.2]	105	77	77	2	155	
1-2	10	1511	894.31	893.78	.40	1.6	1.8	105	83	77	2	140	
1-3	15	1516	897.99	897.92	.48	1.9	2.2	110	85	78	3	170	
1-4	20	1521	901.75	901.84	.50	1.9	2.1	110	88	78	3	130	
1-5	25	1526	905.58	905.68	.52	2.0	2.1	110	86	80	3	140	
1-6	30	1531	909.37	909.33	.51	2.0	1.9	110	84	78	3	135	
1-7	35	1536	913.09	913.09	.49	1.9	2.0	110	84	78	3	130	62
1-8	40	1541	916.92	916.83	.52	2.0	2.0	110	85	80	3	135	
1-9	45	1546	920.68	920.70	.50	1.9	2.1	110	86	79	3	140	64
1-10	50	1551	924.44	924.47	.50	1.9	2.0	110	86	79	3	140	
1-11	55	1556	928.12	928.19	.48	1.9	2.0	110	85	80	3	130	64
1-12	60	1601	931.64	931.67	.44	1.7	1.7	110	84	78	3	130	
Initial	0	1605	931.67 ~~913.67~~										
2-1	5	1610	934.58 ~~916.85~~	934.58	.30	1.2	1.2	110	79	78	2	155	
2-2	10	1615	937.90	937.79	.39	1.5	1.6	110	82	78	2	180	
2-3	15	1620	941.38	941.40	.43	1.7	1.9	110	84	78	2	130	
2-4	20	1625	945.06	945.09	.48	1.9	1.9	110	84	78	2	140	
2-5	25	1630	948.78	948.83	.49	1.9	2.0	110	84	78	2	130	
2-6	30	1635	952.55	952.49	.50	1.9	1.9	105	84	77	2	175	64
2-7	35	1640	956.49	956.45	.55	2.2	2.2	110	84	77	3	150	
2-8	40	1645	960.47	960.49	.56	2.2	2.3	110	84	76	3	120	62
2-9	45	1650	964.45	964.42	.56	2.2	2.2	110	83	76	3	140	76

COMMENTS:

EPA (Dur) 235
4/72

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
2-10	50	1655	968.37	968.45	.54	2.2	2.3	105	83	76	4	150	
2-11	55	1700	972.31	972.48	.55	2.1	2.3	110	83	77	4	135	80
2-12	60	1705	976.16	976.11	.52	2.0	1.9	105	83	77	3	150	
Leak Check													
					.48		1.95	109					

Run Number 4

Date 3-7-79

Sampling Location Scrubber Outlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical

Sampling Location Scrubber Outlet

Test Number Run 4

Date 3-7-79

Initial JT

Isokinetic equation:

$$\% \ I = \frac{1,039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	109
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	87.09
Mole fraction dry gas, $\frac{100-\% \ H_2O}{100}$	Mf	.95
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.30
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	30.07
Stack velocity, fpm $5,128.8 \ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2441.57
Total sample time, minutes	θ	120
Nozzle diameter, inches	Dn	.25
1,039 (109 + 460)(87.09) / (2441.57)(120)(30.07)(.95)(.25 2)	% I	98.4

ANAL'TICAL DATA

PLANT Swift Beaumont Tx.

DATE 3/7/79

SAMPLING LOCATION Outlet

SAMPLE TYPE Ammonium Nitrate

RUN NUMBER 4

SAMPLE BOX NUMBER

CLEAN-UP MAN Cole

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

FILTER NUMBER ______ ______ — CONTAINER ______ ______ mg

FRONT HALF SUBTOTAL ______ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

ETHER-CHLOROFORM EXTRACTION ______ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______ ______ mg

BACK HALF SUBTOTAL ______ mg

TOTAL WEIGHT ______

MOISTURE

IMPINGERS	#1	#2	#3	#4	#5
FINAL VOLUME (ml)	619.9	607.1	584.5	600.7	461.7
INITIAL VOLUME (ml)	572.7	595.5	584.1	593.3	459.4
NET VOLUME (ml)	47.2	11.6	0.4	7.4	2.3

SILICA GEL			
FINAL WEIGHT	703.3 g	g	g
INITIAL WEIGHT	679.1 g	g	g
NET WEIGHT	24.2 g	g	g

47.2
11.6
0.4
7.4
2.3
69.9

TOTAL MOISTURE 69.9

EPA (Dur) 231
4/72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift Beaumont Tx. Run No. (4)
Sample Location Outlet Sample Date 3/2/79
Sample Box No. 7 Recovery Date
Sample Type Ammonium Nitrate Cleanup Person

Filter No.
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE | SILICA GEL

						Silica Gel	
Impinger Sequence	1	2	3	4	5		
Impinger Type[a/]	M	S	M	S	M		
Impinger Solution	H_2O	H_2O	$1N\ H_2SO_4$	$1N\ H_2SO_4$	MT		
Final Volume (wt)[b/]							
Initial Volume (wt)[b/]	100	100	100	100	100	671.1	
Net Volume (wt)[b/]							
Sample No.(s)							

Combined impinger contents, Sample No.
Silica Gel Color
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No.
Liquid Level Marked
Sealed
Impinger Rinse: Sample No.
Liquid Level Marked
Sealed
Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed
Acetone Blank: Sample No.
Liquid Level Marked
Sealed
Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

Date of laboratory custody Seal(s) broken by
Personnel accepting custody Date broken
Remarks:

SAMPLING TASK LOG

Plant Swift Chemical
Date 3-7-79
Project No. 4468 L-(18)

Plant Location Beaumont, TX
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
INITIAL - Leak Check	4	Scrubber Out	AN	1445			
Sample	4	Port 1 "	"	1501	1601	60	Run 4
Sample	4	Port 2	"	1605	1705	60	Run 4
FINAL - Leak Check				1710			

SAMPLE HANDLING LOG

Project Number 4468-L (18)

Source Identification Scrubber Outlet

Test Run Number 4

Pollutant(s) in Sample AN

Task	Date	Time	Personnel	Remarks
Sampling	3-7-79	1501 - 1705	Thomas, DaRos Riley	
Probe Technician	3-7	1501-1705	DaRos, Riley	
Meter Technician	3-7		Thomas	
Other				
Transport of Train to Cleanup Site	3-7	1750	Riley	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN 5

MRI Project Number 4468 L-(18)
Field Dates
Plant Swift Chemical
Sampling Location Scrubber Outlet
Sampling Date 3-8-79

FIELD CREW

Crew Chief DaRos

Testing Engineer 1 Thomas
2
3

Engr. Technician 1 Hansen
2
3

Lab Technician 1 C. Cole
2 R. Jones
3

Process Engineer 1 T Curlin GCA
2

Other 1 G. Scheil (analysis)
2

MRI - Form PO (10/72)

Run Number 5

Date 3-8-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by JT

Assisted by MH

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading (cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx P_m$ = ______ in. Hg

Average Meter Temperature, Tm = ______ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{P_m V_m}{(T_m+460)\, W_m}\right]} = \text{\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 4 Basis calculated from Run 4

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-8-79

SAMPLING LOCATION Scrubber Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	4
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.08
STATIC PRESSURE IN STACK, in. Hg (P_m ± 0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	30.05
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	109
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.48
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.56
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	.48	

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4/72

ISOKINETIC SAMPLING WORKSHEET

Plant Swift Chemical
Sampling Location Scrubber Outlet
Test Number Run 5

Date 3-8-79
Initial JT

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

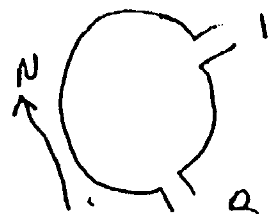
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	80
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.96
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	30.08
$\frac{5.168\ (80 + 460)\ (.84)\ (5)\ (.96)\ (.25^2)}{\sqrt{30.08}}$	K	128.23

FIELD DATA

PLANT Swift Chemical
DATE 3-8-79
SAMPLING LOCATION Scrubber Outlet
SAMPLE TYPE Particulate
RUN NUMBER 5
OPERATOR JT
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 30.08
STATIC PRESSURE, (P_s) -0.35
FILTER NUMBER (s) —



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 7'
NOZZLE I.D. .25
~~ASSUMED~~ MOISTURE, % 4
SAMPLE BOX NUMBER
METER BOX NUMBER 6
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

Leak CK: Initial at 15" Hg, CFM .005
Final at Hg, CFM .007

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 128.23 \times \sqrt{\dfrac{\Delta P_s}{Ts + 460}}$

PROBE TEMP ∴ 100°F

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³ 976.65 Desired	Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0911											
1-1	5	0916	980.12	979.94	.43	1.7	1.7	105	65	62	3	75	
1-2	10	0921	983.90	983.69	.50	1.9	2.1	115	70	62	4	75	
1-3	15	0926	987.99	987.74	.58	2.2	2.4	110	75	63	5	72	
1-4	20	0931	992.29	992.12	.64	2.4	2.7	110	80	64	7	72	
1-5	25	0936	996.75	996.91	.69	2.7	3.0	110	85	66	8	70	
1-6	30	0941	1.15	1.33	.67	2.6	2.6	110	90	70	7	73	
1-7	35	0946	5.45	5.45	.64	2.4	2.4	110	91	72	6	70	56
1-8	40	0951	9.71	9.46	.63	2.4	2.4	112	91	74	5	65	54
1-9	45	0956	14.01	13.83	.64	2.4	2.6	110	94	78	6	65	54
1-10	50	1001	18.27	18.21	.65	2.4	2.6	110	94	78	6	70	54
1-11	55	1006	22.34	22.43	.58	2.2	2.4	115	96	80	6	65	55
1-12	60	1011	26.21	26.13	.52	2.0	2.0	110	96	80	4	70	55
Initial	0	1023	26.13										
2-1	5	1028	29.47	29.26	.39	1.5	1.5	115	78	78	2	75	
2-2	10	1033	33.14	33.03	.47	1.8	2.0	115	82	77	4	75	
2-3	15	1038	37.11	37.09	.55	2.1	2.3	115	89	77	5	78	
2-4	20	1043	41.13	41.12	.57	2.2	2.4	120	92	78	6	80	
2-5	25	1048	45.29	45.32	.61	2.3	2.4	120	96	79	6	80	
2-6	30	1053	49.48	49.42	.62	2.3	2.4	120	95	80	6	80	
2-7	35	1058	53.84	53.81	.67	2.6	2.8	120	98	80	7	85	54
2-8	40	1103	58.33	58.30	.71	2.8	2.9	100	100	82	7	81	56
2-9	45	1107	62.95	62.85	.92	2.8	3.0	120	101	84	7	85	57

COMMENTS:

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TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
2-10	50	1112	67.30	67.26	.70	2.7	2.7	120	101	85	6	85	58
2-11	55	1118	71.75	71.70	.70	2.7	2.9	120	101	84	7	85	58
2-12	60	1123	75.98	76.04	.63	2.4	2.6	120	102	86	6	85	59
Leak Check					.60		2.45	115					

Run Number 5

Date 3-8-79

Sampling Location Scrubber Outlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant *Swift Chemical* Date *3-8-79*

Sampling Location *Scrubber Outlet* Initial *JJ*

Test Number *Run 5*

Isokinetic equation:

$$\% \ I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	*115*
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	*98.25*
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	*.96*
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	*28.84*
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	*28.41*
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	*30.05*
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	*2738.72*
Total sample time, minutes	θ	*120*
Nozzle diameter, inches	Dn	*.25*
$\frac{1{,}039\ (115 + 460)(98.25)}{(2738.72)(120)(30.05)(.96)(.25^2)}$	% I	*99*

ANA[illegible]TICAL DATA

PLANT Swift Beaumont Tx.

DATE 3/8/79

SAMPLING LOCATION outlet

SAMPLE TYPE AN

RUN NUMBER 5

SAMPLE BOX NUMBER 2

CLEAN-UP MAN Cole

COMMENTS:

FRONT HALF

LA[illegible]

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ______

FILTER NUMBER ______ ______ — CONTAINER ______

FRONT HALF SUBTOTAL ______

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______

ETHER-CHLOROFORM EXTRACTION ______

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ______

BACK HALF SUBTOTAL ______

TOTAL WEIGHT ______

MOISTURE

IMPINGERS	#1	#2	#3	#4	#5	
						161.0
FINAL VOLUME (ml)	668.5	598.5	581.3	588.4	481.8	9.6
INITIAL VOLUME (ml) (tare + 100 +)	507.5	588.9	577.3	588.1	479.7	4.0
NET VOLUME (ml)	161.0	9.6	4.0	0.3	2.1	0.3
						2.1
						177.0

SILICA GEL			
FINAL WEIGHT	737.4 g	______ g	______ g
INITIAL WEIGHT	714.9 g	______ g	______ g
NET WEIGHT	22.5 g	______ g	______ g

TOTAL MOISTURE 177.0 ml

EPA (Dur) 231
4/72

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Swift
Sample Location: Bo Outlet
Sample Box No.: 2
Sample Type: AN

Run No.: 5
Sample Date: 3-8-79
Recovery Date: 3-8-79
Cleanup Person: Cole

Filter No. ____ ____ ____
Sample No. ____ ____ ____
Sample Material Description ____

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5	SILICA GEL
Impinger Type[a]	M	S	M	S	M	
Impinger Solution	H_2O	H_2O	H_2SO_4	H_2SO_4	MT	
Final Volume (wt)[b]	668.5	598.5	581.3	588.4	481.9	737.4
Initial Volume (wt)[b]	507.5	588.9	577.3	588.1	479.7	714.9
Net Volume (wt)[b]	161.0	09.6	4.0	0.3	2.1	22.5
Sample No.(s)						

Combined impinger contents, Sample No. ____
Liquid Level Marked ____ Container(s) Sealed ____
Silica Gel Color ____
Description of Impinger Solution ____
Total Moisture, gm ____

a/ S = Greenburg-Smith standard, M = Modified, O = Other ____
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ____
Liquid Level Marked ____
Sealed ____

Impinger Rinse: Sample No. ____
Liquid Level Marked ____
Sealed ____

Water Blank: Sample No. ____
Liquid Level Marked ____

Dry Catch: Sample No. ____
Description ____
Sealed ____

Acetone Blank: Sample No. ____
Liquid Level Marked ____
Sealed ____

Filter Blank: Sample No. ____
Sealed ____

Sample Disposition ____
Carrier ____ Date Shipped: ____
Remarks: ____

Date of laboratory custody ____ Seal(s) broken by ____
Personnel accepting custody ____ Date broken ____
Remarks: ____

SAMPLING TASK LOG

Plant Swift Chemical
Date 3-8-79
Project No. 4468 L (18)

Plant Location Beaumont, TX
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Initial - Leak Check	5	Scrubber Outlet	AN	0850			
Sample	5	Port 1	AN	0911	1011	60	Run 5
Sample	5	Port 2	AN	1023	1123	60	Run 5
Final - Leak Check	5		AN	1130			
Moisture acum. on rear end							
of probe when set on 100°F							
Port 1. Temp. increased to							
130°F on port 2.							

C-2 ROTARY DRUM COOLER TESTS

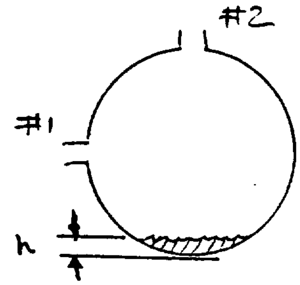
C-2-1 ROTARY DRUM COOLER UNCONTROLLED OUTLET TESTS

TITLE Outlet - Rotary Drum Cooler - Swift / Beaumont, TX.

PROJECT NO. 4468 - C (18) DRAWN [illegible] APPR. DATE 3-79

Port 1 = 27.75"
Port 2 = 26.00"

$$\frac{\pi\left(\frac{27.75 + 26.00}{4}\right)^2}{144} = 3.939 \text{ ft}^2$$



Corrected duct area:

Test No RDC-1 h = 1.75"

3.939 - .102 = 3.837 ft²

Tests Nos RDC-2 and 3 h = 2.5"

3.939 - .187 = 3.752 ft²

MIDWEST RESEARCH INSTITUTE

RUN 1

MRI Project Number 4468-C(18)
Field Dates 3-4, 9- 1979
Plant SWIFT CHEM.
Sampling Location RDC - OUTLET
Sampling Date 3-8-79

FIELD CREW

Crew Chief B.C. DuRoss

Testing Engineer
1 B.C. DuRoss
2
3

Engr. Technician
1 J. THOMAS
2 D. VOGEL
3

Lab Technician
1 C. COLE
2 R. JONES
3

Process Engineer
1 T. CURTIN (GCA)
2

Other
1 G. SCHEIL
2

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

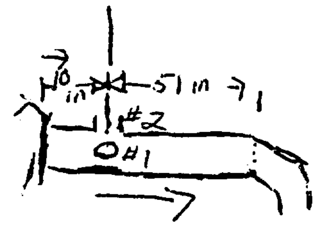
PLANT Swift Chem Co.
DATE 3-8-79
SAMPLING LOCATION Outlet - Cooler
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE A) #1 - 31½ / #2 - 30⅛
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE B) #1 - 3¾ / #2 - 4⅛
STACK I.D., (DISTANCE A - DISTANCE B) #1 - 27.75 / #2 - 26.0
NEAREST UPSTREAM DISTURBANCE 10 inch
NEAREST DOWNSTREAM DISTURBANCE 51 inch
CALCULATOR Daros

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)		DISTANCE B (#1)	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)	(#2)
1	.1	27.75	.305	5/16	#1 3.75 / 4.125 #2	4.06 4 1/16	4.43 4 7/16
2	.32	↓	.888	7/8	↓	4.638 4 5/8	5.013 5 —
3	.55		1.53	1 1/2		5.28 5 1/4	5.66 5 11/16
4	.79		2.19	2 3/16		5.74 15/16	6.315 5/16
5	10.5		2.91	2 15/16		6.66 11/16	7.035 7 —
6	13.2		3.66	3 11/16		7.41 7/16	7.79 13/16
7	16.1		4.47	4 1/2		8.22 1/4	8.60 5/8
8	19.4		5.38	5 3/8		9.13 1/8	9.51 1/2
9	23.0		6.38	6 3/8		10.13 1/8	10.51 1/2
10	27.2		7.55	7 9/16		11.30 5/16	11.68 11/16
11	32.3		8.96	8 15/16		12.71 11/16	13.09 1/16
12	39.8		11.04	11 1/16		14.79 13/16	15.17 9/16
13	60.2		16.71	16 11/16		20.46 7/16	20.84 13/16
14	67.7		18.79	18 13/16		22.54 9/16	22.92 15/16
15	72.8		20.20	20 3/16		23.95 15/16	24.33 5/16
16	77.0		21.37	21 3/8		25.12 1/8	25.50 25 1/2
17	80.6		22.37	22 3/8		26.12 1/8	26.5 26 1/2
18	83.9		23.28	23 1/4		27.03 27 —	27.41 7/16
19	86.8		24.09	24 1/16		27.84 13/16	28.22 3/16
20	89.5		24.84	24 13/16		28.6 5/8	28.97 29 —
21	92.1		25.56	25 9/16		29.31 5/16	29.69 11/16
22	94.5		26.22	26 1/4		29.97 30 —	30.35 3/8
23	96.8	↓	26.86	26 7/8	↓	30.67 11/16	30.99 31 —
24	98.9	27.75	27.44	27 7/16	#1 - 3.75 / 4.125 #2	31.19 3/16	31.57 9/16

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Swift Chemical - Beaumont
DATE 3-5-79
SAMPLING LOCATION COOLER OUTLET
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE A) #1-31½ — #2, 30⅛
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE B) #1, 3¾ - #2, 4⅛
STACK I.D.. (DISTANCE A - DISTANCE B) #1=27¾ — #2=26
NEAREST UPSTREAM DISTURBANCE 10 in
NEAREST DOWNSTREAM DISTURBANCE 51 in
CALCULATOR Stultz - Vogel

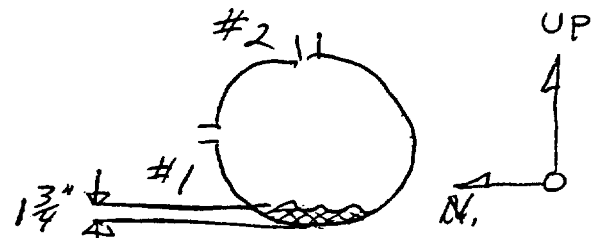


SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.021	27¾	.583 > 1.00	4	4⅝ > 5
2	.067	↓	1.859	↓	5⅞
3	.118		3.275		7¼
4	.177		4.912		8⅞
5	.250		6.938		~~[illegible]~~ 11
6	.356		9.879		13⅞
7	.644		17.871		21⅞
8	.750		20.813		24⅞
9	.823		22.838		26⅞
10	.882		24.476		28½
11	.933		25.891		29⅞
12	.979	↓	27.167 > 26.75	↓	31⅛ > 30¾

PRELIMINARY VELOCITY TRAVERSE

PLANT Swift Chemical, Beaumont
DATE 3-5-79
LOCATION Cooler Outlet
STACK I.D. 27 ¾
BAROMETRIC PRESSURE, in. Hg 30.40
STACK GAUGE PRESSURE, in. H_2O −2.6 @ Point 1-7
OPERATORS Stultz − Vogel



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1-1	0	99
1-2	0	99
1-3	.03	103
1-4	.32	105
1-5	.75 ~~.53~~	105
1-6	.9	105
1-7	.9	103
1-8	1.0	103
1-9	1.0	103
1-10	.9	103
1-11	.35	106
1-12	.15	106
AVERAGE	0.525	103.3

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
2-1	.50	105
2-2	.60	105
2-3	.55	105
2-4	.70	105
2-5	.72	105
2-6	.90	101
2-7	1.03	105
2-8	.95	105
2-9	.94	105
2-10	.95	105
2-11		
2-12		
AVERAGE	~~0.653~~ 0.784	104.6

C-127

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4 72

Avg. ΔP = ~~0.589~~ 0.655
Avg Ts = ~~103~~ 104

Run Number 1

Date 3-8-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by THOMAS

Assisted by ________

NOTE: Same as Run No. ________

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ________ in. Hg

☐ Barometer Location ________

Reading Time ________ by ________

☐ Elevation ________

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx Pm$ = ________ in. Hg

Average Meter Temperature, Tm = ________ oF

Total Weight of Moisture Collected, Wc + Wa = Wm = ________ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = \_\_\_\_\_\_\_\_ \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ________ °F

Wet Bulb Temperature = ________ °F

Moisture Content (from Ref. Table) = ________ % by Volume

C. Predetermined Value

% Moisture 2 Basis Assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-8-79

SAMPLING LOCATION Cooler Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	~~80~~ 100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.08
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.89
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.99
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	104
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.655
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	1.03
C FACTOR		~~1.05~~ 1.1
CALCULATED NOZZLE DIAMETER, in.		.228
ACTUAL NOZZLE DIAMETER, in.		.25
REFERENCE Δp, in. H_2O		~~.46~~ .44

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4/72

FIELD DATA

PLANT Swift Chem
DATE 3-8-79
SAMPLING LOCATION Rotary Drum Cooler
SAMPLE TYPE Partic. / NO3-/AN
RUN NUMBER 1
OPERATOR Duros
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 30.08
STATIC PRESSURE, (P_s) -2.6
FILTER NUMBER (s)

PROBE LENGTH AND TYPE Flexible
NOZZLE I.D. .25
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp .46   1.36 ~~.26~~ Ref-3/16

Leak CK: Initial at 15" Hg, CFM .015
Final at Hg, CFM

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 1 MINUTES

$$VM = \_\_\_ \times \sqrt{\frac{Ps}{Ts + 460}}$$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	27.625 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0 / ~~1405~~											
1-1			28.10	.15	.65	.65	80	75	75			
1-2			28.67	.17	.75	.75	80	76	76			
1-3			29.13	.14	.62	.62	80	78	78			
1-4			29.53	.05	.22	.22	90	80	78			
1-5			30.0	.70	3.0	3.0	90	80	78			
1-6			30.6	.80	3.5	3.5	90	84	78			
1-7			31.70	.95	4.0	4.0	90	85	83		← * MOH	(3-30-79)
1-8			33.0	1.50	6.2	6.2	90	90	88			
1-9			34.1	2.85	3.5	3.5	95	82	80			
1-10			35.1	3.10	4.0	4.0	100	85	80			
1-11			36.1	3.10	3.8	3.8	100	90	80			
1-12			37.2	3.00	3.8	3.9	100	92	82			
1-13			38.4	3.4	4.3	4.3	100	94	82			
1-14			39.45	3.5	4.4	4.4	105	96	82			
1-15			40.70	3.7	4.6	4.6	105	100	83			
1-16	MOH (3-27-79)		41.8	3.8	4.8	4.7	105	102	84			
1-17	* 43.0	→	-	3.7	4.6	4.6	105	104	84			
1-18			44.2	3.6	4.5	4.5	105	106	84			
1-19			45.45	3.5	4.4	4.4	105	106	84	5		
1-20			46.5	3.7	4.6	4.6	105	110	85	6		
1-21			47.7	3.7	4.6	4.6	105	110	85	6	← MOH	(3-30-79)
1-22			48.8	3.7	4.6	4.6	105			6		
1-23			49.7	2.5	3.0	3.1	105	112	86	6		

Ref. ΔP = 1.4

COMMENTS: * Average readings derived by averaging the preceding & succeeding meter readings.

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TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
1-24			50.83	2.5	3.1	3.1	105	112	88	4		
2-1			51.6	2.5	3.1	3.1	100	100	90	5		
2-2			52.6	2.6	3.2	3.2	85	101	90	5		
2-3			53.6	2.5	3.1	3.1	85	102	90	5		
2-4			54.5	2.5	3.1	3.1	85	102	90	5		
2-5			55.5	2.5	3.1	3.1	100	105	90	5		
2-6	1457		56.5	2.7	3.35	3.3	105	106	90	5		
2-7			57.6	3.8	3.5	3.5	105	108	90	5		
2-8			58.2	1.1	1.3	1.3	105	110	90	5		
2-9			58.9	1.1	1.3	1.3	105	—	—	6		
2-10			59.4	2.2	2.3	1.8	—	—	—	<15		
2-11			60.5	2.8	3.5	3.5	100	105	92	5		
2-12			61.5	2.9	3.7	3.6		108	92	4		
2-13			62.7	3.5	4.5	4.5	100	—	—	6		
2-14			63.8	3.4	4.2	4.2	100	110	94	6		
2-15			65.0	3.5	4.4	4.3	100	112	94	6		
2-16			66.1	3.5	4.4	4.4	100	112	94	6		
2-17			67.3	3.6	4.5	4.5	100	112	94	6.5		
2-18			68.4	3.4	4.2	4.2	100	115	94	6.0		
2-19			69.5	3.0	4.0	4.0	100	—	—	—		
2-20			70.1	6.2	7.6	7.6	—	—	—	—		
2-21			70.7	1.1	1.3	1.3	100	—	—	—		
2-22				0								
2-23				0								
2-24				0								
Leak Check		.015 cfm		@ 15 "Hg.								

Run Number 1

Date 3-8-79

Sampling Location Rotary Drum Cooler - Out.

Comments:

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4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical　　Date 3-8-79
Sampling Location ____　　Initial JT
Test Number ____

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

		Pts (1-1) -(1-8)	Pts (7-9) -(2-24)
Average stack temperature, °F	Ts_{avg}	86	101
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	5.12	36.04
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.98	.98
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2 \times 0.44$) + ($\%O_2 \times 0.32$) + ($\%N_2$ + $\%CO \times 0.28$)	Md	28.84	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.62	28.62
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.89	29.89
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2587.13	5951.48
Total sample time, minutes	θ	8	37
Nozzle diameter, inches	Dn	.25	.1875
$\frac{1{,}039\,(86 + 460)(5.12)}{(2587.13)(8)(29.89)(.98)(.25^2)}$	% I	77	93

$$\frac{(1039)(101+460)(36.04)}{(5951.48)(37)(29.89)(.98)(1875^2)} =$$

$$\frac{(8.77)+(37.93)}{45} = 90\%$$

ANA 'TICAL DATA

PLANT: Swift

DATE: 3-8-79

SAMPLING LOCATION: Cooler

SAMPLE TYPE: ____

RUN NUMBER: # 1

SAMPLE BOX NUMBER: 4

CLEAN-UP MAN: RG

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ____

FILTER NUMBER ____ ____ ____ ____ ____ ____ — CONTAINER ____

FRONT HALF SUBTOTAL ____

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ____

ETHER-CHLOROFORM EXTRACTION ____

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ____

BACK HALF SUBTOTAL ____

TOTAL WEIGHT ____

MOISTURE

IMPINGERS	#1	#2	#3	#4	#5
FINAL VOLUME	595.8g ml	611.3g	578.3g	587.7	497.5
INITIAL VOLUME (Tare + 100g)	581.8g ml	611.2g	578.1g	584.8g	496.1
NET VOLUME	14.0 ml	0.1g	0.2g	2.9g	1.4

SILICA GEL			
FINAL WEIGHT	664.5 g	____ g	____ g
INITIAL WEIGHT	654.4 g	____ g	____ g
NET WEIGHT	10.1 g	____ g	____ g

14.0
0.1
0.2
2.9
1.4
18.6

TOTAL MOISTURE 18.6 ml

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PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Swift
Sample Location Cooler
Sample Box No. # 4
Sample Type AN

Run No. 1
Sample Date 3-8-79
Recovery Date 3-8-79
Cleanup Person [illegible]

Filter No. ______
Sample No. ______
Sample Material Description ______

MOISTURE AND/OR SAMPLE

	1	2	3	4	5	SILICA GEL
Impinger Sequence	1	2	3	4	5	
Impinger Type a/	M	S	M	S	M	
Impinger Solution	H_2O	H_2O	$1N\ H_2SO_4$	$1N\ H_2SO_4$	MT	
Final Volume (wt) b/	595.8	611.3	578.3	587.7	497.5	664.5
Initial Volume (wt) b/	581.8	611.2	578.1	584.8	496.1	654.4
Net Volume (wt) b/	14.0	0.1	0.2	2.9	1.4	10.1
Sample No.(s)						

Combined impinger contents, Sample No. ______
Liquid Level Marked ______ Container(s) Sealed ______
Description of Impinger Solution ______
Total Moisture, gm ______

Silica Gel Color ______

a/ S = Greenburg-Smith standard, M = Modified, O = Other ______
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. ______
Liquid Level Marked ______
Sealed ______

Impinger Rinse: Sample No. ______
Liquid Level Marked ______
Sealed ______

Water Blank: Sample No. ______
Liquid Level Marked ______

Dry Catch: Sample No. ______
Description ______
Sealed ______

Acetone Blank: Sample No. ______
Liquid Level Marked ______
Sealed ______

Filter Blank: Sample No. ______
Sealed ______

Sample Disposition ______
Carrier ______
Remarks: ______ Date Shipped: ______

Date of laboratory custody ______
Personnel accepting custody ______
Remarks: ______
Seal(s) broken by ______
Date broken ______

SAMPLING TASK LOG

Plant Swift Chem. Co.
Date 3-8-79
Project No. 4468-L(18)

Plant Location Beaumont, Tx
Recorded by DuRos

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Start 1405	1						
Stop @ end of point 8 – plugged pitot / changed probe tip to 3/16							
Start ~~1418~~							
Complete traverse port 1	1446						
Start Port 2 @							

MIDWEST RESEARCH INSTITUTE

RUN 2

MRI Project Number 4468 L (18)
Field Dates
Plant SWIFT CHEMICAL
Sampling Location Cooler Outlet
Sampling Date 3-9-79

FIELD CREW

Crew Chief: B. DaRos

Testing Engineer
1 B. DaRos
2
3

Engr. Technician
1 J. Thomas
2 D. Vogel
3

Lab Technician
1 C. Cole
2 R. Jones
3

Process Engineer
1 T. Curtin (GCA)
2

Other
1 G. Scheil (Analysis)
2

MRI - Form PO (10/72)

Run Number 2

Date 3-9-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by BD

Assisted by JT

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx Pm$ = ______ in. Hg

Average Meter Temperature, Tm = ______ °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = \_\_\_\_\_\_ \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 2 Basis assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chemical

DATE 3-9-79

SAMPLING LOCATION Cooler Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.06
STATIC PRESSURE IN STACK, in. Hg (P_m±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.87
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.99
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	94
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	2.5
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	3.8
C FACTOR		1.1
CALCULATED NOZZLE DIAMETER, in.		.16
ACTUAL NOZZLE DIAMETER, in.		.1875
REFERENCE Δp, in. H_2O		1.32

EPA (Dur) 234
4/72

FIELD DATA

PLANT Swift Chemical
DATE 3-4-79
SAMPLING LOCATION Cooler Outlet
SAMPLE TYPE Particulate
RUN NUMBER 2
OPERATOR BCD
AMBIENT TEMPERATURE 80
BAROMETRIC PRESSURE 30.06
STATIC PRESSURE, (P_s) -.26
FILTER NUMBER (s)

PROBE LENGTH AND TYPE flexible
NOZZLE I.D. .1875
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 5
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 1.1
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.32

Leak CK: Initial at 15 in. Hg, CFM .006
Final at Hg, CFM .005

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 1 MINUTES

$$VM = \_\_\_ \times \sqrt{\frac{Ps}{Ts + 460}}$$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0945		71.765									
1-1			MOH (3-27-79)	72.15	.128	.42	.92	80	72	72	3		
1-2			* 72.55 *	—	.45	.645	.16	80	—	—	3		
1-3				72.95	.120	.30	.29	80	75	74	3		
1-4				73.3	.25	.36	.35	100	—	—	3		
1-5				73.68	.1	.15	.15	100	78	75	3		
1-6				73.82	.1	.15	.15	100	—	—	3		
1-7				74.5	.8	1.1	1.1	110	80	75	5		
1-8				75.20	1.5	2.0	2.0	110	82	75	6		
1-9				76.30	2.9	4.0	4.0	110	85	76	8		
1-10				77.50	3.2	4.3	4.5	110	88	76	10		
1-11				78.60	3.3	4.5	4.5	110	93	76	10		
1-12				79.75	3.1	4.1	4.1	110	—	—	8.5		
1-13				80.99	3.2	4.3	4.3	110	98	78	9.5		
1-14				82.00	3.2	4.3	4.3	110	100	78	9.5		
1-15				83.20	3.6	4.8	4.8	110	102	79	10.5		
1-16				84.37	3.6	4.8	4.8	110	105	80	10.5		
1-17				85.60	3.7	4.8	4.8	110	106	80	10.5		
1-18				86.80	3.6	4.8	4.8	110	108	80	10.5		
1-19				88.10	4.4	5.9	5.9	110	—	—	—		
1-20				89.40	4.3	5.8	5.8	110	112	83	12.5		
1-21				90.75	4.0	5.5	5.5	110	112	83	12.5		
1-22				92.05	3.8	5.0	5.0	110	115	84	11.5		
1-23				93.26	3.3	4.5	4.5	110	116	85	10.0		

COMMENTS:
* Average Reading, taken by averaging the preceding & succeeding Actual Meter Readings

EPA (Dur) 235
4/72

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
1-24			94.25	3.2	4.2	4.2	110	116	86	9.0		
2-1	1015		95.25	2.5	3.4	3.4	~~110~~ 80	100	86	8.0		
2-2			96.26	2.5	3.4	3.4	~~110~~ 80	104	86	8.0		
2-3			97.30	2.8	3.7	3.7	100	105	88	8.0		
2-4			98.40	2.8	3.7	3.7	115	106	88	8.0		
2-5			99.40	2.6	3.5	3.5	115	108	88	8.0		
2-6			100.40	2.5	3.4	3.4	115	108	88	8.0		
2-7			101.75	2.5	3.4	3.4	115	110	88	8.0		
2-8			102.45	2.5	3.4	3.4	—	—	—	—		
2-9			103.20	1.0	1.3	1.3	115	112	88	9		
2-10			104.03	2.5	3.4	3.4	115	112	90	9		
2-11			105.28	3.5	4.7	4.7	115	—	—	—		
2-12			106.36	3.1	4.1	4.1	115	115	91	9		
2-13			107.59	3.8	5.0	5.0	115	115	91	11		
2-14	MDH	(3-27-79)	108.79	3.8	5.0	5.0	110	—	—	—		
2-15	* 110.02	~~[illegible]~~ →	—	3.8	5.0	5.0	110	118	92	11		
2-16			111.25	3.8	5.0	5.0	110	119	92	11		
2-17			112.5	3.5	4.7	4.7	115	—	—	—		
2-18			113.61	3.5	4.7	4.7	115	121	94	10		
2-19			114.80	3.2	4.2	4.1	110	121	95	10		
2-20			115.62	1.2	1.8	1.8	110	121	95	6		
2-21				0								
2-22				0		3.57	107					
2-23				0								
2-24				~~0~~								
				2.67								
Leak	check	@	15" Hg	.005 cfm				Time		1042		

Run Number 2   Date 3-9-79   Sampling Location Cooler Outlet

Comments: * Average reading, taken by Averaging the preceding & succeeding meter readings

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical | Date 3-9-79
Sampling Location Cooler Outlet | Initial JT
Test Number Run 2

Isokinetic equation:

$$\% \, I = \frac{1,039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	107
Meter volume (std), $\dfrac{17.64(Vm)\left(Pb+\dfrac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	41.52
Mole fraction dry gas, $\dfrac{100-\% \, H_2O}{100}$	Mf	.98
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.62
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.87
Stack velocity, fpm $5,128.8 \, (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\dfrac{Ts+460}{Ps \times Ms}}$	Vs	5733.1
Total sample time, minutes	θ	44
Nozzle diameter, inches	Dn	.1875
$\dfrac{1,039\,(107 + 460)(41.52)}{(5733.1)(44)(29.87)(.98)(.1875^2)}$	% I	94

ANALYTICAL DATA

PLANT Swift

DATE 3-9-79

SAMPLING LOCATION ~~Ex~~ Cooler

SAMPLE TYPE

RUN NUMBER 2

SAMPLE BOX NUMBER ~~3~~ ~~4~~ 2

CLEAN-UP MAN

COMMENTS: 11:05 train disassembly

FRONT HALF

LABORATORY RESULT

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER

FILTER NUMBER — CONTAINER

FRONT HALF SUBTOTAL

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER

ETHER-CHLOROFORM EXTRACTION

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER

BACK HALF SUBTOTAL

TOTAL WEIGHT

MOISTURE

IMPINGERS	#1	#2	#3	#4	#5
FINAL VOLUME ml	580.9 (~~640~~)	595.2	585.9	596.5	460.6
INITIAL VOLUME ml	573.2	594.9	584.6	592.5	459.9
NET VOLUME ml	7.7	0.3	1.3	4.0	0.7

SILICA GEL			
FINAL WEIGHT	g	708.4 g	g
INITIAL WEIGHT	~~683.2~~ g	683.8 g	g
NET WEIGHT	g	24.6 g	g

2
7.7
0.3
1.3
4.0
0.7
14.0

TOTAL MOISTURE 14.0

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4/72

SAMPLING TASK LOG

Plant: Swift Chemical Company
Date: 3-9-79
Project No.: 4468-L(18)

Plant Location: Beaumont, Texas
Recorded by: BD, JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
2½ inches of powder buildup in	2			0920			
bottom of duct							
Pretest Leak check	2			0930			
Begin Test	2	Outlet Port # 1	NH_4, NH_3NO_2	0945	1013		
Change Ports				1013	1015		
Resume Test	2	Outlet Port # 2	NH_4, NH_3NO_2	1015	1042		
Post Test Leak check				1042			
Test Complete					1042		
Note: Damper 3/4 open,							
Pressure Drop across cyclone							
≅ 5.0 in.							
(Velocity and stack Temperature							
average taken from Run 1							
Data)							

MIDWEST RESEARCH INSTITUTE

RUN 3

MRI Project Number 4468-L(18)
Field Dates
Plant SWIFT CHEM Co.
Sampling Location OUTLET - ROTARY DRUM COOLER
Sampling Date 3-9-79

FIELD CREW

Crew Chief B.C. DuRos

Testing Engineer
1 B.C. DuRos
2
3

Engr. Technician
1 J. THOMAS
2 D. VOGEL
3

Lab Technician
1 C. COLE
2
3

Process Engineer
1 T CURTIN (GCA)
2

Other
1 G. SCHEIL
2

MRI - Form PO (10/72)

Run Number 3

Date 3-9-79

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by BD

Assisted by JT

NOTE: Same as Run No. ______

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = ______ in. Hg

☐ Barometer Location ______

Reading Time ______ by ______

☐ Elevation ______

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Meter Pressure, $P_B \approx Pm$ = ______ in. Hg

Average Meter Temperature, Tm = ______ oF

Total Weight of Moisture Collected, Wc + Wa = Wm = ______ gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = \text{\_\_\_\_\_\_ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = ______ °F

Wet Bulb Temperature = ______ °F

Moisture Content (from Ref. Table) = ______ % by Volume

C. Predetermined Value

% Moisture 2 Basis assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Swift Chem Co.

DATE 5-9-79

SAMPLING LOCATION Outlet Rotary Drum Cooler

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.06
STATIC PRESSURE IN STACK, in. Hg (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.87
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.99
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	107
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	2.67
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	4.4
C FACTOR		1.1
CALCULATED NOZZLE DIAMETER, in.		.16
ACTUAL NOZZLE DIAMETER, in.		.1875
REFERENCE Δp, in. H_2O		1.38

EPA (Dur) 234
4/72

FIELD DATA

PLANT Swift Chem Co.
DATE 3-9-79
SAMPLING LOCATION OUTLET - R.D. COOLER
SAMPLE TYPE MOD. METH 5
RUN NUMBER 3
OPERATOR DAROS
AMBIENT TEMPERATURE 80
BAROMETRIC PRESSURE 30.06
STATIC PRESSURE, (P_s) -2.6
FILTER NUMBER (s)

PROBE LENGTH AND TYPE flexible
NOZZLE I.D. .1875
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$ 1.84
C FACTOR 1.1
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.38

Leak CK: Initial at 15" Hg, CFM ~~15~~ .01
Final at Hg, CFM

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 1 MINUTES

$$VM = \_\_\_ \times \sqrt{\frac{Ps}{Ts + 460}}$$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ 115.94 — Desired	Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O — DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE — INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
1-1			116.30	.25	.35	.35	95	76	76	0		
1-2			116.68	.25	.35	.35	95	76	76	1		
1-3			117.05	.25	.35	.35	95	77	76	1		
1-4			117.41	.27	3.6	.36	80	78	76	1		
1-5			117.76	.27	.36	.36	80	—	—	1		
1-6			118.10	.1	.15	.2	90	80	78	0		
1-7			118.64	1.1	1.5	1.3	100	—	—	—		
1-8			119.60	2.5	3.2	3.3	110	84	78	5		
1-9			120.70	3.0	3.9	3.95	120	—	—	5		
1-10			121.80	3.3	4.3	4.4	120	90	78	6		
1-11			122.98	3.2	4.2	4.2	120	93	79	6		
1-12			124.10	3.2	4.2	4.2	120	95	80	6		
1-13	1529		125.25	3.3	4.3	4.2	115	98	80	6		
1-14			126.40	3.5	4.5	4.6	115	100	80	6.5		
1-15			127.60	3.5	4.5	4.6	115	102	81	6.0		
1-16			128.80	3.7	4.7	4.8	115	104	82	7.0		
1-17			130.00	3.7	4.7	4.8	115	—	—	6.		
1-18			131.18	3.7	4.7	4.7	115	108	83	6		
1-19			132.44	3.9	5.0	5.1	115	109	83	6		
1-20			133.65	3.8	4.9	4.7	115	110	84	7		
1-21			134.87	3.8	4.9	4.9	115	111	85	7		
1-22			135.90	2.5	3.2	3.3	115	112	86	4.5		
1-23			136.85	2.0	2.6	2.6	115	112	86	4.0		

COMMENTS:

EPA (Dur) 235
1/72

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
1-24			137.74	2.0	2.6	2.6	115	112	87	4.0		
2-1			138.61	2.5	3.2	3.2	90					
2-2			139.50	2.5	3.2	3.2		114	88	5.0		
2-3			140.55	2.5	3.2	3.2	90	—	—	—		
2-4			141.52	2.3	3.0	3.0	95	106	89	—		
2-5			142.55	2.5	3.2	3.2	110	106	89	4.5		
2-6			143.56	2.6	3.4	3.4	125	—	—	5.0		
2-7			144.61	2.6	3.4	3.5	125	107	90	5.0		
2-8			145.61	2.4	3.2	3.3	125	108	90	5.0		
2-9			146.57	2.0	2.6	2.7	125	—	—	4.5		
2-10			147.56	2.5	3.2	3.4	120	108	92	4.0		
2-11			148.69	2.9	3.8	4.1	120	108	92	6.0		
2-12			149.86	3.2	4.2	4.2	120	—	—	7.0		
2-13			151.10	3.9	5.0	5.0	120	110	93	6.0		
2-14			152.34	4.0	5.2	5.2	115	110	93	7.0		
2-15			153.60	3.8	4.9	5.0	115	113	94	7.5		
2-16			154.80	3.6	4.7	4.7	115	—	—	7.0		
2-17			155.90	2.6	3.4	3.4	115	—	—	6.5		
2-18			156.88	2.5	3.2	3.2	115	115	95	6.0		
2-19			158.02	3.2	4.2	4.2	120	115	96	5.0		
2-20			159.02	2.2	2.9	2.9	120	115	96	6.5		
2-21	1605			0			120	115	96	5.0		
2-22				~~0.28~~		~~3.38~~	111					
2-23				0		3.3						
2-24				0								
Leak Check @ 7.5" Hg = .010 cfm												

Run Number 3

Date 3-9-79

Sampling Location Cooler Outlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Swift Chemical

Sampling Location Cooler Outlet

Test Number Run 3

Date 3-9-79

Initial JT

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	111
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	41.12
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$	Mf	.98
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	28.84
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	28.62
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times \text{stack gage pressure, in } H_2O)$	Ps	30.25
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}_{avg}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	5620
Total sample time, minutes	θ	44
Nozzle diameter, inches	Dn	.1875
$\frac{1{,}039\ (111 + 460)(41.12)}{(5620)(44)(30.25)(.98)(.1875^2)}$	% I	95

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-9-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by DAROS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Pretest Leak check	3			1510			
Begin Test	3	Outlet Port #1	NH_4, NH_3NO_2	1515	1543		
Change Ports				1543			
Resume Test	3	Outlet Port #2	NH_4, NH_3NO_2	1543	1605		
Post Test Leak check	3			1605			
Test complete				16	05		

APPENDIX D BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TEST DATA

D-1 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TEST COMPUTER DATA REDUCTION RESULTS

D-1-1 ROTARY DRUM GRANULATOR SCRUBBER INLET

D-1-2 ROTARY DRUM COOLER UNCONTROLLED OUTLET

D-2 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION FIELD DATA SHEETS

D-2-1 ROTARY DRUM GRANULATOR SCRUBBER INLET

D-2-2 ROTARY DRUM COOLER UNCONTROLLED OUTLET

D-3 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TEST LABORATORY WEIGHING DATA

D-4 ASSOCIATED CORRESPONDENCE PRIOR TO THE FIELD TEST REGARDING BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TESTING

D-1 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TEST COMPUTER DATA REDUCTION RESULTS

D-1-1 ROTARY DRUM GRANULATOR SCRUBBER INLET

BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM GRANULATOR SCRUBBER INLET, RUN NO. 1-IS

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	1-IS	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-07-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	85 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	77 DEG F	PERCENT O2	21.00
FILTER SET	10	BAROMETRIC PRESSURE	30.30 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-3.20 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1252 ACFM	IMPACTOR PRESSURE DROP	11.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	10.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	1.219 SCF				

RUN 1-IS SUMMARY- BRINK IMPACTOR RESULTS

STAGE	WEIGHT (GRAMS) TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.226500	.569700	.342800	97.94	97.94	98.03	98.03		7.00		
1	.416000	.423800	.007400	2.11	100.06	2.12	100.14	1213	3.08	.262	4.64
2	.423800	.424500	.000300	.09	100.14	.09	100.23	2388	1.82	.017	2.37
3	.431300	.431400	-.000300	-.09	100.06	-.09	100.14	3860	1.24	-.023	1.50
4	.427000	.427400	.000000	.00	100.06	.00	100.14	8407	.66	.000	.90
5	.344700	.344900	-.000200	-.06	100.00	-.06	100.09	14079	.41	-.012	.52
FILTER	.262500	.262600	-.000300			-.09	100.00				

.349700 GRAMS COLLECTED= 4.427 GR/SCF

BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM GRANULATOR SCRUBBER INLET, RUN NO. 2-IS

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	2-15	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-07-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	85 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	73 DEG F	PERCENT O2	21.00
FILTER SET	20	BAROMETRIC PRESSURE	30.30 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-3.10 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1201 ACFM	IMPACTOR PRESSURE DROP	11.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	12.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	1.404 SCF				

RUN 2-15 SUMMARY- BRINK IMPACTOR RESULTS

STAGE	-----WEIGHT (GRAMS)----- TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.219300	.983700	.764000	99.67	99.67	99.65	99.65		7.00		
1	.469500	.471600	.001700	.22	99.90	.22	99.87	1164	3.14	.054	4.69
2	.385900	.386500	.000200	.03	99.92	.03	99.90	2291	1.86	.010	2.42
3	.479800	.480400	.000200	.03	99.95	.03	99.92	3703	1.27	.013	1.54
4	.460900	.461600	.000300	.04	99.99	.04	99.96	8064	.67	.012	.93
5	.452100	.452600	.000100	.01	100.00	.01	99.97	13506	.42	.005	.53
FILTER	.259800	.260400	.000200			.03	100.00				

.766700 GRAMS COLLECTED= 8.430 GR/SCF

BRINK IMPACTOR SAMPLING PARAMETERS - ROTARY DRUM GRANULATOR SCRUBBER INLET, RUN NO. 3-IS

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	3-IS	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-08-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	85 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	98 DEG F	PERCENT O2	21.00
FILTER SET	30	BAROMETRIC PRESSURE	30.08 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-4.10 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1184 ACFM	IMPACTOR PRESSURE DROP	11.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	10.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	1.142 SCF				

RUN 3-IS SUMMARY- BRINK IMPACTOR RESULTS

STAGE	-----WEIGHT (GRAMS)----- TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.220900	1.733500	1.512200	99.64	99.64	99.64	99.64		7.00		
1	.472300	.477300	.004600	.30	99.94	.30	99.95	1148	3.17	.180	4.71
2	.493400	.494300	.000500	.03	99.97	.03	99.98	2250	1.87	.030	2.43
3	.462800	.463400	.000200	.01	99.99	.01	99.99	3651	1.28	.016	1.55
4	.480700	.481300	.000200	.01	100.00	.01	100.01	7950	.68	.010	.93
5	.469700	.470100	.000000	.00	100.00	.00	100.01	13314	.42	.000	.53
FILTER	.261900	.262200	-.000100			-.01	100.00				

1.517600 GRAMS COLLECTED=20.511 GR/SCF

D-1-2 ROTARY DRUM COOLER UNCONTROLLED OUTLET

BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM COOLER OUTLET, RUN NO. 1-CO

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	1-CO	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-08-79	AMBIENT TEMPERATURE	4. DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	1. DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	78. DEG F	PERCENT O2	21.00
FILTER SET	40	BAROMETRIC PRESSURE	30.08 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-2.60 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1396 ACFM	IMPACTOR PRESSURE DROP	15.10 IN HG	PERCENT H2O	2.00
SAMPLING TIME	14.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	2.236 SCF				

RUN 1-CO SUMMARY- BRINK IMPACTOR RESULTS

	-----WEIGHT (GRAMS)-----			MASS DISTRIBUTION (PERCENT) WITH OUT FILTER		WITH FILTER		JET	D50	D M/ D LOGD	GEOM MEAN
STAGE	TARE	FINAL	NET(ADJ)		CUM		CUM	VELOCITY (CM/SEC)	DIAM (MIC)	(GR/ SCF)	DIAM (MIC)
CYCLONE	.224200	.314200	.089600	99.45	99.45	100.11	100.11		7.00		
1	.423100	.425000	.001500	1.66	101.11	1.68	101.79	1353.	2.77	.026	4.40
2	.474900	.475100	-.000200	-.22	100.89	-.22	101.56	2663.	1.64	-.006	2.13
3	.347900	.348100	-.000200	-.22	100.67	-.22	101.34	4305.	1.12	-.008	1.36
4	.464900	.465100	-.000200	-.22	100.44	-.22	101.12	9374.	.59	-.005	.82
5	.473200	.473200	-.000400	-.44	100.00	-.45	100.67	15699.	.36	-.013	.47
FILTER	.268300	.268100	-.000600			-.67	100.00				

.089500 GRAMS COLLECTED= .618 GR/SCF

BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM COOLER OUTLET, RUN NO. 2-CO

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	2-CO	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-09-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	1 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	74 DEG F	PERCENT O2	21.00
FILTER SET	50	BAROMETRIC PRESSURE	30.07 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-2.60 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1377 ACFM	IMPACTOR PRESSURE DROP	15.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	14.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	2.205 SCF				

RUN 2-CO SUMMARY- BRINK IMPACTOR RESULTS

STAGE	-----WEIGHT (GRAMS)----- TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.222900	.418700	.195400	98.24	98.24	98.24	98.24		7.00		
1	.486400	.489500	.062700	1.36	99.60	1.36	99.60	1335	2.79	.047	4.42
2	.463400	.464200	.000400	.20	99.80	.20	99.80	2626	1.65	.012	2.14
3	.471400	.472100	.000300	.15	99.95	.15	99.95	4246	1.13	.013	1.37
4	.508100	.508600	.000100	.05	100.00	.05	100.00	9246	.60	.003	.82
5	.483300	.483700	.000000	.00	100.00	.00	100.00	15485	.37	.000	.47
FILTER	.260200	.260600	.000000			.00	100.00				

.198900 GRAMS COLLECTED= 1.392 GR/SCF

BRINK IMPACTOR SAMPLING PARAMETERS AND RESULTS - ROTARY DRUM COOLER OUTLET, RUN NO. 3-CO

PARTICLE SIZING SUMMARY
BRINK IMPACTOR

RUN NUMBER	3-CO	PARTICLE DENSITY	1.00 G/CC	GAS COMPOSITION	
RUN DATE	03-09-79	AMBIENT TEMPERATURE	4 DEG F	PERCENT CO2	0.00
SAMPLING POINT	SWIFT CHEM	STACK GAS TEMPERATURE	1 DEG F	PERCENT CO	0.00
PITOT FACTOR	-0.000	AV. METER TEMPERATURE	77 DEG F	PERCENT O2	21.00
FILTER SET	60	BAROMETRIC PRESSURE	30.07 IN HG	PERCENT N2	79.00
WT. CORRECTION	-.000400 GRAMS	STATIC PRESSURE	-2.60 IN H2O	MOLECULAR WT.	28.84
SAMPLING RATE	.1392 ACFM	IMPACTOR PRESSURE DROP	15.30 IN HG	PERCENT H2O	2.00
SAMPLING TIME	14.00 MIN	NOZZLE DIAMETER	.0790 IN	MOLECULAR WT.	28.62
SAMPLING VOLUME	2.229 SCF				

RUN 3-CO SUMMARY- BRINK IMPACTOR RESULTS

STAGE	-----WEIGHT (GRAMS)----- TARE	FINAL	NET(ADJ)	MASS DISTRIBUTION (PERCENT) WITH OUT FILTER	CUM	WITH FILTER	CUM	JET VELOCITY (CM/SEC)	D50 DIAM (MIC)	D M/ D LOGD (GR/ SCF)	GEOM MEAN DIAM (MIC)
CYCLONE	.222500	.330300	.107400	101.32	101.32	102.29	102.29		7.00		
1	.488400	.490700	.001900	1.79	103.11	1.81	104.10	1349	2.77	.033	4.40
2	.507600	.507700	-.000300	-.28	102.83	-.29	103.81	2655	1.64	-.009	2.13
3	.473600	.473100	-.000900	-.85	101.98	-.86	102.95	4292	1.12	-.038	1.36
4	.487600	.487000	-.001000	-.94	101.04	-.95	102.00	9347	.60	-.025	.82
5	.489100	.488400	-.001100	-1.04	100.00	-1.05	100.95	15654	.36	-.036	.47
FILTER	.265700	.265100	-.001000			-.95	100.00				

.105000 GRAMS COLLECTED= .727 GR/SCF

D-2 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION FIELD DATA SHEETS

D-2-1 ROTARY DRUM GRANULATOR SCRUBBER INLET

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN CALCULATIONS

MRI Project Number 4468-L18
Field Dates
Plant SWIFT CHEM
Sampling Location
~~Sampling~~ Date 3-6-79

FIELD CREW

Crew Chief		DAROS
Testing Engineer	1	STULTZ
	2	
	3	
Engr. Technician	1	DAROS
	2	
	3	
Lab Technician	1	
	2	
	3	
Process Engineer	1	
	2	
Other	1	
	2	

MRI - Form PO (10/72)

Cooler Outlet

3-5-79 RCS

Molecular wt., $M_d = 28.84$

Avg $\Delta P_s = 0.784$

Avg. $T_s = 104$

$C_p = .84$

$P_b = 30.40$

% $H_2O = 2$

$M_f = .98$

$P_s = 30.40 - (2.6 \times .074)$
$= 30.21$

$M_s = (28.84 \times .98) + 18(1 - .98)$
$= 28.62$

$$V_s = 85.48 \times 60 \times .84 \sqrt{\frac{.784\ (104 + 460)}{30.21 \times 28.62}}$$

$= 3081$ fpm

$$V_s = \frac{3081}{60} = 51.3 \text{ fps}$$

Nozzle (from chart) = 2 mm

Sampling flow rate = 0.103 cfm (from chart)

Impactor ΔP = 4.7" Hg (from chart)

Check of sample rate

2 mm nozzle = 0.0787 inches dia

Nozzle area = $0.00486\ in^2$
$= 3.38 \times 10^{-5}\ ft^2$

$(3.38 \times 10^{-5})(3081) = 0.104$ cfm sample rate

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN 1 - SCRUBBER INLET

MRI Project Number 4468-L(18)
Field Dates 3-3,9-79
Plant Swift Chem, Beaumont, Tx.
Sampling Location Scrubber Inlet
Sampling Date 3-7-79

FIELD CREW

Crew Chief B.C. DaRos

Testing Engineer 1 R.C. Stultz
2
3

Engr. Technician 1 D. Vogel
2
3

Lab Technician 1 Hansen
2
3

Process Engineer 1 T. Curtin (GCA)
2

Other 1
2

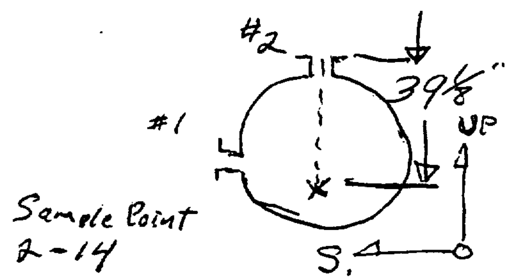
MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. 1 – Scrubber Inlet DATE 3-7-79

Flue Gas Temperature	185	°F
Static Pressure	−3.2	" H_2O
Barometric Pressure	30.30	" Hg
Sample Time	10	min
Probe Tip Diameter	2mm	
Velocity at Sample Point	74.6	FPS
Sample Rate	0.15	CFM

Start Preheat at ~~1409~~ 1307



Schematic of Traverse Point Layout with Dimensions

Gas Composition – ambient air

CO_2 ______

O_2 ______

CO ______

N_2 ______

H_2O ______

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Comments	
1330	11.3	11.3	start meter = Zero	
1332	↓	11.3	Meter Temp-77°F	" 0.261
1334		11.3	77°F	0.496
1336		11.3	77°	0.735
1338		11.3	76°	0.975
1340	↓	11.3	76°	
1340:27			Pump off	1.052

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Preheat Brink Impactor	1			1307			
Begin Test	1	Scrubber Inlet,	Particulate	1330			
		Port #2, point					
		# 2-14					
Stop-Test Complete	1				1340	10	

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN 2

MRI Project Number 4468-L(18)
Field Dates 3-3-9-79
Plant Swift / Beaumont, TX.
Sampling Location Scrub. Inlet
Sampling Date 3-7-79

FIELD CREW

Crew Chief		R.C. DuRose
Testing Engineer	1	R.C. Stoltz
	2	
	3	
Engr. Technician	1	D. Vogel
	2	
	3	
Lab Technician	1	M. Hansen
	2	
	3	
Process Engineer	1	T. Curtin (GCA)
	2	
Other	1	
	2	

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. 2 DATE 3-7-79

Flue Gas Temperature 185 °F

Static Pressure -3.1" " H_2O

Barometric Pressure ______ " Hg

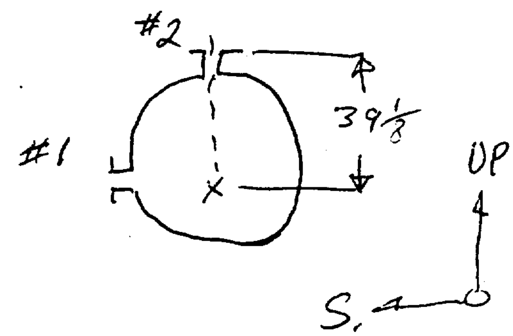
Sample Time ______ min

Probe Tip Diameter 2 mm

Velocity at Sample Point 74.6 FPS

Sample Rate 0.15 CFM

Preheat started 1730



Schematic of Traverse Point Layout with Dimensions

Gas Composition Ambient Air

CO_2 ______

O_2 ______

CO ______

N_2 ______

H_2O ______

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Comments	
1755	11.3	11.3	Meter Temp 73°F	Meter = Zero
1757	↓	11.3	73°	0.258
1759	↓	11.3	73°	0.506
1801	↓	11.3	73°	0.742
1803	↓	11.3	72°	0.969
1805	↓	11.3	72°	1.210
1807		11.3	72°	1.441

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(8)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Preheat Brink Impactor	2			1730			
Begin Test	2	Scrubber Inlet,	Particulate	1755			
		Port #2, point					
		#2-14					
Stop - Test Completed	2				1807	12	

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN 3

MRI Project Number 4468-L(18)
Field Dates 3-3, 9-79
Plant Swift, Beaumont, Tx.
Sampling Location Scrubber Inlet.
Sampling Date 3-8-79

FIELD CREW

Crew Chief: R. C. DuRos

Testing Engineer
1 R. C. Stultz
2
3

Engr. Technician
1 D. Vogel
2
3

Lab Technician
1 M. Hansen
2
3

Process Engineer
1 T. Curtin (GCA)
2

Other
1
2

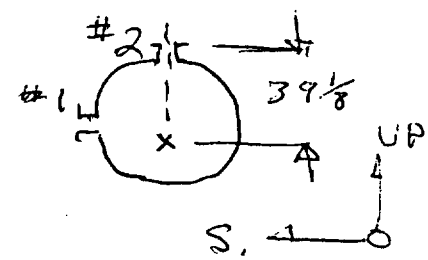
MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. 3 - Scrubber Inlet DATE 3-8-79

Flue Gas Temperature	185	°F
Static Pressure	-4.1	" H_2O
Barometric Pressure	30.08	" Hg
Sample Time		min
Probe Tip Diameter	2 mm	
Velocity at Sample Point	74.6	FPS
Sample Rate	0.15	CFM

Start Preheat at 1340



Schematic of Traverse Point Layout with Dimensions

Gas Composition Ambient Air

CO_2 ______

O_2 ______

CO ______

N_2 ______

H_2O ______

SAMPLING LOG

TIME	ΔP Manometer (in. Hg)		Comments	
	Desired	Actual	Meter Temp.	Meter CF
1400	11.3	11.3	98°	Zero
1402		11.3	98°	0.245
1404		11.3	98°	0.485
1406		11.3	98°	0.710
1408		11.3	97°	0.943
1410		11.3	97°	1.184

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-8-79
Project No. 4468 - L(18)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Preheat Brink Impactor	3			1340			
Begin Test	3	Scrubber Inlet	Particulate	1400			
		Port #2, point					
		#2-14					
Stop- Test Completed	3				1410	10	

D-2-2 ROTARY DRUM COOLER UNCONTROLLED OUTLET

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN 4

MRI Project Number 4468-L(18)
Field Dates 3-3,9-79
Plant Swift / Beaumont
Sampling Location Cooler / Outlet
Sampling Date 3-8-79

FIELD CREW

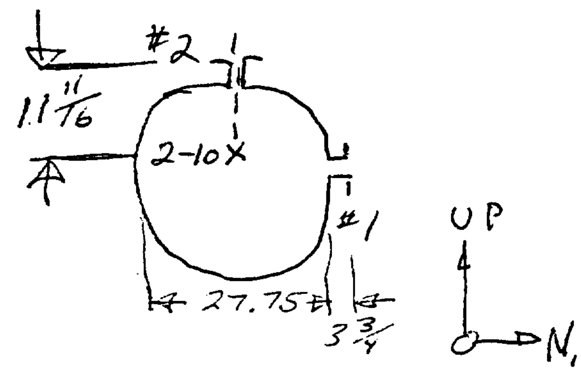
Crew Chief	B.C. DaRos
Testing Engineer	1 R.C. Stultz
	2
	3
Engr. Technician	1 B.C. DaRos
	2
	3
Lab Technician	1 M. Hansen
	2
	3
Process Engineer	1 T. Curtin (GCA)
	2
Other	1
	2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. 4 DATE 3-8-79

Flue Gas Temperature	91	°F
Static Pressure	-2.6	" H_2O
Barometric Pressure	30.08	" Hg
Sample Time	14	min
Probe Tip Diameter	2 mm	
Velocity at Sample Point	88.2	FPS
Sample Rate	0.178	CFM



Schematic of Traverse Point Layout with Dimensions

Gas Composition Ambient Air

CO_2 ______

O_2 ______

CO ______

N_2 ______

H_2O ______

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	Actual	Comments
1705	18	15.2 (Max available)	Meter Temp 78° Meter Vol. Zero
1707	↓	15.2	78° 0.293
1709		15.2	78° 0.575
1711		15.2	78° 0.850
1713		15.1	78° 1.120
1715		15.0	78° 1.398
1717		14.9	78° 1.674
1719	↓	14.9	78° 1.954

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-8-79
Project No. 4468-L(8)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test - Brink Impactor	4	Cooler Outlet,	Particulate	1705			
		Port #2, point					
		#2-10 (Test #1					
		at this location)					
Stop - Test Completed	4				1719	14	

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN 5

MRI Project Number 4468-L(18)
Field Dates 3-3, 9-79
Plant Swift Chem / Beaumont, Tx.
Sampling Location Cooler Outlet
Sampling Date 3-9-79

FIELD CREW

Crew Chief B. C. DaRos

Testing Engineer 1 R. C. Stultz
2
3

Engr. Technician 1 Hasen
2 Vogel
3

Lab Technician 1 Hansen
2
3

Process Engineer 1 T. Curtin (GCA)
2

Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. 5 - Cooler Outlet DATE 3-9-79

Flue Gas Temperature 91 °F

Static Pressure -2.6 " H_2O

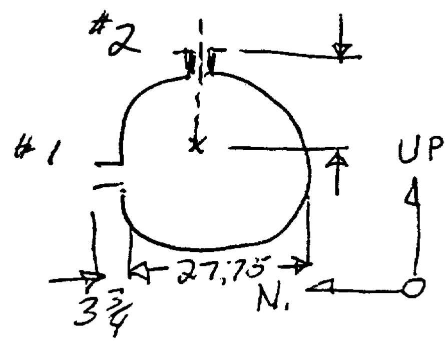
Barometric Pressure 30.07 " Hg

Sample Time 14 min

Probe Tip Diameter 2mm

Velocity at Sample Point 88.2 FPS

Sample Rate 0.178 CFM



Schematic of Traverse Point Layout with Dimensions

Gas Composition Ambient Air

CO_2 ______

O_2 ______

CO ______

N_2 ______

H_2O ______

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Comments	
0834	18	15.4	Meter Temp 74°	Meter Volume Zero
0836	↓	15.4	74°	0.283
0838		15.4	74°	0.557
0840		15.3	74°	0.835
0842		15.3	74°	1.110
0844		15.3	74°	1.375
0846		15.2	74°	1.650
0848	↓	15.2	74°	1.928

SAMPLING TASK LOG

Plant Swift Chemical - Beaumont
Date 3-9-79
Project No. 4468-6 18

Plant Location Beaumont Tex.
Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Vent opended during sampling	5	Cooler outlet 2-10		0834	0848	14	5
Vent is Where ?							

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN 6

MRI Project Number 4468-L18
Field Dates March 3 - 9, 1979
Plant Swift Chemical - Beaumont
Sampling Location Cooler Outlet
Sampling Date 3-9-79

FIELD CREW

Crew Chief DaRos

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Hansen - Vogel
2
3

Lab Technician 1 Hansen
2
3

Process Engineer 1 T. Curtin (GCA)
2

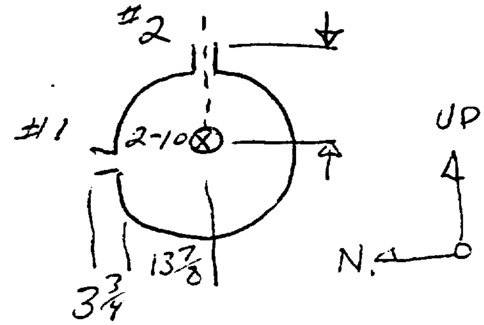
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. 6 - Cooler Outlet DATE 3-9-79

Flue Gas Temperature	91	°F
Static Pressure	-2.6	" H_2O
Barometric Pressure	30.07	" Hg
Sample Time	14	min
Probe Tip Diameter	2 mm	
Velocity at Sample Point	88.2	FPS
Sample Rate	0.178	CFM



Schematic of Traverse Point Layout with Dimensions

Gas Composition Ambient Air

CO_2 ______

O_2 ______

CO ______

N_2 ______

H_2O ______

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	Actual	Comments: Meter Temp	Meter Volume
1058	18	15.5	76°	Zero
1100	↓	15.4	76°	0.289
1102		15.4	76°	0.570
1104		15.35	76°	0.850
1106		15.3	76°	1.120
1108		15.3	77°	1.390
1110		15.25	77°	1.670
1112	↓	15.2	78°	1.949

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-9-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test - Brink Impactor	6	Cooler Outlet,	Particulate	1058			
		Port #2, point					
		#2-10 (Test #3					
		at this location)					
Stop - Test Completed	6				1112	14	

D-3 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TEST LABORATORY WEIGHING DATA

Project No. 4468-L(18) Date of Work: 2-21-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From:

Run No. & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
1-C	0.28263	0.28284	0.28273	0.
1-1	0.47192	0.47212	0.47200	0.
1-2	0.48355	0.48378	0.48361	0.
1-3	0.40914	0.40929	0.40914	0.
1-4	0.40715	0.40725	0.40721	0.
1-5	0.39688	0.39700	0.39693	0.
1-F	0.31983	0.31999	0.31995	0.

Continued To: P.3

Entered By: HANSEN

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-21-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight

Continued From: P. 1

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
2-C	0.27524	0.27542	0.27539	0.
2-1	0.40818	0.40832	0.40822	0.
2-2	0.40867	0.40877	0.40873	0.
2-3	0.40704	0.40711	0.40702	0.
2-4	0.40627	0.40640	0.40633	0.
2-5	0.39313	0.39322	0.39323	0.
2-F	0.31560	0.31570	0.31564	0.

Continued To: P. 5

Entered By: HANSEN

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(1B) Date of Work: 2-21-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 3

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
3-C	0.27731	0.27722	0.27726	
3-1	0.40002	0.40016	0.40006	
3-2	0.40964	0.40969	0.40965	
3-3	0.39965	0.39973	0.39970	
3-4	0.41357	0.41353	0.41337	
3-5	0.40586	0.40568	0.40564	
3-F	0.31797	0.31798	0.31800	

Continued To: P. 7

Entered By: HANSEN

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-21-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 5

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
4-C	0.27931	0.27945	0.27933	0.
4-1	0.40144	0.40145	0.40149	0.
4-2	0.40755	0.40758	0.40767	0.
4-3	0.40033	0.40034	0.40041	0.
4-4	0.47701	0.47715	0.47706	0.
4-5	0.47472	0.47498	0.47495	0.
4-F	0.32255	0.32269	0.32271	0.

Continued To: P. 9

Entered By: HANSEN

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-21-79 Work Performed by: Hansen

Title or Purpose: Brink Tare Weight

Continued From: P. 7

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
5-C	0.27798	0.27809	0.27801	0.
5-1	0.40574	0.40580	0.40576	0.
5-2	0.40141	0.40154	0.40149	0.
5-3	0.40362	0.40354	0.40361	0.
5-4	0.40073	0.40066	0.40071	0.
5-5	0.40926	0.40925	0.40929	0.
5-F	0.31524	0.31529	0.31527	0.

Continued To: P. 11

Entered By: Hansen

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-21-79 Work Performed by: Hansen

Title or Purpose: Brink Tare Weight

Continued From: P. 9

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
6-C	0.27747	0.27757	0.27754	0.
6-1	0.46844	0.46841	0.46841	0.
6-2	0.48388	0.48397	0.48390	0.
6-3	0.40770	0.40770	0.40770	0.
6-4	0.40830	0.40823	0.40827	0.
6-5	0.40498	0.40499	0.40499	0.
6-F	0.32107	0.32120	0.32119	0.

Continued To: P. 13

Entered By: Hansen

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-21-79 Work Performed by: Hansen

Title or Purpose: Brink Tare Weight Continued From: P. 11

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
7-C	0.28165	0.28185	0.28180	0.
7-1	0.48739	0.48765	0.48750	0.
7-2	0.47655	0.47673	0.47661	0.
7-3	0.48716	0.48739	0.48725	0.
7-4	0.48089	0.48103	0.48094	0.
7-5	0.48753	0.48751	0.48746	0.
7-F	0.33185	0.33182	0.33190	0.

Continued To: P. 15

Entered By: Hansen

Date: 2-21-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-21-79

Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight

Continued From: P. 13

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
8-C	0.27842	0.27854	0.27846	0.
8-1	0.48427	0.48432	0.48422	0.
8-2	0.47632	0.47636	0.47633	0.
8-3	0.46322	0.46320	0.46319	0.
8-4	0.47832	0.47827	0.47833	0.
8-5	0.47404	0.47407	0.47408	0.
8-F	0.32413	0.32413	0.32410	0.

Continued To: P. 17

Entered By: HANSEN

Date: 2-22-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-22-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 15

Run E

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
9-C	0.27831	0.27827	0.27830	0.
9-1	0.46627	0.46628	0.46628	0.
9-2	0.47620	0.47621	0.47626	0.
9-3	0.47772	0.47764	0.47764	0.
9-4	0. ~~50784~~ 49525	0.49521	0.49516	0.
9-5	0.48016	0.48009	0.48009	0.
9-F	0.32347	0.32342	0.32346	0.

Continued To: P. 19

Entered By: HANSEN

Date: 2-22-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-22-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 17

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
10-C	0.29046	0.29055	0.29041	0.
10-1	0.48223	0.48237	0.48221	0.
10-2	0.47758	0.47751	0.47760	0.
10-3	0.48348	0.48348	0.48341	0.
10-4	0.48406	0.48406	0.48400	0.
10-5	0.47817	0.47814	0.478~~63~~ 16	0.
10-F	0.32519	0.32514	0.32517	0.

Continued To: P. 21

ntered By: HANSEN

ate: 2-22-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-22-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 19

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
11-C	0.28031	0.28019	0.28020	0.
11-1	0.45713	0.45701	0.45710	0.
11-2	0.46603	0.46600	0.46600	0.
11-3	0.44838	0.44843	0.44841	0.
11-4	0.47871	0.47858	0.47864	0.
11-5	0.47204	0.47204	0.47200	0.
11-6	0.32075	0.32066	0.32071	0.

Continued To: P. 23

Entered By: HANSEN

Date: 2-22-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-LC(18) Date of Work: 2-22-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 21

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
12-C	0.28400	0.28397	0.28400	0.
12-1	0.47765	0.47765	0.47766	0.
12-2	0.47570	0.47572	0.47572	0.
12-3	0.48310	0.48314	0.48310	0.
12-4	0.49024	0.49036	0.49027	0.
12-5	0.45954	0.45957	0.45958	0.
12-F	0.31577	0.31577	0.31580	0.

Continued To: P. 25

Entered By: HANSEN

Date: 2-22-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-22-79 Work Performed by: Hansen

Title or Purpose: Brink Tare Weight

Continued From: P. 23

Run & Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
A-C	0.28303	0.28309	0.28311	0.
A-1	0.47273	0.47277	0.47280	0.
A-2	0.54105	0.54102	0.54110	0.
A-3	0.48102	0.48095	0.48105	0.
A-4	0.47224	0.47223	0.47222	0.
A-5	0.47709	0.47697	0.47704	0.
A-F	0.32537	0.32526	0.32538	0.

Continued To: P. 27

Entered By: Hansen

Date: 2-22-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-22-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weight Continued From: P. 25

Run #

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
B-C	0.33238	0.33233	0.33233	0.
B-1	0.53294	0.53298	0.53296	0.
B-2	0.50889	0.50880	0.50877	0.
B-3	0.50069	0.50062	0.50063	0.
B-4	0.50332	0.50316	0.50318	0.
B-5	0.51223	0.51220	0.51211	0.
B-F	0.36565	0.36548	0.36554	0

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 2-22-79 Work Performed by: HANSEN

Title or Purpose: Brink Filter Sets Continued From:

The Brink filter sets 1-12 and A, B consisted of the following components for Tare Weighing:

Stage No.	Components
C (cyclone)	Empty cup + aluminum foil cover
1	Cup + spring + aluminum foil disc + foil cover
2	↓
3	↓
4	↓
5	↓
F (Final filter)	Cup + filter + foil cover

Note:

All filter sets were vacuum desiccated for 1 hour, prior to weighing. After each of three tare weighings, each filter set was again vacuum desiccated for 15 minutes.

Note: 3-12-79

All Brink filter sets weighed at MRI were unusable for sampling at Swift Ag. Chemical Co. in Beaumont, Tx. See Page for details.

Continued To: P. 60

Entered By: HANSEN

Date: 3-12-79

Disclosed To And Understood By Me:

Date:

Date:

Project No 4468-L(18) Date of Work: March 7, 1979 Work Performed by: HANSEN

Title or Purpose: Brink Weights Continued From:

The Brink filter sets that were pre-weighed at MRI for project 4468-L(18) were unusable at Swift Ag. Chemical Co. due to the reaction of amonium nitrate on the aluminum foil discs. Therefore all filter sets were altered. The new filter sets contained the following components:

Stage No.	Components Weighed
C (cyclone)	Empty cup
1	cup + spring + fiber filter
2	↓
3	↓
4	↓
5	↓
F (Final Filter)	Cup + filter

Each set was tared and final weighed 3 times. A 15-minute period in a desiccator was allowed between each weighing. All sets were pre-conditioned in a silica gel desiccator for 24 hours prior to initial weighing; both for tare and final weights. All weights are in grams.

All weights were obtained on a Mettler Model H135 scale owned by Swift Ag. Chemical Corp. The scale had been serviced 28 Dec. 1978. The scale had a maximum weighing capacity of 1,000 grams; d = 0.1 mg.

Continued To: P. 61

Entered By: HANSEN

Date: 3-12-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-LC(18) Date of Work: 3-7-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weights Continued From: P. 60

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
1-C	0.2258	0.2267	0.2269	0.2265
1-1	0.4158	0.4163	0.4160	0.4160
1-2	0.4236	0.4239	0.4238	0.4238
1-3	0.4315	0.4312	0.4313	0.4313
1-4	0.4270	0.4269	0.4270	0.4270
1-5	0.3449	0.3445	0.3448	0.3447
1-F	0.2628	0.2624	0.2624	0.2625

Brink Final Weights
March 8, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
1-C	0.5697	0.5697	0.5698	0.5697
1-1	0.4239	0.4237	0.4239	0.4238
1-2	0.4244	0.4245	0.4246	0.4245
1-3	0.4313	0.4314	0.4316	0.4314
1-4	0.4274	0.4273	0.4274	0.4274
1-5	0.3449	0.3448	0.3450	0.3449
1-F	0.2627	0.2624	0.2627	0.2626

Continued To: P. 62

Entered By: HANSEN

Date: 3-13-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 3-7-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weights Continued From: P. 61

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
2-C	0.2192	0.2191	0.2196	0.2193
2-1	0.4696	0.4690	0.4698	0.4695
2-2	0.3857	0.3854	0.3866	0.3859
2-3	0.4797	0.4793	0.4804	0.4798
2-4	0.4607	0.4604	0.4616	0.4609
2-5	0.4518	0.4518	0.4527	0.4521
2-F	0.2593	0.2594	0.2608	0.2598

Brink Final Weights
March 8, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
2-C	0.9837	0.9835	0.9839	0.9837
2-1	0.4718	0.4714	0.4717	0.4716
2-2	0.3867	0.3863	0.3865	0.3865
2-3	0.4806	0.4802	0.4803	0.4804
2-4	0.4618	0.4615	0.4614	0.4616
2-5	0.4529	0.4525	0.4525	0.4526
2-F	0.2607	0.2603	0.2603	0.2604

Continued To: P. 63

Disclosed To And Understood By Me:

Entered By: HANSEN

Date:

Date: 3-13-79

Date:

Project No. 4468-L(18) Date of Work: 3-7-79 Work Performed by: Hansen

Title or Purpose: Brink Tare Weights Continued From: P. 62

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
3-C	0.2207	0.2205	0.2214	0.2209
3-1	0.4722	0.4720	0.4728	0.4723
3-2	0.4930	0.4931	0.4940	0.4934
3-3	0.4625	0.4626	0.4633	0.4628
3-4	0.4804	0.4804	0.4814	0.4807
3-5	0.4694	0.4693	0.4704	0.4697
3-F	0.2617	0.2614	0.2627	0.2619

Brink Final Weights
March 9, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
3-C	1.7334	1.7336	1.7335	1.7335
3-1	0.4774	0.4774	0.4772	0.4773
3-2	0.4944	0.4944	0.4942	0.4943
3-3	0.4636	0.4635	0.4632	0.4634
3-4	0.4814	0.4813	0.4811	0.4813
3-5	0.4702	0.4702	0.4699	0.4701
3-F	0.2623	0.2622	0.2620	0.2622

Continued To: P. 64

Disclosed To And Understood By Me:

Entered By: Hansen

Date:

Date: 3-13-79

Date:

Project No. 4468-L(18) Date of Work: 3-7-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weights Continued From: P. 63

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
4-C	0.2240	0.2241	0.2245	0.2242
9-1	0.4230	0.4233	0.4230	0.4231
4-2	0.4753	0.4744	0.4750	0.4749
9-3	0.3479	0.3481	0.3478	0.3479
4-4	0.4651	0.4646	0.4651	0.4649
4-5	0.4737	0.4725	0.4733	0.4732
4-F	0.2686	0.2675	0.2687	0.2683

* Stages 4-3 + 4-1 were destroyed during assembly. They were replaced with stages 9-3 and 9-1 respectively.

Brink Final Weights
March 9, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
4-C	0.3142	0.3142	0.3142	0.3142
9-1	0.4251	0.4250	0.4250	0.4250
4-2	0.4752	0.4751	0.4751	0.4751
9-3	0.3482	0.3481	0.3481	0.3481
4-4	0.4653	0.4650	0.4650	0.4651
4-5	0.4733	0.4731	0.4732	0.4732
4-F	0.2682	0.2681	0.2681	0.2681

Continued To: P. 65

Entered By: HANSEN

Date: 3-13-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-2(18) Date of Work: 3-7-79 March 7, 1979 Work Performed by: Hansen

Title or Purpose: Brink Tare Weights Continued From: P. 64

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
5-C	0.2236	0.2225	0.2225	0.2229
5-1	0.4871	0.4859	0.4863	0.4864
5-2	0.4640	0.4628	0.4633	0.4634
5-3	0.4720	0.4707	0.4714	0.4714
5-4	0.5089	0.5073	0.5080	0.5081
5-5	0.4841	0.4825	0.4833	0.4833
5-F	0.2610	0.2594	0.2602	0.2602

Brink Final Weights
March 10, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
5-C	0.4188	0.4186	0.4186	0.4187
5-1	0.4897	0.4895	0.4894	0.4895
5-2	0.4642	0.4641	0.4643	0.4642
5-3	0.4722	0.4719	0.4721	0.4721
5-4	0.5088	0.5084	0.5086	0.5086
5-5	0.4839	0.4836	0.4836	0.4837
5-F	0.2609	0.2604	0.2606	0.2606

* Humidity in Swift Ag. Chemical Co. lab was very high on March 10, 1979.

Continued To: p. 66

Entered By: Hansen

Date: 3-13-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 3-7-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weights Continued From: P. 65

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
6-C	0.2233	0.2217	0.2224	0.2225
6-1	0.4893	0.4876	0.4883	0.4884
6-2	0.5085	0.5069	0.5074	0.5076
6-3	0.4745	0.4729	0.4734	0.4736
6-4	0.4884	0.4869	0.4874	0.4876
6-5	0.4898	0.4885	0.4889	0.4891
6-F	0.2658	0.2655	0.2657	0.2657

Brink Final Weights
March 10, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
6-C	0.3304	0.3304	0.3302	0.3303
6-1	0.4909	0.4907	0.4906	0.4907
6-2	0.5080	0.5075.	0.5075	0.5077
6-3	0.4734	0.4730	0.4730	0.4731
6-4	0.4873	0.4869	0.4868	0.4870
6-5	0.4886	0.4883	0.4882	0.4884
6-F	0.2654	0.2652	0.2648	0.2651

* Humidity in Swift Ag. Chemical Co. lab was very high on March 10, 19709.

Continued To: P. 67

Entered By: HANSEN

Date: 3-13-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 3-7-79 March 7, 1979 Work Performed by: Hansen

Title or Purpose: Brink Tare Weights Blank Set Continued From: P. 66

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
7-C	0.2265	0.2265	0.2264	0.2265
7-1	0.4721	0.4723	0.4726	0.4723
7-2	0.4830	0.4832	0.4832	0.4831
7-3	0.4621	0.4623	0.4625	0.4623
7-4	0.4984	0.4989	0.4991	0.4988
7-5	0.4830	0.4833	0.4837	0.4833
7-F	0.2731	0.2733	0.2737	0.2734

Brink Final Weights
March 10, 1979

Stage No.	Final 1	Final 2	Final 3	Avg. Final
7-C	0.2266	0.2267	0.2267	0.2267
7-1	0.4726	0.4725	0.4726	0.4726
7-2	0.4836	0.4836	0.4836	0.4836
7-3	0.4627	0.4626	0.4627	0.4627
7-4	0.4993	0.4993	0.4993	0.4993
7-5	0.4838	0.4838	0.4839	0.4838
7-F	0.2738	0.2739	0.2737	0.2738

* Humidity in Swift Ag. Chemical Co. lab was very high March 10, 1979.

Continued To: P. 68

Entered By: Hansen

Date: 3-13-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-LC(18) Date of Work: 3-7-79 Work Performed by: HANSEN

Title or Purpose: Brink Tare Weights Continued From: P. 67

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
8-C	0.2208	0.2208	0.2208	0.2208
8-1	0.4808	0.4809	0.4811	0.4809
8-2	0.4891	0.4890	0.4891	0.4891
8-3	0.4751	0.4749	0.4750	0.4750
8-4	0.4918	0.4917	0.4919	0.4918
8-5	0.4665	0.4664	0.4665	0.4665
8-F	0.2687	0.2689	0.2688	0.2688

No final weights were obtained for this set since it was not used in any test or as a blank. (Hansen 3-13-79).

Continued To: P. 69

Entered By: HANSEN

Date: 3-13-79

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-LC(8) Date of Work: 3-7-79 Work Performed by: Hansen

Title or Purpose: Brink Tare Weights Continued From: P. 68

Stage No.	Tare 1	Tare 2	Tare 3	Avg. Tare
9-C	0.2230	0.2232	0.2230	0.2231
9-1	0.4230	0.4233	0.4230	0.4231
9-2	0.4233	0.4235	0.4234	0.4234
9-3	0.3479	0.3481	0.3478	0.3479
9-4	0.3514	0.3518	0.3514	0.3515
9-5	0.3509	0.3510	0.3507	0.3509
9-F	0.2685	0.2688	0.2686	0.2686

* Stages 9-3 and 9-1 had to be used to replace stages 4-3 and 4-1 respectively because they had been destroyed during assembly. (Hansen, 3-9-79).

* Since this set had been partially used for another set, no final weights or tests were conducted using set 9. (Hansen, 3-13-79).

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

MIDWEST RESEARCH INSTITUTE
PROJECT DEVELOPMENT SKETCH

TITLE Swift Chem. / Beaumont, TX.
Brink Particle Size - Blank Corrections

PROJECT NO. 4468-1(18) DRAWN [illegible] APPR. ________ DATE 3-13-79

Filter Set No 7

Stage	Avg. Final Wt.	Avg. Tare Wt.	Difference
7-C	.2267	.2265	+ .0002
7-1	.4726	.4723	.0003
7-2	.4836	.4831	.0005
7-3	.4627	.4623	.0004
7-4	.4993	.4988	.0005
7-5	.4838	.4833	.0005
7-F	.2738	.2734	+ .0004
	g.	g.	g.
			.0022 [1]

$\therefore \frac{.0022}{5} = .0004$ gram

.0004 gram was used to correct stages 1 thru 5 by subtracting this value.

[1] Value for stages 7-1 thru 7-5

MIDWEST RESEARCH INSTITUTE

Run No. 1 - Scrubber Inlet BRINK Date 3-13-79

MRI Project No. 4468-L(18) Particle Size Analysis Recorded by HANSEN

ANALYSIS

Final Weights

By: HANSEN Date: 3-8-79

Location: Swift Chemical Co. Beaumont, TX

Tare Weights

By: HANSEN Date: 3-7-79

Location: Swift Chemical Co. Beaumont, TX

Stage	Filter Set ~~Paper~~ No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm) a/	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	1-C	.5697	.2265	.3430	* / **	* / **	
1	1-1	.4238	.4160	.0074			
2	1-2	.4245	.4238	.0003			
3	1-3	.4314	.4313	-.0003			
4	1-4	.4274	.4270	0			
5	1-5	.3449	.3447	-.0002			
Filter	1-F	.2626	.2625	-.0003			
			Total	* / .3507**			

CONCENTRATION CALCULATION

Sampling Duration 10 min

Flow Rate (Brink) 0.15 cfm

Baro. Pressure 30.30 in. Hg

Temperature 185 °F

a/ Includes blank correction.

Particulate Concentration ______ μg/m³, actual conditions

______ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter

** Without filter

MIDWEST RESEARCH INSTITUTE

Run No. 2 - Scrubber Inlet BRINK
MRI Project No. 4468-L(18) Particle Size Analysis

Date 3-13-79
Recorded by HANSEN

ANALYSIS

Final Weights

By: HANSEN Date: 3-8-79
Location: Swift Chemical Co. Beaumont, TX

Tare Weights

By: HANSEN Date: 3-7-79
Location: Swift Chemical Co. Beaumont, TX

Stage	Filter Set ~~Paper~~ No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm) a/	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	2-C	.9837	.2193	.7642	* **	* **	
1	2-1	.4716	.4695	.0017			
2	2-2	.3865	.3859	.0002			
3	2-3	.4804	.4798	.0002			
4	2-4	.4616	.4609	.0003			
5	2-5	.4526	.4521	.0001			
Filter	2-F	.2604	.2598	.0002			
			Total	* .7669 **			

CONCENTRATION CALCULATION

Sampling Duration 12 min
Flow Rate (Brink) 0.15 cfm
Baro. Pressure 30.30 in. Hg
Temperature 185 °F

a/ Includes blank correction.

Particulate Concentration ______ μg/m³, actual conditions
______ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter
** Without filter

MIDWEST RESEARCH INSTITUTE

Run No. 3-Scrubber Inlet BRINK Date 3-13-79

MRI Project No. 4468-LC(8) Particle Size Analysis Recorded by HANSEN

ANALYSIS

Final Weights

By: HANSEN Date: 3-9-79

Location: Swift Chemical Co. Beaumont, TX

Tare Weights

By: HANSEN Date: 3-7-79

Location: Swift Chemical Co. Beaumont, TX

Stage	Filter Set ~~Paper~~ No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm) a/	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	3-C	1.7335	.2209	1.5124	* / **	* / **	
1	3-1	.4773	.4723	.0046			
2	3-2	.4943	.4934	.0005			
3	3-3	.4634	.4628	.0002			
4	3-4	.4813	.4807	.0002			
5	3-5	.4701	.4697	0			
Filter	3-F	.2622	.2619	-.0001			
			Total	* / 1.5179 **			

CONCENTRATION CALCULATION

Sampling Duration 10 min

Flow Rate (Brink) 0.15 cfm

Baro. Pressure 30.08 in. Hg

Temperature 185 °F

a/ Includes blank correction.

Particulate Concentration ____________ μg/m³, actual conditions

____________ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter

** Without filter

MIDWEST RESEARCH INSTITUTE

Run No. 1-Cooler Outlet BRINK Date 3-14-79

MRI Project No. 4468-L(18) Particle Size Analysis Recorded by HANSEN

ANALYSIS

Final Weights

By: HANSEN Date: 3-9-79

Location: Swift Chemical Co. Beaumont, TX

Tare Weights

By: HANSEN Date: 3-7-79

Location: Swift Chemical Co. Beaumont, TX

Stage	Filter Set ~~Paper~~ No. *	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm) a/	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	4-C	.3142	.2242	.0898	* / **	* / **	
1	9-1	.4250	.4231	.0015			
2	4-2	.4751	.4749	-.0002			
3	9-3	.3481	.3479	-.0002			
4	4-4	.4651	.4649	-.0002			
5	4-5	.4732	.4732	-.0004			
Filter	4-F	.2681	.2683	-.0006			
Total				* / .0913 **			

* stages 4-1 and 4-3 were destroyed during assembly. they were replaced with stages 9-1 and 9-3 respectively.

CONCENTRATION CALCULATION

Sampling Duration 14 min

Flow Rate (Brink) 0.178 cfm

Baro. Pressure 30.08 in. Hg

Temperature 91 °F

a/ Includes blank correction.

Particulate Concentration ______ μg/m³, actual conditions

______ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter

** Without filter

MIDWEST RESEARCH INSTITUTE

Run No. 2- Cooler Outlet BRINK Date 3-14-79

MRI Project No. 4468-L(18) Particle Size Analysis Recorded by HANSEN

ANALYSIS

Final Weights

By: HANSEN Date: 3-10-79

Location: Swift Chemical Co. Beaumont, TX

Tare Weights

By: HANSEN Date: 3-7-79

Location: Swift Chemical Co. Beaumont, TX

Stage	Filter Set ~~Paper~~ No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm) a/	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	5-C	.4187	.2229	.1956	* **	* **	
1	5-1	.4895	.4864	.0027			
2	5-2	.4642	.4634	.0004			
3	5-3	.4721	.4714	.0003			
4	5-4	.5086	.5081	.0001			
5	5-5	.4837	.4833	0			
Filter	5-F	.2606	.2602	0			
			Total	* .1991 **			

CONCENTRATION CALCULATION

Sampling Duration 14 min

Flow Rate (Brink) 0.178 cfm

Baro. Pressure 30.07 in. Hg

Temperature 91 °F

a/ Includes blank correction

Particulate Concentration ____________ μg/m³, actual conditions

____________ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter

** Without filter

MIDWEST RESEARCH INSTITUTE

Run No. 3-Cooler Outlet BRINK Date 3-14-79

MRI Project No. 4468-LC(8) Particle Size Analysis Recorded by HANSEN

ANALYSIS

Final Weights

By: HANSEN Date: 3-10-79

Location: Swift Chemical Co. Beaumont, TX

Tare Weights

By: HANSEN Date: 3-7-79

Location: Swift Chemical Co. Beaumont, TX

Stage	Filter Set ~~Paper~~ No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm) a/	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	6-C	.3303	.2225	.1076	* / **	* / **	
1	6-1	.4907	.4884	.0019			
2	6-2	.5077	.5076	-.0003			
3	6-3	.4731	.4736	-.0009			
4	6-4	.4870	.4876	-.0010			
5	6-5	.4884	.4891	-.0011			
Filter	6-F	.2651	.2657	-.0010			
			Total	* / .1095 **			

CONCENTRATION CALCULATION

Sampling Duration 14 min

Flow Rate (Brink) 0.178 cfm

Baro. Pressure 30.07 in. Hg

Temperature 91 °F

a/ Includes blank correction.

Particulate Concentration ________ μg/m³, actual conditions

________ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter

** Without filter

D-4 ASSOCIATED CORRESPONDENCE PRIOR TO THE FIELD TEST REGARDING BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TESTING

10/2/78

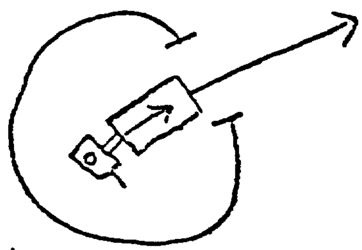
Gene, my thoughts on P.Sizing

1. Cyclone pre-~~cotton~~ condition strongly recommended on inlet (wouldn't hurt at outlet either). See if TRC has this accessory.

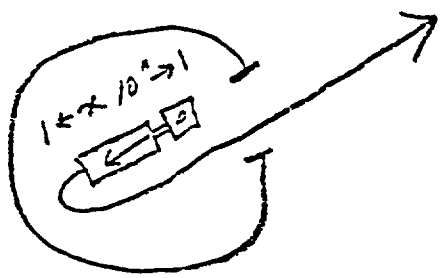
2. Appears that Sierra sells glass fiber substrates for plates. These should probably be preconditioned before use, i.e., heated and baked to temperature above that to be found in stack. Make sure proper taring procedures are used since only very small weight gains will be obtained.

3. Horizontal duct and location of ports at inlet may be problem. Although impactors theoretically work in all orientations - practically upright vertical or horizontal is best, especially at inlet where high loadings will occur and overloading is a strong possibility.

A possible modification which might be wise is to use a "u-turn" probe and keep impactor in upright position.



Preferred:



Impactor diam. 3". This leaves only 1" clearance for probe if "u-turn" approach is used. This approach also restricts how deeply into the duct one can traverse since the inlet is now towards the center of the duct instead of the end of the probe. In this case the impactor is ~10" long. In a 5 foot duct this should not be significant.

4. Heating at outlet necessary. Inlet may be required. If heating at inlet is not used the instrument should be placed in the duct prior to testing in order to reach stack temperature before testing begins.

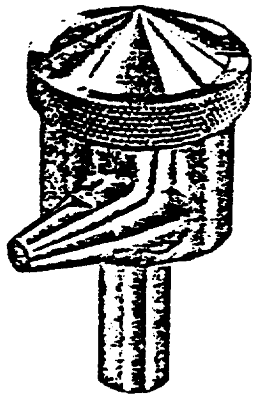
Even with heating at outlet, if entrained water is present, moisture will probably be a problem. Sometimes moving to a different point on the traverse where entrained water is ~~not~~ present helps.

Heat by using some sort of heating jacket and covering electrical components to prevent shorting. alum foil

To save time unit can be heated in oven prior to sampling (using heater tape may take forever to raise temperature).

A nice accessory (if you can convince the contractor)would be a thermocouple at the impactor outlet to monitor temperature.

. 220 CP
ʟONE PRESEPARATOR
(SOURCE CASCADE IMPACTORS



FITS THROUGH 3" PORT

SPECIFICATIONS:

Flow Rate	0.5 SCFM nominal; 0.1 to 2.0 SCFM range
Construction	316 stainless steel, welded
Collection Efficiency	Curve shown below. Particle diameter at 50% collection efficiency is 4.6 microns at 0.5 SCFM. Geometric standard deviation is 1.3. All particle sizes referenced to equivalent spherical particles with unity mass density in air at 25° C and 760 mm Hg
Outside Dimensions	Maximum O.D. of cyclone body (cover): 1-7/8"; Max. width, including Model 220CP-N nozzle and Model 226 impactor: 2-15/16"; total height: 3-1/2"; 5/8" O.D. X 1-1/2" l tube fits into impactor inlet section
Net Weight/Shipping Weight	9 oz. / 1.5 lbs.
Nozzles	Model 220CP-N Isokinetic Sampling Nozzles; 316 stainless steel 1/2, 3/8, 9/32, 7/32, 3/16, 5/32" I.D.; 5/8" O.D. x 15/16" l.

DESCRIPTION:

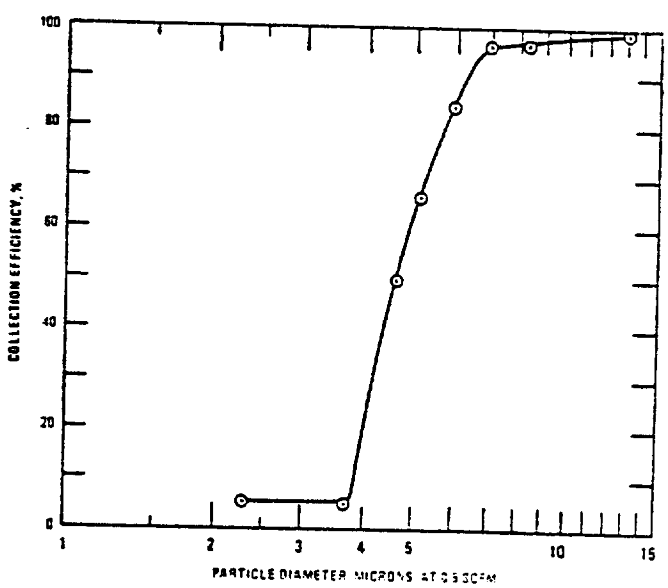
The Model 220CP Cyclone Preseparator attaches to Sierra's Model 226 and 2600 source cascade impactors and collects particles larger than nominally 5 microns. It is used when measuring particle size distributions in stacks with *high grain loadings* and permits longer sampling times. The miniature Model 220CP cyclone is constructed of 316 stainless steel and is only 1-5/8" in diameter. The cyclone is used with Model 220CP-N Isokinetic Sampling Nozzles. With these nozzles it fits through a 3" sampling port.

The Model 220CP is also used with the Model 814S In-Stack Filter Holder for separating fine and coarse particles.

Model 220CP
Mounted on Model 226
Source Cascade Impactor

PRINCIPLE OF OPERATION:

The centrifugal forces in the Model 220CP cyclone preseparator bring larger particles in contact with the walls and top cover of the cyclone where they are collected. After sampling, the top cover is removed, and particles collected on the internal surfaces of the cyclone are removed with a camel's hair brush or by washing for subsequent gravimetric or chemical analysis. Removal of such larger particles by the cyclone gives longer sampling times by extending the time before reintrainment occurs in the cascade impactor and eliminates those particles having the greatest potential of bouncing after impaction.



PARTICLE COLLECTION EFFICIENCY OF MODEL 220CP

APPENDIX E	VISIBLE EMISSIONS DATA
E-1	VISIBLE EMISSIONS SUMMARY DATA
E-2	VISIBLE EMISSIONS FIELD DATA
E-2-1	VISIBLE EMISSIONS FIELD DATA SHEETS
E-2-2	VISIBLE EMISSIONS OBSERVATION LOCATIONS FIGURE 1-E-2-2
E-3	COPY OF EPA VISIBLE EMISSIONS CERTIFICATION CERTIFICATE

E-1 VISIBLE EMISSIONS SUMMARY DATA

MIDWEST RESEARCH INSTITUTE

SUMMARY OF VISIBLE EMISSIONS

Type of Plant: Ammonium Nitrate Date: 3-5-79

Type of Discharge: Scrubber Outlet Height of Point of Discharge: ______

Location of Discharge: See diagram Height of Observation Point: Ground level

Distance from Observer to Discharge Point: @ 80' Duration: 1 hour and 18 min.

Direction of Observer from Discharge Point: South-southeast of stack

Descript. of Background: Sky Wind Direction: W-E Color of Plume: white

Descript. of Sky: High cirrus clouds Wind Velocity: ______ Detached Plume: No

SUMMARY OF TIME AND AVERAGE OPACITY

Set No.	Start	End	Sum	Avg.	Set No.	Start	End	Sum	Avg.
1	1529	1534:45	120	5	21				
2					22				
3					23				
4					24				
5					25				
6					26				
7					27				
8					28				
9					29				
10					30				
11					31				
12					32				
13					33				
14					34				
15					35				
16					36				
17					37				
18					38				
19					39				
20					40				

Sketch showing how opacity varied with time:

Opacity, percent

Time, hours

MIDWEST RESEARCH INSTITUTE

SUMMARY OF VISIBLE EMISSIONS

Type of Plant: Ammonium Nitrate Date: 3-6-79
Type of Discharge: Scrubber Outlet Height of Point of Discharge: ______
Location of Discharge: See diagram Height of Observation Point: Ground level
Distance from Observer to Discharge Point: @80' Duration: 3 hours and 15 min.
Direction of Observer from Discharge Point: South-southeast of stack
Descript. of Background: Sky Wind Direction: W-E Color of Plume: White
Descript. of Sky: Clear, no clouds Wind Velocity: ______ Detached Plume: No

SUMMARY OF TIME AND AVERAGE OPACITY

Set No.	Start	End	Sum	Avg.	Set No.	Start	End	Sum	Avg.
1	0904	0909:45	355	14.79	21	1124	1129:45	425	17.70
2	0916	0921:45	235	9.79	22	1130	1135:45	460	19.16
3	0922	0927:45	245	10.20	23	1136	1141:45	485	20.20
4	0929	0933:45	270	11.25	24	1142	1147:45	405	16.87
5	0934	0939:45	320	13.33	25	1148	1153:45	450	18.75
6	0940	0945:45	270	11.25	26	1154	1159:45	360	15.00
7	0946	0951:45	160	6.66	27	1200	1205:45	285	11.87
8	0952	0957:45	150	6.25	28	1206	1211:45	405	16.87
9	0958	1003:45	235	9.79	29	1212	1217:45	435	18.12
10	1009	1014:45	310	12.91	30				
11	1015	1020:45	380	15.83	31				
12	1021	1026:45	360	15.00	32				
13	1027	1032:45	670	27.91	33				
14	1033	1038:45	455	18.95	34				
15	1039	1044:45	350	14.58	35				
16	1045	1050:45	460	19.16	36				
17	1051	1056:45	640	26.66	37				
18	1106	1111:45	510	21.25	38				
19	1112	1117:45	390	16.25	39				
20	1118	1123:45	325	13.54	40				

Sketch showing how opacity varied with time:

Opacity, percent

Time, hours

MIDWEST RESEARCH INSTITUTE

SUMMARY OF VISIBLE EMISSIONS

Type of Plant: Ammonium Nitrate Date: 3-7-79
Type of Discharge: Scrubber Outlet Height of Point of Discharge: ______
Location of Discharge: See diagram Height of Observation Point: Ground level
Distance from Observer to Discharge Point: @120' Duration: 53 minutes.
Direction of Observer from Discharge Point: West of stack
Descript. of Background: Sky Wind Direction: W-E Color of Plume: White
Descript. of Sky: Clear, < 5% clouds Wind Velocity: ______ Detached Plume: No

SUMMARY OF TIME AND AVERAGE OPACITY

Set No.	Start	End	Sum	Avg.	Set No.	Start	End	Sum	Avg.
1	1640:15	1646	120	5	21				
2	1646:15	1652	120	5	22				
3	1652:15	1658	120	5	23				
4	1658:15	1704	120	5	24				
5	1704:15	1710	125	5.20	25				
6	1710:15	1716	130	5.41	26				
7	1716:15	1722	125	5.20	27				
8	1722:15	1728	135	5.62	28				
9					29				
10					30				
11					31				
12					32				
13					33				
14					34				
15					35				
16					36				
17					37				
18					38				
19					39				
20					40				

Sketch showing how opacity varied with time:

Opacity, percent

Time, hours

MIDWEST RESEARCH INSTITUTE

SUMMARY OF VISIBLE EMISSIONS

Type of Plant: Ammonium Nitrate Date: 3-8-79
Type of Discharge: Scrubber Outlet Height of Point of Discharge: ______
Location of Discharge: See diagram Height of Observation Point: Ground level
Distance from Observer to Discharge Point: @ 80' Duration: 5 hours and 59 min.
Direction of Observer from Discharge Point: South - Southwest of stack
Descript. of Background: Sky Wind Direction: NN-SE Color of Plume: White
Descript. of Sky: Clear Wind Velocity: ______ Detached Plume: No

SUMMARY OF TIME AND AVERAGE OPACITY

Set No.	Start	End	Sum	Avg.	Set No.	Start	End	Sum	Avg.
1	0900	0905:45	330	13.75	21	1156:15	1202	360	15.00
2	0920	0925:45	310	12.91	22	1202:15	1208	340	14.16
3	0926	0931:45	325	13.54	23	1208:15	1214	395	16.45
4	0932	0937:45	325	13.54	24	1214:15	1220	420	17.50
5	0952:15	0958	335	13.95	25	1220:15	1226	315	13.12
6	0958:15	1004	380	15.83	26	1226:15	1232	330	13.75
7	1004:15	1010	355	14.79	27	1232:15	1238	325	13.54
8	1010:15	1016	345	14.37	28	1238:15	1244	290	12.08
9	1016:15	1022	355	14.79	29	1244:15	1250	315	13.12
10	1022:15	1028	370	15.41	30	1250:15	1256	345	14.37
11	1033:45	1039:30	415	17.29	31	1256:15	1302	330	13.75
12	1039:45	1045:30	360	15.00	32	1335	1340:45	465	19.37
13	1045:45	1051:30	380	15.83	33	1341	1346:45	360	15.00
14	1051:45	1057:30	380	15.83	34	1347	1352:45	345	14.37
15	1108:15	1114	430	17.91	35	1353	1358:45	410	17.08
16	1114:15	1120	375	15.62	36	1403	1408:45	370	15.41
17	1126	1131:45	375	15.62	37	1409	1414:45	390	16.25
18	1132	1137:45	350	14.58	38	1415	1420:45	415	17.29
19	1138	1143:45	310	12.91	39	1421	1426:45	310	12.91
20	1150:15	1156	345	14.37	40	1427	1432:45	350	14.58

Sketch showing how opacity varied with time:

Opacity, percent

Time, hours

MIDWEST RESEARCH INSTITUTE

SUMMARY OF VISIBLE EMISSIONS

Type of Plant: Ammonium Nitrate Date: 3-8-79 Continued
Type of Discharge: Scrubber Outlet Height of Point of Discharge: ______
Location of Discharge: See diagram Height of Observation Point: Ground level
Distance from Observer to Discharge Point: @80' Duration: 5 hours and 54 min.
Direction of Observer from Discharge Point: South - southwest of stack
Descript. of Background: Sky Wind Direction: NW-SE Color of Plume: White
Descript. of Sky: Clear Wind Velocity: ______ Detached Plume: No

SUMMARY OF TIME AND AVERAGE OPACITY

Set No.	Start	End	Sum	Avg.	Set No.	Start	End	Sum	Avg.
41	1433	1438:45	350	14.58	21				
42	1439	1444:45	380	15.83	22				
43	1445	1450:45	390	16.25	23				
44	1451	1456:45	325	13.54	24				
5					25				
6					26				
7					27				
8					28				
9					29				
10					30				
11					31				
12					32				
13					33				
14					34				
15					35				
16					36				
17					37				
18					38				
19					39				
20					40				

Sketch showing how opacity varied with time:

Opacity, percent

Time, hours

E-2 VISIBLE EMISSIONS FIELD DATA

E-2-1 VISIBLE EMISSIONS FIELD DATA SHEETS

MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift Chemical Co.
Date: 3/5/79
Plant Address: Beaumont Tex.
Observer: C. Cole
Stack Location: see diagram
Observer's Location: SW of Stack, approximately 90 feet
Weather Conditions: High cirrus clouds [redacted]

+4 min diff to be in syn. w/ control clock

HR	MIN	00	15	30	45	COMMENTS	HR	MIN	00	15	30	45	COMMENTS
[illegible]	00	5	5	5	5			30	5	5	5	5	discontinued readings*
	01	5	5	5				31					
	02							32					
	03							33					
	04							34					
	05							35					
	06							36					
	07							37					
	08							38					
	09						16	39	5	5	5	5	Blue sky
	10						16	40	5	5	5	5	occasionally
	11						16	41	5	5	5	5	less than 5
	12						16	42	5	5	5	5	even against blue
	13						16	43	5	5	5	5	sky plume is only
	14							44					occasionally visible
	15							45					
	16							46					
	17							47					
	18							48					
	19							49					
	20							50					
	21							51					
	22							52					
	23							53					
	24							54					
15	25	5	5	5	5	very light plume		55					
	26	5	5	5	5	only visible		56					
	27	5	5	5	5	at proximately		57					
	28	5	5	5	5	15–25 feet above		58					
	29	5	5	5	5	stack		59					

* Visible emissions from observer's position consisted of [redacted] occassional wisps of white smoke (steam?) against side of Prill tower. Light overcast from high cirrus clouds totally obscured reading.

Moving ~~out~~ position to approximately 30 feet ~~and viewing~~ from stack and viewing against Prill tower made visible a ~~very definite~~ continuous ~~plume~~ white plume which was ~~visible~~ light enough to allow heat waves to be also visible

5–10 mph

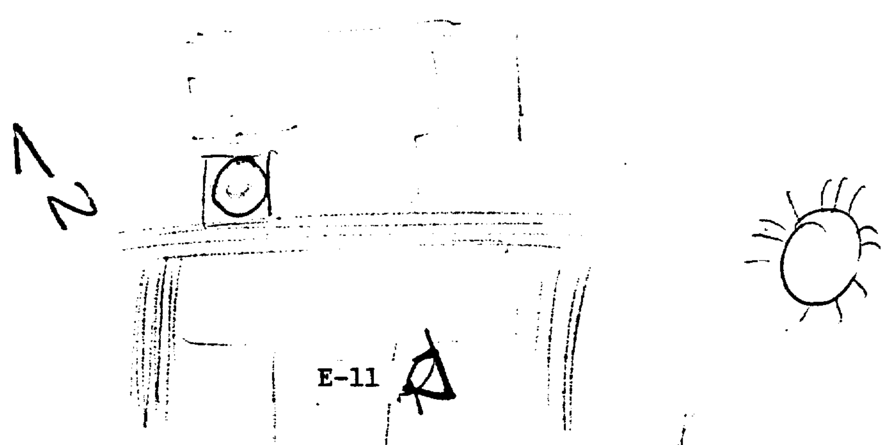
MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift Date: 3/6/79
Plant Address: Beaumont Observer:
Stack Location: Clear-Blue Sky Observer's Location: #1
Weather Conditions:

HR	MIN	00	15	30	45	COMMENTS
09	00	5	5	5	5	
09	01	5	10	10	10	
09	02	10	10	10	10	
09	03	15	15	20	20	
09	04	20	25	25	20	
09	05	25	25	25	25	
09	06	25	30	30	25	
09	07	30	30	30	30	
09	08	25	25	20	20	
09	09	[redacted]				Not observing
09	10					[redacted]
09	11					
09	12	10	15	10	10	
09	13	10	15	15	15	
09	14	10	10	15	10	
09	15	10	5	5	5	
09	16	10	5	5	10	
09	17	10	10	10	5	
09	18	10	5	5	5	
09	19	5	5	5	5	
09	20	10	10	15	15	
09	21	20	20	20	15	
09	22	10	10	5	5	
09	23	10	15	10	10	
09	24	10	15	20	20	
09	25	15	10	10	10	
09	26	10	15	15	15	
09	27	10	15	10	10	
09	28	10	10	5	5	
09	29	10	5	10	5	

HR	MIN	00	15	30	45	COMMENTS
09	30	10	5	10	10	
09	31	10	15	10	10	
09	32	10	15	15	10	
09	33	10	15	15	15	
09	34	15	15	20	20	
09	35	20	15	15	15	
09	36	15	15	10	15	
09	37	10	15	15	15	
09	38	10	10	10	10	
09	39	10	5	5	10	
09	40	10	10	10	10	
09	41	15	10	10	15	
09	42	10	10	5	5	
09	43	5	5	5	5	
09	44	10	10	5	5	
09	45	5	5	5	5	
09	46	5	5	5	10	
09	47	5	10	10	10	
09	48	10	10	10	10	
09	49	5	5	5	5	
09	50	5	5	5	5	
09	51	5	10	5	5	
09	52	5	5	5	5	
09	53	5	5	10	5	
09	54	10	5	10	5	
09	55	5	5	10	10	
09	56	10	10	15	15	
09	57	15	15	10	15	
09	58	10	10	15	15	
09	59	5	5	5	5	



MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

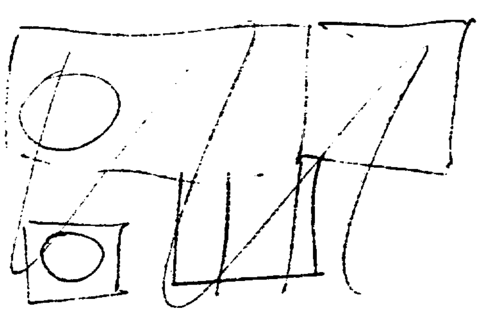
#1

Company Name: Swift
Plant Address: Beaumont Tx.
Stack Location: Seedwagram
Weather Conditions: Clear-Blue Sky

Date: 3/6/79
Observer: C. Cole
Observer's Location: 90' SE of Stack
+ 4 min diff to be in synchronization w/ plant control room clock

HR	MIN	00	15	30	45	COMMENTS
10	00	—	—	—	—	Took a Break
10	01	—	—	—	—	
10	02	—	—	—	—	
10	03	—	—	—	—	
10	04	—	—	—	—	
10	05	15	15	10	10	
10	06	10	5	5	5	
10	07	5	10	5	5	
10	08	5	10	15	15	
10	09	20	25	20	30	
10	10	20	20	15	15	
10	11	10	10	10	10	
10	12	10	15	15	15	
10	13	10	15	15	15	
10	14	15	15	20	20	
10	15	20	20	25	20	
10	16	20	15	20	20	
10	17	15	10	15	20	
10	18	15	20	15	15	
10	19	15	15	15	15	
10	20	15	10	10	20	
10	21	15	15	15	15	
10	22	15	20	20	15	
10	23	15	20	25	35	
10	24	30	30	50	50	
10	25	25	35	35	30	
10	26	35	40	35	[illegible]	75 - white screen
10	27	35	25	20	15	
10	28	15	15	15	10	
10	29	15	20	20	20	

HR	MIN	00	15	30	45	COMMENTS
10	30	35	25	15	20	
10	31	25	25	20	25	
10	32	25	20	20	15	
10	33	15	15	15	10	
10	34	15	10	15	15	
10	35	10	15	10	10	
10	36	15	15	15	15	
10	37	10	15	15	15	
10	38	15	15	15	15	
10	39	15	15	10	20	
10	40	15	15	20	20	
10	41	15	15	15	15	
10	42	10	15	15	10	
10	43	20	20	25	20	
10	44	25	25	20	15	
10	45	15	15	25	20	
10	46	25	25	30	25	
10	47	20	20	20	15	
10	48	15	15	15	25	
10	49	30	30	35	35	
10	50	30	30	40	55	
10	51	40	35	30	30	
10	52	30	30	25	25	
10	53	20	25	20	20	
10	54	20	25	20	20	
10	55	25	20	20	20	
10	56	20	25	20	20	
10	57	20	20	20	20	
10	58	25	—	—	—	
10	59	—	—	—	—	



MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

#1

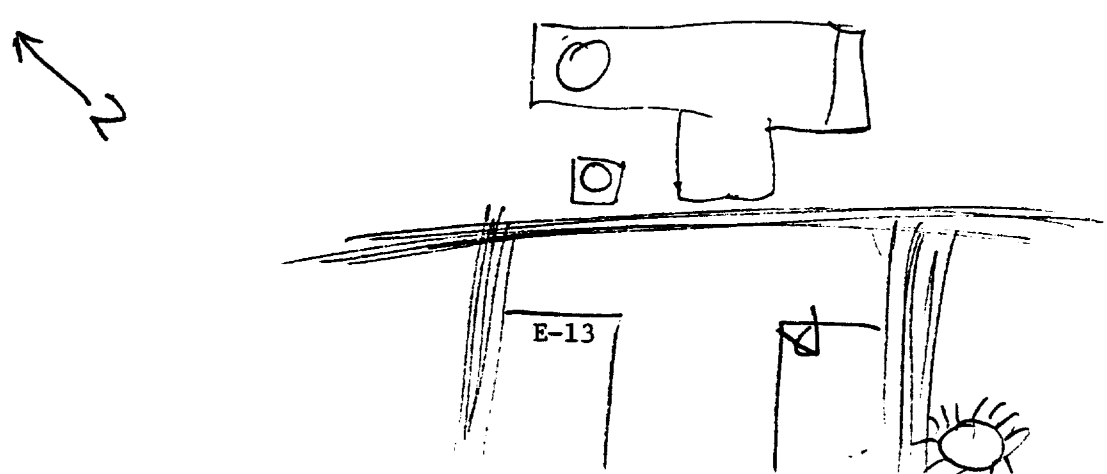
Company Name: Swift
Plant Address: Beaumont Tx.
Stack Location: See diagram
Weather Conditions: Clear Blue Sky

Date: 3/6/79
Observer: C. Cole
Observer's Location: 90' SE of Stack

+4 min to be in synchrony w/Control Rm. Clock.

HR	MIN	00	15	30	45	COMMENTS
11	00	—	—	—	—	Break
11	01	—	—	—	—	
11	02	25	25	20	20	
11	03	20	25	25	25	
11	04	25	20	20	25	
11	05	20	20	20	15	
11	06	20	20	20	20	
11	07	20	20	20	20	
11	08	25	20	20	20	
11	09	20	20	25	20	
11	10	20	20	20	15	
11	11	15	15	15	15	
11	12	10	10	10	10	
11	13	10	10	10	15	
11	14	10	15	15	15	
11	15	15	15	15	15	
11	16	15	15	10	15	
11	17	15	10	15	15	
11	18	15	10	10	10	
11	19	15	15	10	15	
11	20	15	10	10	10	
11	21	15	10	15	25	
11	22	20	20	25	20	
11	23	15	20	20	20	
11	24	20	20	20	25	
11	25	20	15	15	20	
11	26	20	20	25	25	
11	27	25	20	20	20	
11	28	20	15	15	15	
11	29	15	15	15	20	

HR	MIN	00	15	30	45	COMMENTS
11	30	20	20	15	20	
11	31	20	20	20	20	
11	32	25	20	15	15	
11	33	20	25	25	25	
11	34	25	20	25	20	
11	35	25	20	20	20	
11	36	15	20	20	15	
11	37	15	15	15	15	
11	38	15	20	15	15	
11	39	20	20	20	20	
11	40	15	15	20	15	
11	41	20	20	15	15	
11	42	20	20	15	15	
11	43	15	15	15	10	
11	44	10	20	15	15	
11	45	20	20	20	20	
11	46	20	25	20	15	
11	47	20	15	15	15	
11	48	20	15	20	25	
11	49	25	25	25	20	
11	50	20	20	20	15	
11	51	15	15	15	10	
11	52	10	10	10	10	
11	53	15	15	15	15	
11	54	15	20	20	15	
11	55	15	15	15	15	
11	56	10	10	10	10	
11	57	10	10	10	10	
11	58	15	10	10	15	
11	59	15	20	15	15	



MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift

Plant Address: Beaumont Tx

Stack Location:

Weather Conditions:

Date: 3/6/79 #1

Observer:

Observer's Location:

+4 min, Synchronized w/ Control Rm clock.

TIME						COMMENTS	TIME						COMMENTS
HR	MIN	SECONDS					HR	MIN	SECONDS				
		00	15	30	45				00	15	30	45	
12	00	10	10	10	10			30					
12	01	10	10	15	15			31					
12	02	10	15	20	20			32					
12	03	15	20	20	15			33					
12	04	15	15	15	15			34					
12	05	15	20	15	20			35					
12	06	15	20	20	20			36					
12	07	15	20	15	15			37					
12	08	20	20	20	15			38					
12	09	20	20	20	20			39					
12	10	15	15	15	15			40					
12	11	20	20	15	20			41					
12	12	20	25	20	20			42					
12	13	15	15	15	15			43					
12	14	15	15	20	15			44					
12	15	15	20	15	15			45					
	16							46					
	17							47					
	18							48					
	19							49					
	20							50					
	21							51					
	22							52					
	23							53					
	24							54					
	25							55					
	26							56					
	27							57					
	28							58					
	29							59					

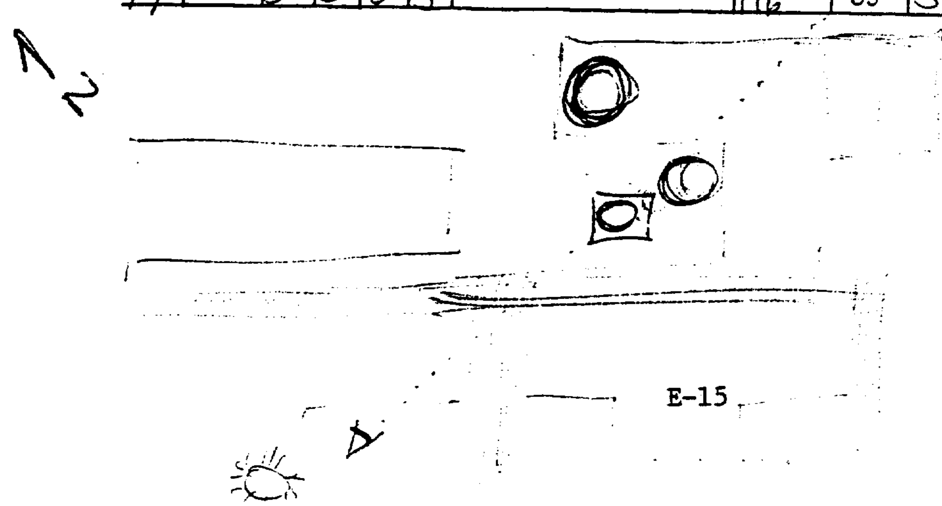
MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift
Plant Address: Beaumont Tx
Stack Location: See diagram
Weather Conditions: ~~[illegible]~~ clear w/ < 5% cloud windy, quickly changing sky

Date: 3/7/79
Observer: Cole
Observer's Location: See diagram

HR	MIN	00	15	30	45	COMMENTS	HR	MIN	00	15	30	45	COMMENTS
17	00	5	5	5	5			30					
17	01	5	5	5	5			31					
17	02	5	5	5	5			32					
17	03	5	5	5	5			33					
17	04	5	5	5	5			34					
17	05	5	5	5	5			35					
17	06	5	5	5	5		16	36	5	5	5	5	plume read against blue
17	07	5	5	5	5		16	37	5	5	10	10	sky.
17	08	5	10	5	5		16	38	5	5	5	5	
17	09	5	5	5	5		16	39	5	—	—	—	a Cloud
17	10	5	5	5	10		16	40	—	5	5	5	
17	11	5	5	5	5		16	41	5	5	5	5	
17	12	5	5	5	5		16	42	5	5	5	5	
17	13	5	5	5	5		16	43	5	5	5	5	
17	14	5	5	10	5		16	44	5	5	5	5	
17	15	5	5	5	5		16	45	5	5	5	5	
17	16	5	5	5	5		16	46	5	5	5	5	
17	17	5	5	10	5		16	47	5	5	5	5	
17	18	5	5	5	5		16	48	5	5	5	5	
17	19	5	5	5	5		16	49	5	5	5	5	
17	20	5	5	5	5		16	50	5	5	5	5	
17	21	5	5	5	5		16	51	5	5	5	5	
17	22	5	5	5	5		16	52	5	5	5	5	
17	23	5	5	5	5		16	53	5	5	5	5	
17	24	5	5	5	10		16	54	5	5	5	5	
17	25	10	5	5	5		16	55	<5	<5	5	5	
17	26	5	10	5	5		16	56	<5	5	5	5	
17	27	5	5	5	5		16	57	5	5	5	5	
17	28	5	5	5	5		16	58	5	5	5	5	
17	29	5	5	5	5		16	59	5	<5	<5	<5	



MIDWEST RESEARCH INSTITUTE

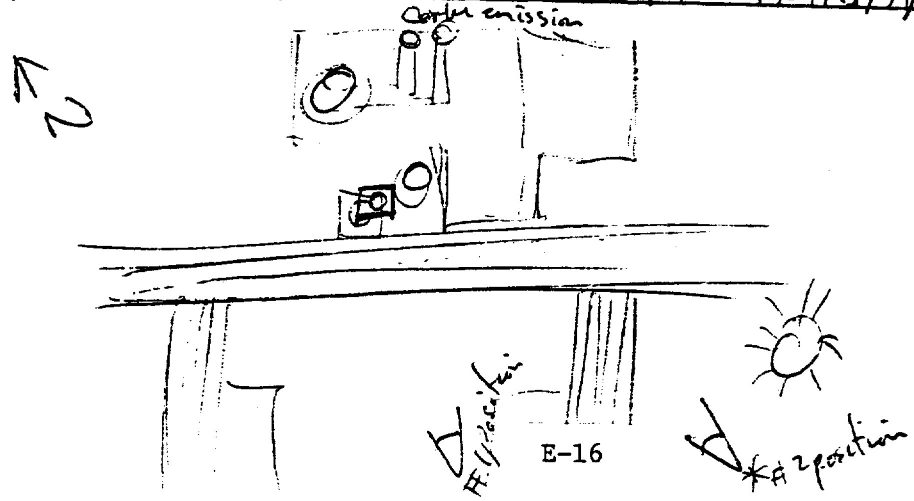
RECORD OF VISIBLE EMISSIONS

Company Name: Swift
Plant Address: Beaumont Tx.
Stack Location: See diagram
Weather Conditions: Clear - Blue sky
wind NW -

Date: 3/8/79
Observer:
Observer's Location: 90 feet SE of Stack
See diagram

HR	MIN	00	15	30	45	COMMENTS
09	00	15	15	15	15	when the Cooler emissions are rising behind the stack so as to make it very difficult to separate plumes I will designate with a (CE) in comments
09	01	15	10	15	10	
09	02	15	10	10	15	
09	03	15	10	10	10	
09	04	15	15	15	15	
09	05	15	20	15	15	
09	06	15	15	20	20	
09	07	15	15	15	15	
09	08	15	15	15	15	
09	09	15	15	15	10	
09	10	15	15	10	10	
09	11	15	-	-	-	CE
09	12	-	-	-	-	CE
09	13	-	-	-	-	CE
09	14	-	-	10	15	CE
09	15	10	10	10	10	
09	16	15	15	15	15	
09	17	15	15	15	15	
09	18	10	10	10	10	
09	19	10	15	15	[illegible]	CE
09	20	15	15	15	15	
09	21	10	10	10	15	
09	22	15	15	15	15	
09	23	10	15	15	10	
09	24	15	10	10	10	
09	25	10	15	15	10	
09	26	10	10	10	15	
09	27	15	15	15	15	
09	28	15	10	10	15	
09	29	15	20	15	15	

HR	MIN	00	15	30	45	COMMENTS
09	30	10	15	15	15	
09	31	10	10	15	15	
09	32	15	10	10	15	
09	33	15	10	15	15	
09	34	10	10	15	15	
09	35	15	15	10	10	
09	36	10	10	15	15	
09	37	15	20	20	15	
09	38	15	15	15	15	
09	39	15	15	20	15	
09	40	15	15	15	15	
09	41	15	10	15	15	
09	42	15	15	15	15	
09	43	15	-	-	-	CE
09	44	-	-	-		CE
09	45	10	10	15	15	
09	46	10	15	15	15	
09	47	15	15	10	15	
09	48	15	15	15	15	
09	49	15	15	10	15	
09	50	-	-	-	-	CE
09	51	-	-	-	-	CE
09	52	-	15	15	15	
09	53	15	10	10	10	* Moved to new location due to fumes from nitric acid process.
09	54	15	15	10	10	
09	55	10	15	15	15	
09	56	15	15	15	15	
09	57	15	15	15	15	Moved back to #1 position
09	58	20	15	15	15	White particles visible from stack (large
09	59	15	15	15	15	



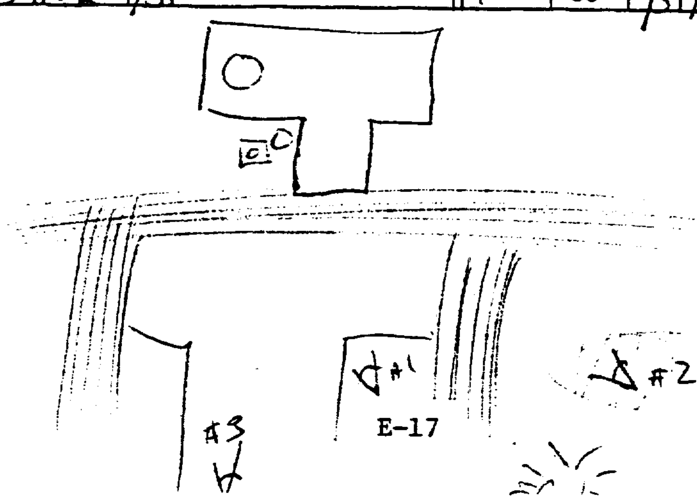
MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift
Plant Address: Beaumont Tx
Stack Location: See diagram
Weather Conditions: Clear Blue Sky

Date: 3/8/79
Observer: Cole
Observer's Location: See diagram

HR	MIN	00	15	30	45	COMMENTS	HR	MIN	00	15	30	45	COMMENTS
10	00	15	15	15	20	Position #1	10	30	15	15	15	20	
10	01	20	20	15	15		10	31	15	—	—	-	CE
10	02	20	15	15	15		10	32	—	—	15	—	CE
10	03	15	15	15	15		10	33	—	—	-	20	CE
10	04	15	15	15	15		10	34	20	15	20	20	
10	05	15	15	15	15		10	35	20	15	15	15	
10	06	15	15	10	15		10	36	20	15	15	15	
10	07	15	10	15	15		10	37	20	20	20	20	
10	08	15	15	15	20		10	38	15	20	15	15	
10	09	15	15	15	15		10	39	15	15	15	15	
10	10	15	15	15	15		10	40	15	15	15	15	
10	11	15	15	15	15		10	41	15	15	20	15	
10	12	20	15	15	15		10	42	15	15	15	15	
10	13	15	15	15	15		10	43	15	15	10	15	
10	14	15	15	10	10		10	44	15	15	15	15	
10	15	10	10	15	15		10	45	15	15	15	15	
10	16	15	15	15	10		10	46	15	15	15	15	
10	17	10	15	10	10		10	47	15	15	15	15	
10	18	15	15	10	15		10	48	15	15	20	15	
10	19	15	15	10	15		10	49	20	20	20	15	
10	20	15	20	20	20		10	50	15	15	15	15	
10	21	15	15	20	20		10	51	15	15	15	15	
10	22	15	15	15	20		10	52	15	20	15	20	
10	23	15	15	15	20		10	53	15	15	15	15	
10	24	15	15	10	10		10	54	15	15	15	15	
10	25	15	15	15	15		10	55	15	15	15	15	
10	26	10	15	15	15		10	56	15	15	15	15	
10	27	15	15	20	20		10	57	20	15	20	15	
10	28	20	15	20	20		10	58	15	15	20	20	
10	29	15	15	20	15		10	59	15	15	15	15	



MIDWEST RESEARCH INSTITUTE

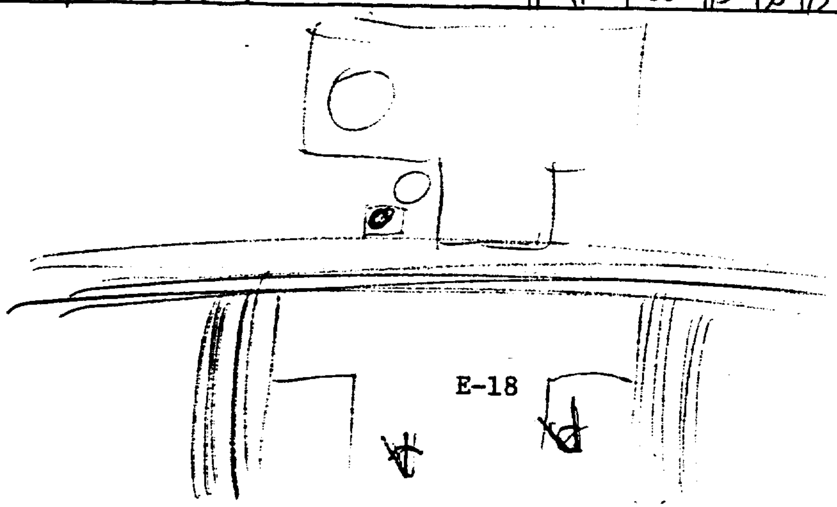
RECORD OF VISIBLE EMISSIONS

#1

Company Name: Swift
Plant Address: Beaumont Tx
Stack Location: See diagram
Weather Conditions: Clear blue Sky

Date: 3/8/79
Observer: Cole
Observer's Location: See diagram

HR	MIN	00	15	30	45	COMMENTS
11	00	15	15	15	20	
11	01	15	15	15	15	
11	02	15	15	15	15	
11	03	15	—	—	—	CE #1
11	04	—	—	—	—	CE #2
11	05	—	—	—	—	CE #3
11	06	—	—	—	—	CE
11	07	—	—	—	—	CE
11	08	—	15	15	20	
11	09	20	20	20	20	#2
11	10	20	20	20	15	
11	11	20	15	15	20	
11	12	20	15	15	15	
11	13	15	20	20	20	
11	14	15	15	15	15	
11	15	15	15	20	15	
11	16	15	20	15	15	
11	17	15	20	15	15	
11	18	15	15	15	15	
11	19	15	15	15	15	
11	20	15	15	20	15	
11	21	20	20	20	20	
11	22	20	15	20	20	
11	23	15	—	—	—	CE
11	24	—	15	15	15	
11	25	15	—	—	—	CE
11	26	15	15	20	20	
11	27	15	15	15	15	
11	28	15	15	15	15	
11	29	15	15	15	15	
11	30	15	15	15	15	
11	31	20	15	15	15	
11	32	15	15	15	15	
11	33	10	15	15	15	
11	34	15	15	15	15	
11	35	10	15	15	15	
11	36	15	15	15	15	
11	37	15	15	15	15	
11	38	15	15	15	15	
11	39	15	15	15	15	
11	40	15	10	10	10	
11	41	10	15	10	15	
11	42	10	10	10	10	
11	43	10	15	15	15	
11	44	15	15	15	15	
11	45	15	15	10	15	
11	46	15	15	15	15	
11	47	15	15	15	15	
11	48	15	15	15	15	
11	49	15	15	—	—	CE
11	50	—	15	15	15	
11	51	15	10	15	15	
11	52	15	15	10	15	
11	53	15	15	15	15	
11	54	15	10	15	15	
11	55	15	15	15	15	
11	56	15	15	15	15	
11	57	15	15	15	15	
11	58	15	15	15	15	
11	59	15	15	15	15	



MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

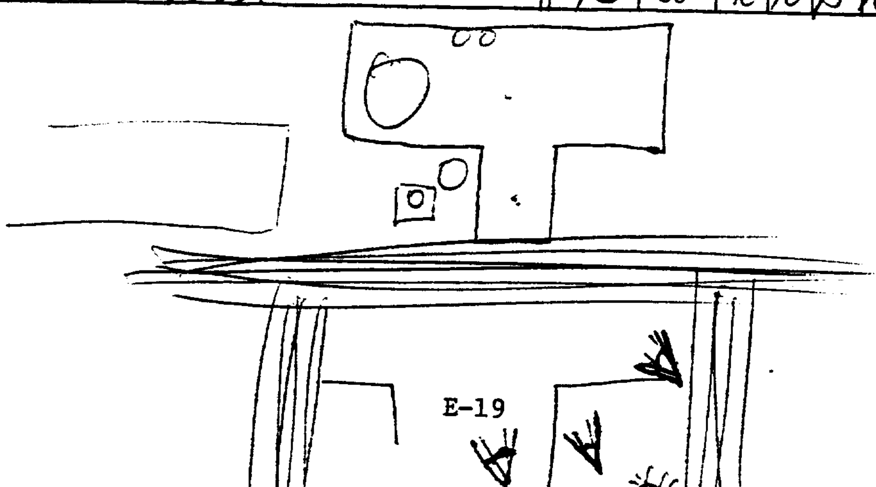
Company Name: ______________________ Date: 3-8-79 #1

Plant Address: ______________________ Observer: ______________________

Stack Location: ______________________ Observer's Location: ______________________

Weather Conditions: ______________________

HR	MIN	00	15	30	45	COMMENTS
12	00	15	15	15	15	
12	01	15	15	15	15	
12	02	15	15	15	15	
12	03	15	15	15	15	
12	04	15	10	15	15	
12	05	15	15	10	10	
12	06	10	15	15	15	
12	07	15	15	15	15	
12	08	15	15	15	15	
12	09	15	15	20	15	
12	10	15	15	15	15	
12	11	15	15	15	15	
12	12	15	15	15	20	
12	13	20	20	20	20	
12	14	20	15	15	20	
12	15	15	20	20	15	
12	16	15	15	15	20	
12	17	20	25	20	20	
12	18	15	20	15	20	
12	19	20	15	15	15	
12	20	15	15	15	15	
12	21	15	15	15	15	
12	22	15	15	15	15	
12	23	15	15	10	10	
12	24	10	15	10	10	
12	25	15	10	10	10	
12	26	10	15	10	10	
12	27	10	15	10	15	
12	28	15	15	15	15	
12	29	15	10	15	15	
12	30	15	10	15	15	
12	31	15	15	15	15	
12	32	15	15	15	15	
12	33	15	15	10	15	
12	34	15	15	15	15	
12	35	15	15	15	15	
12	36	10	15	15	10	
12	37	15	15	10	10	
12	38	10	10	10	15	
12	39	15	15	10	15	
12	40	15	15	15	15	
12	41	15	15	10	10	
12	42	10	10	10	10	
12	43	10	10	10	10	
12	44	10	10	15	15	
12	45	15	15	10	10	
12	46	10	10	10	10	
12	47	10	10	15	15	
12	48	15	15	15	15	
12	49	15	15	15	15	
12	50	15	15	15	15	
12	51	15	15	15	15	
12	52	10	15	10	15	
12	53	15	15	15	15	
12	54	15	15	15	15	
12	55	10	15	15	15	
12	56	15	15	15	10	
12	57	15	15	15	15	
12	58	15	15	15	10	
12	59	10	10	15	10	



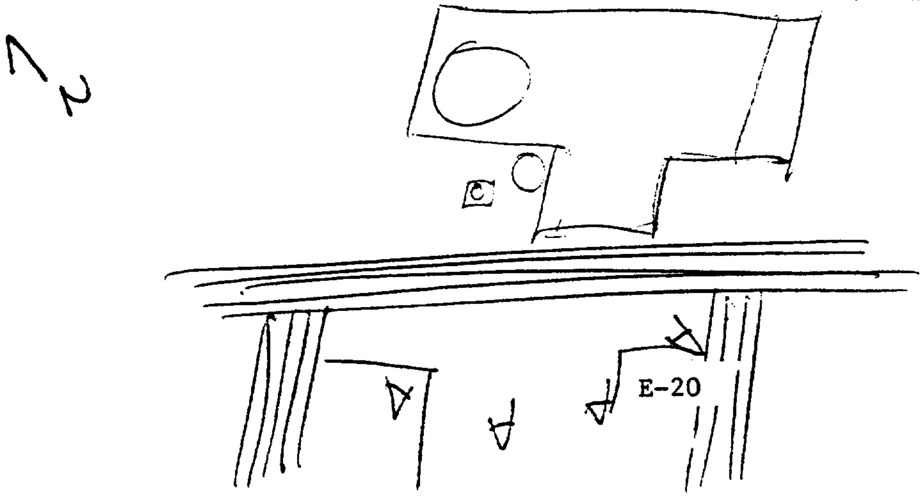
MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift
Plant Address: Beaumont TX.
Stack Location: See diagram
Weather Conditions: Clear blue sky

Date: 3/8/79
Observer: Cole
Observer's Location: ~~@ 90 ft E of Stack~~ See diagram

HR	MIN	SECONDS 00	15	30	45	COMMENTS	HR	MIN	SECONDS 00	15	30	45	COMMENTS
13	00	15	15	15	15		13	30					
13	01	15	15	15	10		13	31					
13	02	15	15	15	10		13	32					
13	03	10	12	10	15		13	33					
13	04	15	15	15	15		13	34					
13	05	15	10	15	10		13	35	20	20	20	20	
13	06	10	15	15	15		13	36	20	20	20	20	
13	07					Break for lunch	13	37	20	20	20	20	
13	08					↓	13	38	20	20	20	20	
13	09						13	39	20	20	20	20	
13	10						13	40	20	15	15	15	
13	11						13	41	15	15	15	15	
13	12						13	42	15	15	15	13	
13	13						13	43	15	15	15	15	
13	14						13	44	15	15	15	15	
13	15						13	45	15	15	15	15	
13	16						13	46	15	15	15	15	
13	17						13	47	15	15	15	15	
13	18						13	48	15	15	15	15	
13	19						13	49	15	15	15	15	
13	20						13	50	10	10	10	15	
13	21						13	51	15	15	15	15	
13	22						13	52	15	15	15	15	
13	23						13	53	15	20	20	20	
13	24						13	54	20	20	20	20	
13	25						13	55	20	15	15	15	
13	26						13	56	20	20	20	15	
13	27						13	57	15	15	15	15	
13	28						13	58	15	15	15	10	
13	29						13	59	10	15	20	15	

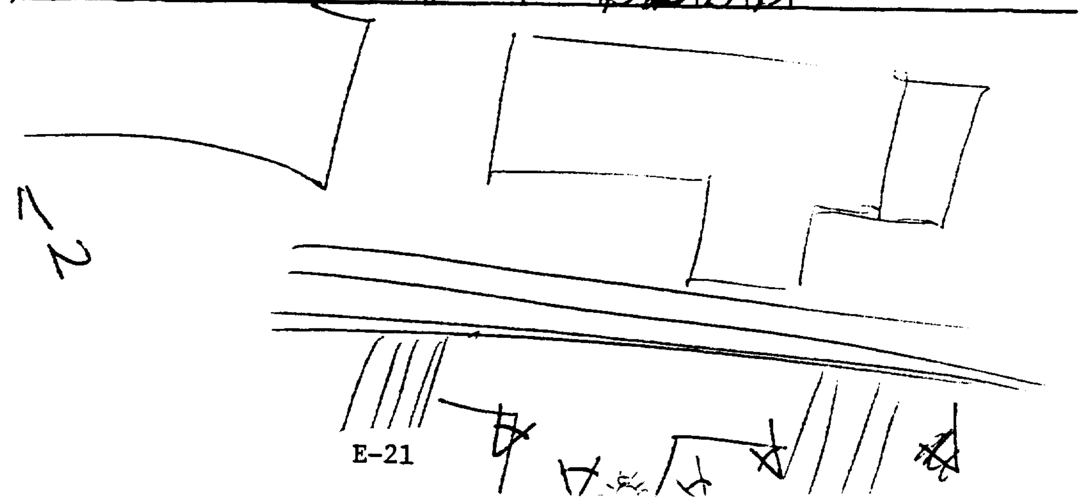


MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: Swift Date: 3/8/78
Plant Address: Beaumont Tx. Observer: Cole
Stack Location: See diagram Observer's Location: See diagram
Weather Conditions: Clear-blue Sky

HR	MIN	00	15	30	45	COMMENTS	HR	MIN	00	15	30	45	COMMENTS
14	00	~~15~~	~~15~~	—	—	Went to get new	14	30	15	10	10	15	
14	01	—	—	—	—	~~[illegible]~~ Record	14	31	15	15	15	15	
14	02	—	—	—	—	Sheets	14	32	15	15	15	15	
14	03	15	15	15	15		14	33	15	15	15	15	
14	04	15	15	15	15		14	34	15	15	15	15	
14	05	15	15	15	15		14	35	15	15	15	15	
14	06	15	15	20	20		14	36	15	15	15	15	
14	07	15	15	15	15		14	37	15	15	15	15	
14	08	15	15	15	15		14	38	15	15	10	10	
14	09	15	15	15	15		14	39	10	15	15	15	
14	10	20	25	20	20		14	40	10	15	15	10	
14	11	20	15	15	15		14	41	15	20	20	20	
14	12	15	15	15	15		14	42	20	15	20	20	
14	13	15	15	15	15		14	43	2..	15	15	15	
14	14	15	15	15	15		14	44	15	15	15	15	
14	15	15	15	15	15		14	45	15	15	15	15	
14	16	15	15	15	15		14	46	15	15	15	20	
14	17	15	15	20	20		14	47	20	20	20	20	
14	18	20	20	20	15		14	48	20	15	15	15	
14	19	20	15	20	20		14	49	15	15	15	15	
14	20	20	20	20	15		14	50	15	15	15	15	
14	21	15	15	15	15		14	51	15	10	15	15	
14	22	15	15	15	15		14	52	15	15	15	15	
14	23	15	15	10	15		14	53	15	10	10	10	
14	24	10	10	10	10		14	54	10	10	15	15	
14	25	10	10	10	10		14	55	15	10	15	15	
14	26	15	15	10	15		14	56	15	15	15	15	
14	27	15	15	15	15		14	57	15	15	15	15	
14	28	15	15	15	15		14	58	15	15	15	15	
14	29	15	15	15	15		14	59	15	20	15	15	



E-2-2 VISIBLE EMISSIONS OBSERVATION LOCATIONS
FIGURE 1-E-2-2

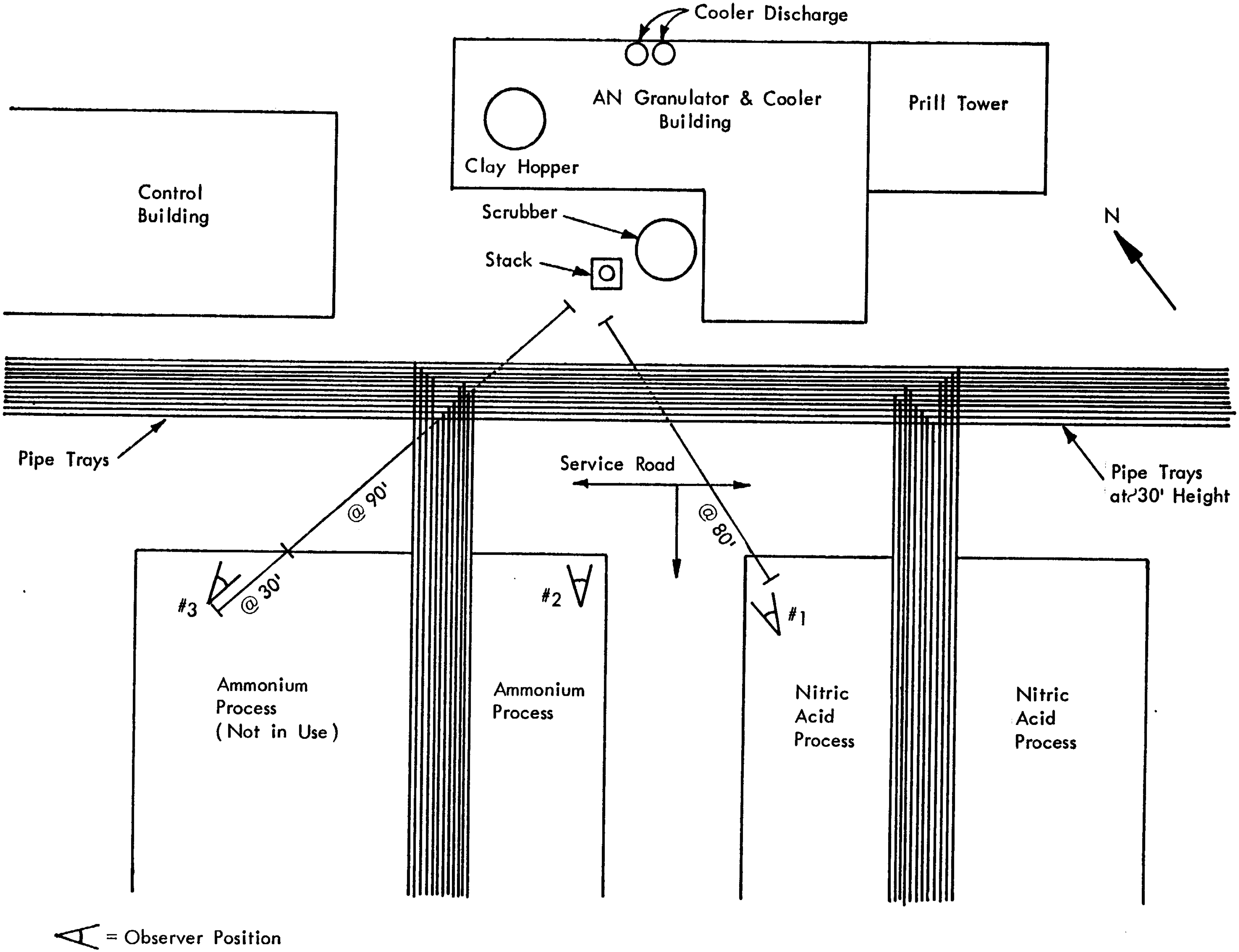


Figure 1-E-2-2. Diagram of Visible Emission Observer Stations - Swift Chemical Company, Beaumont, Texas

E-3 COPY OF EPA VISIBLE EMISSIONS CERTIFICATION CERTIFICATE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION
REGION VII
25 FUNSTON ROAD
KANSAS CITY, KANSAS 66115

October 10, 1978

Mr. Christopher Cole
Midwest Research Institute
425 Volker Blvd.
Kansas City, Missouri 64110

Dear Mr. Cole:

Enclosed is your copy of the Smoke School Training Form in which you met the certification requirements outlined in the Federal Register, Volume 39, Number 219, Tuesday, November 12, 1974, Method 9.

Sincerely yours,

Dewayne E. Durst

Dewayne E. Durst
Chief, Air Section
Technical Services Branch
Surveillance & Analysis Division

Enclosure

eck

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VII
SMOKE SCHOOL TRAINING FORM

1. Name of Observer Christopher Cole
2. Affiliation Hillcrest Research Inst.
3. Date 10/3/78 Time 11
4. Wind Speed 5-10 mph gusting Direction E Easterly Sky Condition Clear
5. Observers Position South 50 feet
6. Corrected By Joe Aelly EPA

(Record Black of Gray Smoke in Ringelmann No. - 1/4 Unit Smallest Division)
(Record All Other Smoke In % Opacity - 5% Smallest Division)

RUN NO. 14 Black

Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	- Deviation	Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	- Deviation
1	10	15		5	13	25	25	—	
2	5	5	—		14	35	30	5	
3	25	25	—		15	35	30	5	
4	35	35	—		16	20	20	—	
5	40	35	5		17	15	20		5
6	50	45	5		18	20	20	—	
7	60	50	10		19	5	10		5
8	70	60	10		20	0	5		5
9	60	55	5		21	30	20	10	
10	55	50	5		22	35	30	5	
11	45	35	10		23	40	35	5	
12	35	30	5		24	40	40	—	
					25	50	35	15	

RUN NO. 14 White

Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	- Deviation	Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	- Deviation
1	10	10	—		13	20	15	5	
2	15	15	—		14	25	20	5	
3	25	30		5	15	25	25	—	
4	30	35		5	16	35	30	5	
5	40	45		5	17	~~40~~ 30	30	—	
6	45	45	—		18	40	35	5	
7	50	50	—		19	50	50	—	
8	55	55	—		20	60	55	5	
9	65	60	5		21	~~45~~ 35	40		5
10	75	70	5		22	30	30	—	
11	60	50	10		23	20	25		5
12	55	45	10		24	20	20	—	
					25	0	0	—	

Clear

7. Run Number	14 B	14 W
8. Number Correct	7	11
9. Number of Plus Deviations	14	9
10. Number of Minus Deviations	4	5
11. Average Plus Deviations = $\frac{\text{Sum of Plus Deviations}}{\text{No. of Plus Deviations}}$	100/14	55/9
12. Average Minus Deviations = $\frac{\text{Sum of Minus Deviations}}{\text{No. of Minus Deviations}}$	20/4	25/5
13. Average Deviation = $\frac{\text{(Sum of Plus Deviations) + (Sum of Minus Deviations)}}{\text{Total No. of Readings}}$	120/25	80/25
14. Number of Readings 20% Deviation and Over	0	0

N

Sun

Johnson

GSA-KC-7701045

APPENDIX F RELATIVE HUMIDITY, AMBIENT TEMPERATURE, AND INLET-TO-OUTLET DIFFERENTIAL PRESSURE DATA

F-1 SUMMARIES OF FIELD DATA

F-2 FIELD DATA SHEETS

F-2-1 ROTARY DRUM GRANULATOR SCRUBBER TESTS

F-2-2 ROTARY DRUM COOLER UNCONTROLLED OUTLET TESTS

F-1 SUMMARIES OF FIELD DATA

TITLE Swift Chemical Co. / Beaumont, TX.
Summary Log: Scrubber ΔP, Ambient Parameters

PROJECT NO. 4468-L(18) DRAWN DAPOS APPR. ____ DATE 4-2-79

Time	Pressure Drop ("H_2O)	Dry Bulb (°F)	Wet Bulb (°F)	% RH.
0900-0945	7.23	55.8	48.5	55.0
1000-1045	7.83	59.3	49.8	48.2
1100-1145	8.95	62.6	50.4	41.3
1200-1215	8.8	64.3	50.4	37.0
3-6-79				
0915-1030	10.5	62.4	51.7	47.2
1047-1130	10.0	66.0	52.8	40.3
1145-1230	9.4	68.6	53.5	34.8
1245-1345	8.9	71.5	55.2	31.0
1445-1530	10.1	77.2	56.3	24.5
1545-1630	10.4	76.6	56.3	24.3
1645-1710	10.2	75.2	56.4	27.0
3-7-79				
0903-0947	13.4	57.8	48.6	49.0
1003-1048	12.5	62.0	49.3	37.5
1103-1405	12.5	66.2	51.5	33.5
1418-1505	12.3	75.4	56.2	29.0
1512-1533	12.5	76.2 [1]	57.0 [1]	28.0 [1]
1405-1448	—	74.9	56.7	29.3
1505-1518	—	76.0	57.0	28.0
3-8-79				
0845-1000	4.9	71.7	65.3	74.0
1015-1100	4.8	74.0	65.6	68.3
1515-1600	4.5	77.2	66.4	55.0
1615-	4.5 [1]	77.5 [1]	66.0 [1]	53. [1]

[1] Not an average

SWIFT CHEM. CO., BEAUMONT, TX 4468-L(18)

SUMMARY LOG: MARCH 6, 1979

Day 2 B.C. DAROS

Time	Pressure Drop ("H_2O)	Dry Bulb (°F) TP-7	Wet Bulb (°F) TP-7	Relative Hum. (%) TP-7	Scrubber-I Liquor (TP-3) pH/°C (time)	Scrubber-I Liquor (TP-3) °F	Scrubber-O Liquor (TP-4) pH/°C (time)	Scrubber-O Liquor (TP-4) °F	AN Melt TP-5
0800									
0900	7.1	54.2	N/R	N/A					
	7.3	55.6	48.3	55	(0900)				
	7.3	56.2	48.4	55	6.6@38	129.0	(0955)		
	7.3	57.3	49.0	55	(1005)		5.2@28	100.0	
1000	7.2	57.7	49.3	51	6.5@40	130.0	(1010)		
	7.1	59.0	50.0	52			5.23@30	100.0	
	8.4	59.6	49.8	48	(1040)		(1044)		
	8.6	60.7	49.8	44	6.65@40	136.0	5.55@30	100.0	
1100	9.0	61.2	50.6	44	(1120)		(1124)		
	9.1	62.2	50.0	41	6.85@38	130.0	5.55@30	100.0	
	8.9	63.0	50.6	42					GRAB
	8.8	64.0	50.8	38	(1201)		(1210)		
1200	8.8	64.2	50.6	38	7.05@30	134.0	5.5@26	102.0	
	8.8	64.6	50.6	35					
1300									
1400									
1500									
1600									
1700									
1800									

SWIFT CHEM. Co., BEAUMONT, TX. 4468-C(11)

SUMMARY LOG: MARCH 7, 1979

Doc 3 / 6

B.C. DuRos

Time	Pressure Drop ("H2O)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Hum. (%)	Scrubber-I Liquor (TP-3) Ph/°C	Scrubber-I Liquor (TP-3) °F	Scrubber-O Liquor (TP-4) Ph/°C	Scrubber-O Liquor (TP-4) °F	Granular or Product TP-6
0800									
0900									
	10.7	54.0	50.6	57					
1000		63.6	51.6	46					
		63.8	52.3	43					
	10.3	64.3	52.4	43	6.45@36	136.			
	10.1	65.1	52.8	44			5.9@29	92.	
1100	9.9	65.8	52.8	40					
	9.9	66.4	53.1	40	6.7@36	130.	5.8@29	94.	
	10.2	66.7	52.6	37					130°F
1200	9.4	67.7	53.2	34	6.6@40	121.	6.18@30	94.	
	9.4	68.1	53.1	34					
	9.5	68.2	53.8	38			5.74@30	94.	
	9.2	70.0	54.0	33	6.52@40	123.			
	8.8	71.5	55.2	31			6.55@40	94.	
1300	8.6				6.51@30	122.			
	9.2								
1400									
	9.7	77.4	52.6	26.					
1500	10.4	77.4	55.6	24.	6.54@40.	121.			
	9.9	77.2	57.4	23.			5.23@32.	98.	
	10.51	76.8	55.6	23.	6.55@40.	124.			
	10.5	76.8	56.3	23.					
1600	10.4	77.0	56.4	26.	6.57@40.	127.	5.00@32	98.	136°F
	10.2	76.7	56.3	23.			5.11@32	99.	
	10.4	75.8	56.0	25.					
1700	10.4	75.4	56.4	27.	6.55@43.	128.	5.36@32	99.	
	10.0	75.0	56.3	27.					
							5.21@31	99.	
1800					6.4@40	125.			

SWIFT CHEM. CO., BEAUMONT, TX. 4468- C(18)

SUMMARY LOG: MARCH 8, 1979 Day 4 B.C. DuRos

Time	Pressure Drop ("H_2O)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Hum. (%)	Scrubber-I Liquor Ph/°C	Scrubber-I Liquor (TP-3) °F	Scrubber-O Liquor Ph/°C	Scrubber-O Liquor TP-4 °F	Gran. Product TP-6
0800									
0900		55.9	48.2	55					
	13.8	56.3	48.8	55					
	13.7	57.0	48.8	47	7.35@40.	140.	6.0@25.	99.	
	13.2	59.9	49.4	39					
1000	12.5	61.0	47.0	40	7.30@43.	143.	5.95@30	100.	
	12.5	61.8	49.0	36					
	12.8	62.5	49.5	37	7.10@46.	140.	5.8@32	100	136°F
	12.6	62.8	49.5	37					
1100	12.9	62.9	49.5	37	6.99@48.	144.	5.76@32	100	
	12.6	63.6	50.0	34	7.10@46.	150			
	12.6	64.3	50.4	34			5.71@31	100	
1200									
1300									
1400	11.8	74.0	56.2	29					
	12.3	74.7	56.7	30					
	11.9	75.2	56.6	30					
	12.5	75.8	57.4	28					126°F
1500	12.5	75.8	57.0	28					
	12.4	76.2	57.0	28					
	12.6								
1600									
1700									
1800									

SWIFT CHEM. CO., BEAUMONT, TX. 4768-L(10)

SUMMARY LOG: MARCH 9, 1979

Day 5 — B.C. DaRos

Time	Pressure Drop ("H_2O)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Hum. (%)	Scrubber-I Liquor (TP-3) Ph/°C	Scrubber-I Liquor (TP-3) °F	Scrubber-O Liquor (TP-4) Ph/°C	Scrubber-O Liquor (TP-4) °F
0800								
0900	5	69.4	64.4	85				
	4.8	72.2	65.4	69				
	4.8	72.2	65.4	69				
1000	4.8	73.1	65.6	73				
	4.7	73.4	65.4	73				
	4.8	73.8	65.8	67				
	4.8	74.1	65.4	69				
1100	4.8	75.5	65.8	62				
1200								
1300								
1400								
1500								
	4.5	77.0	66.3	56.				
	4.5	77.2	66.4	56.				
1600	4.6	77.3	66.4	56.				
	4.5	77.5	66.3	53.				
	4.5	77.5	66.0	53.				
1700								
1800								

F-2 FIELD DATA SHEETS

F-2-1 ROTARY DRUM GRANULATOR SCRUBBER TESTS

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-6-79

By C. E. Riley

Readings:

Time	Pressure Drop "H_2O" (~~Wind Direction Velocity~~)	°F Temperature	Wet Bulb (~~RH~~)	R.H. (~~Cloud Cover~~)
0800	3.8+3.3 = 7.1	54.2	N.A.	N.A.
0915	3.8+3.5 = 7.3	55.6	48.2	55.
0930	3.8+3.4 = 7.2	56.2	48.4	55.
0945	3.8+3.5 = 7.3	57.2	~~48.0~~ 49.0	55.
1000	3.8+3.4 = 7.2	57.9	49.3	51.
1015	3.8+3.3 = 7.1	59.0	50.0	52.
1030	4.4+4.0 = 8.4	59.6	49.8	48.
1045	4.5+4.1 = 8.6	60.7	49.8	44.
1100	4.7+4.3 = 9.0	61.2	50.0	44.
1115	4.8+4.3 = 9.1	62.2	50.0	[illegible]
1130	4.7+4.2 = 8.9	63.0	50.6	42.
1145	4.6+4.2 = 8.8	64.0	50.8	38.
~~1150~~			~~50.~~	38.
1200	4.6+4.2 = 8.8	64.2	50.6	[illegible]
1215	4.6+4.2 = 8.8	64.6	50.6	35.

Comments:

N. A. – not available

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-7-79

By Tim Curtain - C. E. Riley

Readings:

Time	Pressure Drop "H_2O ~~Wind~~ Direction Velocity	°F Temperature	Wet Bulb ~~RH~~	% R.H. ~~Cloud Cover~~
0915	5.6 + 5.1 = 10.7	59.0	50.6	57.
1003	plugged inlet hose	62.6	51.6	46.
1019	" " "	63.8	52.3	43.
1030	5.2 + 5.1 = 10.3	64.3	52.4	43
1047	5.0 + 5.1 = 10.1	65.1	52.8	44.
1103	4.9 + 5.0 = 9.9	65.8	52.8	40.
1118	4.9 + 5.0 = 9.9	66.4	53.1	40.
1130	5.1 + 5.1 = 10.2	66.7	52.6	37.
1145	4.7 + 4.7 = 9.4	67.9	53.2	34.
1204	4.7 + 4.7 = 9.4	68.1	53.1	34.
1217	4.8 + 4.7 = 9.5	68.2	53.8	38.
1230	4.6 + 4.6 = 9.2	70.0	54.0	added H_2O 33.
1245	4.4 + 4.4 = 8.8	71.5	55.2	31.
1300	4.3 + 4.3 = 8.6			[illegible]
1345	4.7 + 4.5 = 9.2			[illegible]

Comments:

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-7-79

By Tim Curtain - C.C. Riley

Readings:

Time	Pressure Drop in, H_2O ~~Wind~~ ~~Direction~~ ~~Velocity~~	°F Temperature	Wet Bulb ~~RH~~	RH % ~~Cloud Cover~~
1445	5.1+4.6=9.7	77.4	56.6	26.
1500	5.4+5.0=10.4	77.4	55.6	26.
1515	5.2+4.7=9.9	77.2	57.4	23
1530	5.5+5.0=10.5	76.8	55.6	23.
1545	5.5+5.0=10.5	76.8	56.3	23.
1600	5.4+5.0=10.4	77.0	56.6	26.
1615	5.4+4.8=10.2	76.7	56.3	23.
1630	5.4+5.0=10.4	75.8	56.0	25.
1645	5.4+5.0=10.4	75.4	56.4	27.
1710	4.8+5.2=10.0	75.0	56.3	27.

Comments:

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-8-79

By Tim Curtani

Readings:

Time	~~Wind Direction Velocity~~ Pressure Drop in. H_2O	°F Temperature	~~RH~~ Wet Bulb	~~Cloud Cover~~ RH %
0903		55.9	48.2	55.
0916	6.9+6.4=13.3	56.3	48.8	55.
0932	7.1+6.6 =13.7	59.6	48.8	47.
0947	6.8+6.4 = 13.2	59.9	48.4	39.
1003	6.0 6.5 = 12.5	61.0	49.0	40.
1018	6.2 + 6.3 =12.5	61.8	49.0	36.
1033	5.9 + 6.4 = 12.3	62.5	49.5	37
1048	6.5 + 6.1 =12.6	62.8	~~50.2~~ 49.5	37.
1103	6.1 + 6.8 =12.9	62.8	49.5	37.
1117	6.1 + 6.5 =12.6	63.6	50.0	34.
1134	6.1 +6.5 = 12.6	64.3	50.4	34.
1405 (Cooler Data)	*6.1 +5.7 = 11.8	74	56.2	29.
1413	*6.6 +5.7 = 12.3	74.7	56.7	30.
1433	*6.1 +5.8 = 11.9	75.2	56.6	30.
1448	*6.0 +6.5 =12.5	75.8	57.4	28.
1305	*6.0 +6.5 =12.5	75.8	57.0	28.
1318	*6.0 +6.4 = 12.4	76.2	57.0	28.
1533	*6.1 +6.5 =12.6			—

Comments:

* Pressure drop data recorded on granulator scrubber.

F-2-2 ROTARY DRUM COOLER UNCONTROLLED OUTLET TESTS

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-8-79 Cooler Test

By Tim Custani

Readings:

Time	~~Wind~~ ~~Direction~~ Velocity	°F Temperature	Wet Bulb ~~RH~~	RH % ~~Cloud Cover~~
1405		74	56.2	29.
1418		74.7	56.7	30.
1433		75.2	56.6	30.
1448		75.8	57.4	3?.
1505		75.8	57.0	28.
1518		76.2	57.0	28.
~~1533~~				[illegible]

Comments:

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-9-79 Cooler

By C.E. Riley

Readings:

Time	Cooler Pressure Drop "H_2O" ~~Wind~~ ~~Direction~~ ~~Velocity~~	°F Temperature	Wet Bulb ~~RH~~	R.H. % Cloud Cover
8:45	2.5+2.5=5	69.4	64.6	85.
0930 ~~9:00~~	2.4+2.4=4.8	72.2	65.4	69.
09:45 ~~9:15~~	2.4+2.4=4.8	72.2	65.4	69.
1000 ~~9:30~~	2.4+2.4=4.8	73.1	65.6	73.
10:15	2.4+2.5=4.9	73.4	65.4	73.
10:30	2.4+2.4=4.8	73.8	65.8	69.
10:45	2.4+2.4=4.8	74.1	65.4	69.
11:00	2.4+2.4=4.8	74.5	65.8	62.

Comments:

0900 Damper 3/4 open for cooler

DAILY FIELD LOG FOR WIND, TEMPERATURE, RH

Date 3-9-79 Coole

By C. E. Riley

Readings:

Time	~~Wind~~ Cooler Pressure Drop " H_2O ~~Direction Velocity~~	°F Temperature	Wet Bulb ~~RH~~	%R.H. Cloud Cover
1515	2.3+2.2=4.5	77.0	66.3	56
1530	2.3+2.2=4.5	77.2	66.4	56
1545	2.3+2.3=4.6	77.3	66.4	56
1600	2.3+2.2=4.5	77.5	66.3	53
1615	2.3+2.2=4.5	77.6	66.0	53

Comments: Damper $\frac{3}{4}$ open!

APPENDIX G AMMONIUM NITRATE AND AMMONIA ANALYSIS LABORATORY DATA

G-1 SUMMARY OF LABORATORY DATA
TABLE 1-G-1
TABLE 2-G-1
TABLE 3-G-1

G-2 LABORATORY NOTEBOOK DATA FOR SELECTIVE ION ELECTRODE (SIE) ANALYSIS

G-3 LABORATORY NOTEBOOK DATA FOR DIRECT NESSLER ANALYSIS

G-4 LABORATORY WEIGHING DATA
TABLE 1-G-4

G-1 SUMMARY OF LABORATORY DATA

TABLE 1-G-1

TABLE 2-G-1

TABLE 3-G-1

TABLE 1-G-1. SUMMARY OF LABORATORY ANALYSIS DATA FOR AMMONIUM NITRATE UTILIZING AN NO_3^- SELECTIVE ION ELECTRODE AND FOR AMMONIA BY DIRECT NESSLER - ROTARY DRUM GRANULATOR SCRUBBER INLET

				NO_3^- selective ion electrode[a,b]					
Location	Test No.	Sample No.	Fraction	Sample volume (mℓ)	Dilution factor	Potential (mv)	Aliquot conc. (μg/ml)	Sample conc. (μg/mℓ)	Mass (mg)
Rotary drum granulator scrubber inlet	3-IS	167	water	2,000	200X	127 131 132	126.4	25,279	50,557
	3-IS	166	Acid	500	0	103 103 103	418.6	418.6	209.3
Rotary drum granulator scrubber inlet	4-IS	172	water	2,000	200X	127 127 128	138.8	27,765	55,530
	4-IS	174	Acid	500	0	130 132 132	132.6	132.6	66.3
Rotary drum granulator scrubber inlet	5-IS	179	water	1,000	200X	110 110 109	283.9	56,773	56,773
	5-IS	178	Acid	500	0	124 123 125	178.2	178.2	89.1

(continued)

TABLE 1-G-1. (concluded)

Location	Test No.	Sample No.	Fraction	Direct Nesslerization[c,d] Sample volume (mℓ)	Dilution factor	Absorbance (A.U.)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Rotary drum granulator	3-IS	168	water	2,000	6,250X	0.430 0.398 0.384	2.19	13,700	27,400
	3-IS	166	Acid	500	62.5X	0.122 0.114 0.112	0.574	35.8	9,000[e]
Rotary drum granulator	4-IS	173	water	2,000	6,250X	0.183 0.175 0.174	0.984	6,150	12,300
	4-IS	174	Acid	500	62.5X	0.013 0.000 0.000	0.00	0.00	0.00
Rotary drum granulator	5-IS	180	water	1,000	6,250X	0.496 0.457 0.459	2.31	14,400	14,400
	5-IS	178	Acid	500	62.5X	0.003 0.014 0.026	0.032	2.00	1.00

a This data does not include a 1.45 mg blank correction for the water fraction or a 30 mg blank correction for the acid fraction.

b Results are reported as ammonium nitrate.

c Zero blank correction.

d Results are reported as ammonia.

e May have been sample carryover in the impinger.

TABLE 2-G-1. SUMMARY OF LABORATORY ANALYSIS DATA FOR AMMONIUM NITRATE UTILIZING AN NO_3^- SELECTIVE ION ELECTRODE AND FOR AMMONIA BY DIRECT NESSLER ANALYSIS - ROTARY DRUM GRANULATOR SCRUBBER OUTLET

				NO_3^- selective ion electrode[a,b]					
Location	Test No.	Sample No.	Fraction	Sample volume (mℓ)	Dilution factor	Potential (mv)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Rotary drum granulator scrubber outlet	3-OS	171	Water	1,000	0	130 130 130	140.9	140.9	140.9
Rotary drum granulator scrubber outlet	3-OS	170	Acid	500	0	147 147 147	60.0	60.0	30.0
Rotary drum granulator scrubber outlet	4-OS	175	Water	1,000	0	140 138 138	99.5	99.5	99.5
Rotary drum granulator scrubber outlet	4-OS	177	Acid	500	0	135 133 133	111.8	111.8	55.9
Rotary drum granulator scrubber outlet	5-OS	182	Water	1,000	0	132 133 130	130.5	130.5	130.5
Rotary drum granulator scrubber outlet	5-OS	183	Acid	500	0	125 124 124	151.2	151.2	75.6

(continued)

TABLE 2-G-1. (concluded)

Location	Test No.	Sample No.	Fraction	Direct Nesslerization[c,d] Sample volume (mℓ)	Dilution factor	Absorbance (A.U.)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Rotary drum granulator scrubber outlet	3-OS	169	Water	1,000	62.5X	0.109 0.100 0.101	0.558	34.9	34.9
Rotary drum granulator scrubber outlet	3-OS	170	Acid	500	62.5X	0.227 0.235 0.240	1.11	69.4	34.7
Rotary drum granulator scrubber outlet	4-OS	176	Water	1,000	62.5X	0.071 0.061 0.064	0.358	22.4	22.4
Rotary drum granulator scrubber outlet	4-OS	177	Acid	500	62.5X	0.056 0.057 0.062	0.213	13.3	6.65
Rotary drum granulator scrubber outlet	5-OS	181	Water	1,000	62.5X	0.219 0.208 0.205	1.16	72.5	72.5
Rotary drum granulator scrubber outlet	5-OS	183	Acid	500	62.5X	0.565 0.560 0.563	2.78	173	86.5

a This data does not include a 1.45 mg blank correction for the water fraction or a 30 mg blank correction for the acid fraction.

b Results are reported as ammonium nitrate.

c Zero blank corrections.

d Results are reported as ammonia.

TABLE 3-G-1. SUMMARY OF LABORATORY ANALYSIS DATA FOR AMMONIUM NITRATE UTILIZING AN NO_3^- SELECTIVE ION ELECTRODE AND FOR AMMONIA BY DIRECT NESSLER ANALYSIS - ROTARY DRUM COOLER UNCONTROLLED OUTLET

				NO_3^- selective ion electrode [a,b]					
Location	Test No.	Sample No.	Fraction	Sample volume (mℓ)	Dilution factor	Potential (mv)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Rotary drum cooler outlet	1-ORDC	186	Water	1,000	20X	112 112 112	257.0	5,139	5,139
	1-ORDC	185	Acid	500	0	131 130 131	118.2	118.2	59.1
	2-ORDC	193	Water	1,000	20X	114 114 114	238.3	4,766	4,766
	2-ORDC	194	Acid	500	0	140 139 140	82.8	82.8	41.4
	3-ORDC	197	Water	1,000	20X	113 113 113	246.6	4,931	4,931
	3-ORDC	196	Acid	500	0	147 136 134	91.2	91.2	45.6

(continued)

TABLE 3-G-1. (concluded)

Location	Test No.	Sample No.	Fraction	Sample volume (mℓ)	Direct Nesslerization[c,d] Dilution factor	Absorbance (A.U.)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Rotary drum cooler outlet	1-ORDC	184	Water	1,000	6,250X	0.047 0.041 0.051	0.152	950	950
	1-ORDC	185	Acid	500	62.5X	0.016 0.030 0.026	0.136	850	4.25
	2-ORDC	195	Water	1,000	6,250X	0.042 0.045 0.034	0.122	763	763
	2-ORDC	194	Acid	500	62.5X	0.000 0.000 0.004	0.00	0.00	0.00
	3-ORDC	198	Water	1,000	6,250X	0.038 0.037 0.049	0.127	794	794
	3-ORDC	196	Acid	500	62.5X	0.018 0.012 0.008	0.079	4.94	2.47

a This data does not include a 1.45 mg blank correction for the water fraction or a 30 mg blank correction for the acid fraction.

b Results are reported as ammonium nitrate.

c Zero blank corrections.

d Results are reported as ammonia.

G-2 LABORATORY NOTEBOOK DATA FOR SELECTIVE ION ELECTRODE (SIE) ANALYSIS

Reference Standard B

ml → 100ml	mg/ml	y µg/ml	x mV
0	0	0	
1	0.02072	20.72	177
5	0.10360	103.60	137
10	0.20720	207.20	119
15	0.31080	310.80	117
20	0.41440	414.40	101
25	0.51800	518.00	96

m = ⁻0.04
b = 25930

$y = ae^{bx}$ or $\ln y = \ln a + bx$

where: a = b
b = m

Project No. 4468-L(18) Date of Work: 3/13/79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis Continued From:

Standardizing soln.

0 ml = 244 mv	25 ml = 97 mv
1 ml = 178 mv	20 ml = 100 mv
5 ml = 138 mv	15 ml = 107 mv
10 ml = 122 mv	Switched to diff. meter due
15 ml = 154 mv	to zero glue
20 ml = 105 mv	
25 ml = 103 mv	

A.)

25 ml = 98 mv	0 ml = 243
20 ml = 103 mv	1 ml = 178
15 ml = 109 mv	5 ml = 138
10 ml = 121 mv	10 ml = 121
5 ml = 138 mv	15 ml = 110
1 ml = 178 mv	20 ml = 103
0 ml = 243 mv	25 ml = 98 mv

Container #171, 3-0 NO_3^- Fract.

Run #1 = 130 mv

Run #2 = 130 mv

Run #3 = 130 mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4465-6 (19) Date of Work: 3/14/79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis Continued From:

B) Standardizing solns.

0 ml = 243 mv	25 ml = 98 mv
1 ml = 177 mv	20 ml = 102 mv
5 ml = 137 mv	15 ml = 117 mv
10 ml = 119 mv	10 ml = 119 mv
15 ml = 116 mv	5 ml = 137 mv
20 ml = 100 mv	1 ml = 177 mv
25 ml = 94 mv	0 ml = 243 mv

Container # 219, Run 5 Inlet Comp.
off scale. Dilution 100 times required to read, 10 ml ~~[illegible]~~ L
(scrubber sample)

Container # 160, Run 2, Outlet NO_3^- fract.

1. = ~~80~~ 100 mv

Container # 182, Run 5, Outlet NO_3^- fract.

1. = ~~[illegible]~~ 132 mv

~~Container # 209 Run 7 Outlet~~

~~1. = off scale Dilution 100 x [illegible] sample~~

Stand. 10 ml = 119 mv

1. Container # 193, Run 7, cooler
off scale. dilute 5 ml to 100 ml on all cooler samples

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4465-6 (15) **Date of Work:** 3/14/79 **Work Performed by:** R.J.

Title or Purpose: NO_3^- analysis **Continued From:**

Container # 154, Run 1, Outlet NO_3^- fract.
1. 128 mv

Container # 175, Run 4, Outlet NO_3^- fract.
1. 140 mv

Container # 182, Run 3, Outlet
2. 130 mv

Container # 160, Run 2, Outlet
2. 100 mv

Container # 154, Run 1, Outlet
2. 128 mv

Container # 175, Run 4, Outlet
2. 138 mv

Stand. 10 ml = 115 mv

Container # 182, Run 3, Outlet
3. 133 mv

Container # 160, Run 2, Outlet
3. ~~103~~ 104

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 3/14/79 Work Performed by: R.J.

Title or Purpose: NO_3^- Analysis Continued From:

Container # 154, Run 1, Outlet
3. 122 mv

Container # 175, Run 4, Outlet
3. 138 mv

Container # 189, Blank # 3, NO_3^- from # 103
1.) 242 mv

Container # 192, Blank # 1, NO_3^- from # 101
1.) 245 mv

Container # 166, Run 3, Inlet Acid fraction
1.) 103 mv

Container # 174, Run 4, Inlet, Acid fraction
1.) 130 mv

Stand. 10 ml = 117 mV

Container # 165, Run 2, 3 Inlet Acid fract
1.) 131 mv

Container # 178, Run 5, Inlet, Acid fract.
1.) 124 mv

Container # 157, Run 1, Inlet, Acid fract.
1.) 138 mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-18 Date of Work: 3/14/79 Work Performed by: R.J.

Title or Purpose: NO_3^- Analysis Continued From:

Container # 189, Blank #3, NO_3^- from # 103
2) 242 mv

Container # 192, Blank # 1, NO_3^- from # 101
2). 244 mv

Container # 166, Run 3. Inlet, acid fraction
2) 103 mv

Container # 174, Run 4, Inlet, acid fraction
2). 132 mv

Container # 165, Run 2, Inlet acid fract.
2) 131 mv

Container # 178. Run 5, Inlet acid fract.
2) 123 mv

Container # 157, Run 1, Inlet acid fract
2) 138 mv

Stand. 10ml = 119mv

Container # 189, Blank # 3. NO_3^- from # 103
3). ~~243~~ 238 mv

Container # 192, Blank # 1, NO_3^- from # 101
3). 243

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) Date of Work: 3/14/77 Work Performed by: KG

Title or Purpose: NO_3^- Analysis Continued From:

Container #166, Run 3, Inlet, acid fract.
3). 103 mv

Container #174, Run 4, Inlet acid fract.
3). 132 mv

Container #165, Run 2, Inlet acid fract
3). 130 mv

Container #178, Run 5, Inlet acid fract.
3). ~~135~~ 125 mv

Container #157, Run 1, Inlet acid fract.
3). 138 mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. L-468-L(15) Date of Work: 3/15/79 Work Performed by: R.T.

Title or Purpose: NO_3^- Analysis Continued From:

C.) Standardizing soln

0 ml = 241 mv	25 ml = 94 mv
1 ml = 175 mv	20 ml = 100 mv
5 ml = 134 mv	15 ml = 108 mv
10 ml = 118 mv	10 ml ~~20 ml~~ = 118 mv
15 ml = 108 mv	5 ml = ~~134~~ 135 mv
20 ml = 100 mv	1 ml = 175 mv
25 ml = 94 mv	0 ml = 241 mv

Diluted 5 ml Cooler NO_3^- samps. to 100 ml w/ H_2O

Container # 193, Run 7, Cooler, NO_3^- fract.

1.) 114 mv

Container # 197, Run 8, Cooler, NO_3^- fract.

1.) 113 mv

Container # 186, Run 6, Cooler, NO_3^- fract

1.) 112 mv

Container # 193, Run 7, Cooler, NO_3^- fract.

2.) 114 mv

Container # 197, Run 8, Cooler, NO_3^- fract.

2.) 113 mv

Container # 186, Run 6, Cooler, NO_3^- fract.

2.) 112 mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-C(18) Date of Work: 3/15/79 Work Performed by: R. J.

Title or Purpose: NO_3^- Analysis Continued From:

Container # 193, Run 7, Cooler, NO_3^- fract.
3) 114 mv

Container # 197, Run 8, Cooler, NO_3^- fract
3). 113 mv

Container # 186, Run 6, Cooler, NO_3^- fract.
3), 112 mv

Stand 10 ml = 118 mv

Diluted 5 ml Inlet front half samps (NO_3^-) to 1 L w. H_2O

Container # 164, Run 2, Inlet, NO_3^- fract.
1.) 128 mv

Stand 10 ml = 118 mv

Container # 167, Run 3, Inlet, NO_3^- fract
1.) 127 mv

Container # 172, Run 4, Inlet, NO_3^- fract.
1.) 127 mv

Container # 179, Run 5, Inlet, NO_3^- fract
1.) 170 mv

Container # 159, Run 1, Inlet, NO_3^- fract.
1.) 138 mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) **Date of Work:** 3/15/79 **Work Performed by:** Jones

Title or Purpose: NO_3^- Analysis **Continued From:**

Stand. 10ml = 118mv

Container # 164, Run 2, Inlet, NO_3^- fract.
2) 128mv

Container # 167, Run 3, Inlet NO_3^- fract.
2) 131mv

Container # 172, Run 4, Inlet, NO_3^- fract.
2) 127mv

Container # 179, Run 5, Inlet, NO_3^- fract.
2) 110mv

Container # 159, Run 1, Inlet, NO_3^- fract.
2) 139mv

Container # 164, Run 2, Inlet, NO_3^- fract.
3) 127mv

Container # 167, Run 3, Inlet, NO_3^- fract.
3) 132 mv

Container # 172, Run 4, Inlet, NO_3^- fract.
3) 128mv

Container # 179, Run 5, Inlet, NO_3^- fract.
3) 109mv

Container # 159, Run 1, Inlet, NO_3^- fract.
3) 140 mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(18) **Date of Work:** 3/15/79 **Work Performed by:** RJ

Title or Purpose: NO_3^- Analysis **Continued From:**

* (5 ml samp. diluted to 100 ml.)

Stand. 10 ml = 118 mv

Container # 203, Comp # 1, Scrub Inlet, NO_3^- fract.

1) 156 mv

Container # 208, Comp # 2, Scrub Outlet, NO_3^- fract

1) 119 mv

Container # 209, ~~Comp~~ (comp.) run 3, Outlet to scrub, NO_3^- fract

1). 127 mv

Container # 214, run 4 I, scrub. Comp. Inlet, NO_3^- fract

1) 153 mv

Container # 219, run 5, scrub comp Inlet, NO_3^- fract.

1) 159 mv

Stand 10 ml = 118 mv

Container # 203, Comp. # 1, Scrub inlet, NO_3^- fract

2) 157

Container # 208, Comp. # 2, Scrub Out., NO_3^- fract

2) 119 mv

Container # 209, run 3, scrub comp Out., NO_3^- fract.

2) 128 mv

Container # 214, run 4, scrub comp. Inlet, NO_3^- fract

2) 153 mv

* Note - sample diluted again 5 ml / 100 ml

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L(15) Date of Work: 3/15/79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis Continued From:

Stand 10 ml = 117 mv

Container # 219, run 5, scrub comp. Inlet, NO_3^- fract.
2) 158 mv

Container # 203, comp #1, scrub Inlet, NO_3^- fract
3) 157

Container # 208, comp #2, scrub Out, NO_3^- fract.
3) 119 mv

Container # 209, run 3, scrub comp. out, NO_3^- fract.
3)
128 mv

Container # 214, run 4, scrub comp. Inlet, NO_3^- fract.
3) 153 mv

Container # 219, run 5, scrub comp. Inlet, NO_3^- fract.
3) 158 mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-L(16) Date of Work: 3/16/79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis Continued From:

0.) Standardizing solns

0 ml = 241 mv	25 ml = 97 mv
1 ml = 177 mv	20 ml = 102 mv
5 ml = 137 mv	15 ml = 109 mv
10 ml = 119 mv	10 ml = 119 mv
15 ml = 109 mv	5 ml = 137 mv
20 ml = 102 mv	1 ml = 177 mv
25 ml 97 mv	0 ml = 241 mv

Container # 201, Comp. #1, Out to scrub., NO_3^- fract
1.) 121 mv

Container # 207, Comp #2, Inlet to scrub., NO_3^- fract.
1.) 153 mv

Container # 212, Scrub inlet comp., NO_3^- fract. run 3
1.) 147 mv

Container # 216, Scrub out. comp., NO_3^- fract run 4
1.) ~~135~~ mv 125 mv

Container # 217, Scrub out comp. NO_3^- fract. run 5
1.) 123 mv

Stand 10 ml = 121
Container # 201, Comp. # 1, Out to scrub, NO_3^- fract.
2.) 121 mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-L(18) Date of Work: 3/16/79 Work Performed by: RG

Title or Purpose: NO_3^- Analysis Continued From:

Container # 207, Comp #2, Inlet to scrub, NO_3^- fract.
2) 154mv

Contain # 212, Scrub In comp., NO_3^- fract, Run 3
2) 147mv

Contain # 216, Scrub out comp., NO_3^- fract, Run 4
2) 125 mv

Contain # 217, Scrub out comp., NO_3^- fract, Run 5
124mv

Contain # 201, Comp #1, Out. to scrub. NO_3^- fract.
3) 122mv

Contain # 207, Comp. #2, Inlet to scrub, NO_3^- fract.
3) 153mv

Contain # 212, ~~Comp #~~ Scrub in comp., Run 3
3) 147 mv

Contain # 216, Scrub out comp., NO_3^- fract Run 4
3) 125mv

Contain # 217, Scrub out comp., NO_3^- fract, Run 5
3) 124mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-C(B) Date of Work: 3/16/79 Work Performed by: JONES

Title or Purpose: NO_3^- Analysis Continued From:

Stand 10ml = 118 mv no d.i.

Container # 188, Blank #3, acid fract., from # 104.
1). 149 mv

Container # 151, Plant H_2O-distilled Blank, run 1 → n.
1). 247 mv

Container # 196, run 8-C, acid fract.
1). 147 mv

Container #162, run 2-3-0, acid fract.
1) 128 mv

Container # 156, run 1-0, acid fract.
1) 139 mv

Container # 177, run 4-0, acid fract.
1) 135 mv

Stand 10ml = 118 mv

Container # 188, Blank #3, acid fract., from # 104.
2) 151 mv

Container #. 151, Plant H_2O-distilled Blank, run 1 → n.
2) 261 mv

Container # 196, run 8-C, acid fract.
2). 136

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-1(15) Date of Work: 3-16-79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis

Continued From:

Contain. #162, run 2-3-0, acid fract.
2). 127mv

Contain #156, run 1-0, acid fract.
2) 138mv

Contain. #177, run 4-0, acid fract.
2) 133mv

Stand 10ml = 117mv
Contain #188, Blank #3, acid fract, from #10
3) 149mv

Contain #151, Plant H_2O, distilled Blank, run 1-0.
3) 253mv

Contain #196, run 8-0, acid fract.
3) 134mv

Contain. #162, run 2-3-0, acid fract.
3) 127mv

Contain. #156, run 1-0, acid fract.
3). 138mv

Contain. #177, run 4-0, acid fract.
3). 133mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L18 Date of Work: 3/16/79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis Continued From:

Stand. 10 ml = 116 mv

Contain #190, Blank #1, acid fract.
1) 149 mv

Contain. #185, run 6-C, acid fract.
1) 131 mv

Contain #194, run 7-C, acid fract.
1) 140 mv

Contain #183, run 5-O, acid fract.
1) 125 mv

Contain #170, run 3-O, acid fract.
1) 147 mv

Contain #153, ~~run~~ audit AN3 → diluted 1:20
1) 164 mv

Contain #152, audit AN1
1) 128 mv

Stand 10 ml = 116 mv
Contain. #190, Blank #1, acid fract.
2) 149 mv

Contain #185, run 6-C, acid fract.
2) 130 mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-L18 Date of Work: 3/16/79 Work Performed by: Jones

Title or Purpose: NO_3^- Analysis Continued From:

Contain #194, 7-C, acid fract.
2) 139mv

Contain #183, 5-0, acid fract.
2) 124mv

Contain #170, 3-0, acid fract.
2) 147mv

Contain #153, audit AN3 → diluted 1:20
2) 164 mv

Contain #152, audit AN1
~~130mv~~ 129mv

Contain #190, Blank #1, acid fract.
3) 149mv

Contain #185, 6-C, acid fract.
3) 131mv

Contain #194, 7-C, acid fract.
3) 140mv

Contain #183, 5-0, acid fract.
3) 124mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L18 Date of Work: 3/16/79 Work Performed by: Jones

Title or Purpose: NO_3^- Analysis Continued From:

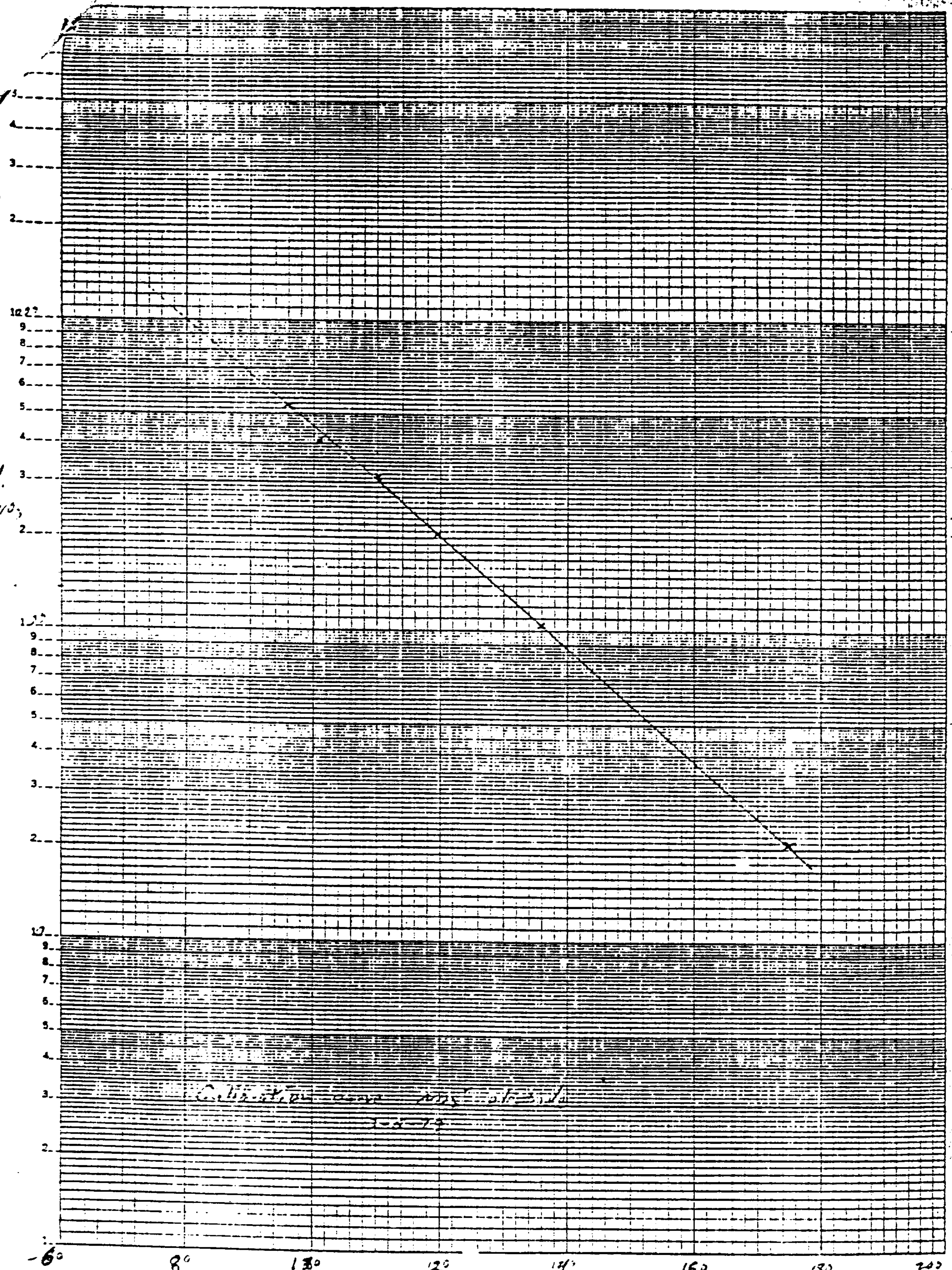
Contain #170, 3-0, acid fract.
3) 147mv

Contain #153, audit AN3 → diluted 1:20
3) 164mv

Contain. #152, audit AN1
3) ~~Ran~~ Ran out of 100ml sample sol so diluted 1:20
= 205mv

Continued To:
Entered By:
Date:

Disclosed To And Understood By Me:
Date:
Date:



60
80
100
120
140
160
180
200

Sample Calculations (NO_3^-)

equation #1,[1]

ML std. × 20.72 × D.F. = mg/L NH_4NO_3

where,

ML std = Calibration curve readings

20.72 = mg/L in 1 ml standard NH_4NO_3,

standard NH_4NO_3 = 2.072 g/L = 2072 mg/L,

2072 mg/L × 1 mL / 100 mL = 20.72 mg/L

D.F. = Dilution factor of sample

example #1, Wet scrubber liquor, 1-I:

2.0 × 20.72 × 4000 = 165760 mg/L,

rounding to 3 significant figures = 166000 mg/L

[1] equation #1 corresponds only to wet scrubber liquors in and out and aud-r samples.

Sample Calculations (NO_3^-)

equation # 2,[a]

$$ML\ std. \times 20.72 \times D.F. \times T.V. = mg\ NH_4NO_3$$

where,

ML std = Calibration curve readings

20.72 = mg/L in 1 ml standard NH_4NO_3

D.F. = Dilution factor of sample

T.V. = Total volume of sample (Liters)

example # 2, NO_3^- Analysis of rotary drum granulator, 3-I;

$$6.1 \times 20.72 \times 200 \times 2.00 = 50556.8\ mg\ NH_4NO_3$$

Rounding to 3 significant figures = 50600 mg NH_4NO_3

[a] equation #2 corresponds only to train samples

G-3 LABORATORY NOTEBOOK DATA FOR DIRECT NESSLER ANALYSIS

Project No. 446218 Date of Work: 3/14/79 Work Performed by: [illegible initials]

Title or Purpose: DETERMINATION OF AMMONIA Continued From:

DETERMINATION of SPEC 20 CALIBRATION FACTOR:

CURVE #1

0.0 ml	100 %T	0 A
1.0	83.3	.078
2.0	68.2	.165
5.0	36.7	.435
7.0	24.7	.610
10.0	14.2	.850

PROCEDURE *

1) ADD 0.0, 1.0, 2.0, 5.0, 7.0, & 10.0 ml of WORKING STANDARD AMMONIUM CHLORIDE SOLN. TO A SERIES of 6 (SIX) 25 ml VOL. FLASKS.
2) ADJUST TOTAL VOLUME of EACH FLASK TO 20 ml WITH D&D H_2O
3) ADD 10 N NaOH DROPWISE TO ADJUST pH of EACH FLASK TO 8-10
4) PIPETTE EXACTLY 0.5 ml of NESSLER REAGENT INTO EACH FLASK AND DILUTE TO 25 ml WITH D&D H_2O.
5) MIX WELL & ALLOW TO STAND FOR 10 to 30 MIN.
6) MEASURE ABSORBANCE of each STANDARD AT 405 nm

* 10 ml of 3.566 g/l NH_4Cl WAS DILUTED TO 1 liter and then the above procedure was followed

Project No. 4468L-18 Date of Work: 3/14/79 Work Performed by: YW

Title or Purpose: DETERMINATION OF AMMONIA Continued From: p 43

SAMPLE ANALYSIS PROCEDURE:

1) PIPETTE 10 ml OF SAMPLE INTO A 500 ml VOL. FLASK DILUTE TO MARK
2) PIPETTE 20 ml OF THIS SOLN. INTO A 25 ml VOL. FLASK
3) ADD ~~0.5 ml of NESSLER~~ 10N NaOH DROPWISE TILL pH IS BETWEEN 8 & 10
4) ADD 0.5 ml NESSLER REAGENT AND DILUTE TO 25 ml WITH D&D H_2O
5) MIX WELL - ALLOW TO STAND FOR 20 MINUTES
6) MEASURE A AT 405 nm USING BLANK SOLN. AS ZERO REFERENCE
7) DILUTE THE SAMPLE AND BLANK WITH EQUAL AMOUNTS OF DEIONIZED DISTILLED H_2O IF ABSORBANCE EXCEEDS THAT OF THE 10 mg NH_3 SOLN.

SAMPLE #155 (1-1-0) NESSLER TO 1.0 l AND SPLIT

	%T	A
155-1	75.8	.121
155-2	75.5	.122
155-3	75.9	~~[illegible]~~ .120

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. 446L-18 Date of Work: 3/14/79 Work Performed by: JW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p 44

#161✓ (2-0) NESSLER TO 1 l & SPLIT

	%T	A
161-1	53.7	.268
161-2	54.0	.265
161-3	53.7	.268

#169✓ (3-0) H_2O NESSLER TO 1.00 l AND SPLIT

	%T	A
169-1	77.7	.109
169-2	79.3	.100
169-3	79.1	.101

#176✓ (4-0) H_2O NESSLER to 1.00 l AND SPLIT

	%T	A
176-1	84.7	.071
176-2	86.8	.061
176-3	86.2	.064

~~#181✓ (5-0)~~ PREPARED NEW CALIBRATION CURVE: (p 43) CURVE #2

		%T	A
~~181-1~~	0.00 ml		
~~181-2~~	1.00	85.7	.066
~~181-3~~	2.00	69.9	.155
	5.00	36.8	.433
	7.00	25.8	.590
	10.00	14.3	.84

Continued To:

Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468L-18 Date of Work: 3/14/79 Work Performed by: YEW

Title or Purpose: DETERMINATION OF AMMONIA Continued From: p45

#181 (5-0)

		%T	A
NESSLER	181-1	60.02	.219
1.0 l	182-2	61.8	.208
	181-3	62.1	.205

#158 (H-I) NESSLER TO 1.00 LITER AND SPLIT

	%T	A
158-1	76.1	.118
158-2	78.2	.105
158-3	77.7	.109

TOOK 10 ml of SOLN AND DILUTED TO 1000 ml AFTER Following PROCEDURE ON Page 44

#163 (2-1-T) NESSLER to 2.00 LITERS AND SPLIT

	%T	A
163-1	64.5	.189
163-2	64.3	.191
163-3	62.2	.205

TOOK 10 ml of SOLN AND DILUTED TO 1000 ml AFTER Following PROCEDURE on Page 44

#168 (3-1-I) H_2O NESSLER FRACTION TO 2.0 l AND SPLIT

	%T	A
163-1	38.1	.430
163-2	40.0	.398
163-3	41.2	.384

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468L-18 Date of Work: 3/14/79 Work Performed by: YW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p46

~~H2O~~ TOOK 10ml AND DILUTED TO 1000 ml AFTER FOLLOWING PROCEDURE ON PAGE 44.

#173 (4-I) (H_2O) NESSLER TO 2.0 l AND SPLIT

	%T	A
173-1	65.4	.183
173-2	66.7	.175
173-3	66.8	.174

TOOK 10ml AND DILUTED TO 1000ml AFTER FOLLOWING PROCEDURE ON PAGE 44

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No: 4468L-18 Date of Work: 3/15/79 Work Performed by: [signature]

Title or Purpose: NITRATES - DETERMINATION of AMMONIA Continued From: p.47

CALIBRATION CURVE: (p43) CURVE #3

ml	%T	A
0.00	100	0.
1.00	77.2	.111
2.00	62.8	.262
5.00	33.7	.472
7.00	28.8	.642
10.00	12.6	.899

SAMPLES: (p 44)

#180 (5-I)	%T	A	H_2O NESSLER TO 1.0 l AND SPLIT
180-1	31.9	.496	
180-2	34.9	.457	.471
180-3	34.7	.459	

TOOK 10 ml of SAMPLE AND DILUTED to 1000 ml AFTER following PROCEDURE on PAGE 44

#184 (6-C)	%T	A	H_2O NESSLER TO 1.0 l AND SPLIT
184-1	89.7	.047	
184-2	91.0	.041	
184-3	89.0	.051	

TOOK 10 ml of SAMPLE AND DILUTED TO 1000 AFTER following PROCEDURE on page 44

Continued To:

Witnessed By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 446848 Date of Work: 3-15-79 Work Performed by: DW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p48

#195 (7-C)✓

	%T	A	
			H_2O NESSLER TO 1.0 l AND SPLIT
195-1	90.7	.042	
195-2	90.1	.045	
195-3	92.5	.034	

10ml - 1000 AFTER NORMAL PROCEDURE

#198 (8C)✓ H_2O NESSLER TO 1.0 l AND SPLIT

	%T	A
198-1	91.5	.038
198-2	91.7	.037
198-3	89.3	.049

10ml - 1000 AFTER NORM. PROCEDURE

#191 (BLANK #1)✓ NESSLER FRACTION TO VOLUME

	%T	A
191-1	1.2	1.92
191-2	.08	3.09
191-3	.08	3.09

SAME AS Procedure of ON p.44

NOTE: UPON ADDITION OF THE NESSLER REAGENT THE SOLN. TURNED A CLOUDY GREEN

Continued To:

Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468L-18 Date of Work: 3/15/79 Work Performed by: [initials]

Title or Purpose: Determination of Ammonia Continued From: p 49

#187 (BLANK #3) Nessler Fraction to volume

	%T	A
187-1	96.8	.014
187-2	96.1	.017
187-3	98.3	.007

SAME AS PROCEDURE on page 44.

#177 (ACID) (4-0)✓ TO 500 ml

	%T	A
177-1	87.8	.056
177-2	87.7	.057
177-3	86.7	.062

SAME AS PROCEDURE on p 44

#156 (ACID) (1-0)✓ TO VOLUME

	%T	A
156-1	84.1	.075
156-2	89.2	.049
156-3	89.2	.049

SAME AS PROCEDURE on (P 44)

#170 (ACID) (3-0)✓ TO 500 ml

	%T	A
170-1	59.2	.227
170-2	58.2	.235
170-3	57.5	.240

SAME AS PROCEDURE on (P 44)

Continued To:

Disclosed To And Understood By Me:

Entered By: Date:

Date:

Project No. 4468L-18 Date of Work: 3/15/79 Work Performed by: DW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p50

#183 ✓ (ACID) (5-0) TO 500 ml

	%T	A
183-1	22.2	.565
183-2	22.5	.560
183-3	22.3	.563

p.44 procedure

#162 ✓ ACID (2-3-0) TO VOLUME

	%T	A
162-1	75.9	.119
162-2	74.5	.127
162-3	74.3	.129

p.44 procedure

#194 ACID ✓ (7-C) TO 500 ml

	%T	A
194-1		
194-2		
194-3		

ON Page 58

p.44 procedure

~~#196 (ACID) (8-C)~~

~~%T A~~

~~196-1~~
~~196-2~~
~~196-3~~

Continued To:

Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4168-18 Date of Work: 3/15/79 Work Performed by: JW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p51

~~#185 (ACID) (6-C)~~

	%T	A
~~185-1~~		
~~185-2~~		
~~185-3~~		

NEW STANDARDS WERE PREPARED BECAUSE A RED PRECIPITATE WAS FOUND IN THE O ABSORBANCE CALIBRATION BLANK REFER TO PAGE 43

CURVE #4

	%T	A
0.00 ml	100	0
1.00	83.1	.080
2.00	66.8	.175
5.00	37.2	.429
7.00	25.3	.596
10.00	13.6	.866

#196 (ACID) (8-C) TO 500 ml

	%T	A
196-1	95.9	.018
196-2	97.1	.012
196-3	98.0	.008

SAME procedure as p.44

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468L-18 Date of Work: 3/15/79 Work Performed by: DW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p52

#185 (6-C) ✓ ACID TO 500ml

	%T	A
185-1	96.2	.016
185-2	93.2	.030
185-3	94.0	.026

SAME PROCEDURE AS p.44

#188 ✓ (ACID) (BLANK) (#3) TO 500ml

	%T	A
188-1	100+	
188-2	100+	
188-3	100+	

SAME PROCEDURE AS p44

#190 ✓ (BLANK #1) ACID TO VOLUME

	%T	A
190-1	99.1	.004
190-2	100+	
190-3	98.0	.009

#151 ✓ (PLANT DIST. H2O BLANK)

	%T	A
151-1	100+	
151-2	100+	
151-3	100+	

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-18 Date of Work: 3/16/79 Work Performed by: GW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p53

CALIBRATION curve: p43 curve #5

	%T	A
0.00 ml	100	0
1.00	80.1	.096
2.00	65.2	.185
5.00	37.7	.423
7.00	24.2	.616
~~[illegible]~~		
10.00	14.0	.853

√ #202 INLET TO SCRUBBER - COMPOSITE #1 NESSLER

	%T	A
202-1	7.3	1.13
202-2	7.9	1.10
202-3	6.9	1.16

TOOK 10 ml of REGULAR Procedure and diluted to 1000 ml

#165 √ (2-3-I) — ACID PERoxide TO 500 ml

	%T	A
165-1	100+	
165-2	100+	
165-3	100.0	0.0

NORMAL PROCEDURE

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. 4468L-18 Date of Work: 3/16/79 Work Performed by: YW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p.54

#157✓ (1-I) ACID FRACTION TO VOLUME

	%T	A
157-1	97.6	.010
157-2	95.1	.022
157-3	96.3	.016

NORMAL PROCEDURE

#178✓ (5-I) ACID FRACTION TO 500ml

	%T	A
178-1	99.3	.003
178-2	96.8	.014
178-3	94.0	.026

Normal PROCEDURE

#174✓ (4-I) (ACID) TO 500ml

	%T	A
174-1	97.0	.013
174-2	100+	
174-3	100.0	

Normal procedure

#166✓ (3-I)

		%T	A
ACID FRACTION	166-1	75.5	.122
TO 500ml	166-2	76.8	.114
	166-3	77.3	.112

Normal Procedure

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

ject No. 4168-18 Date of Work: 3/11/79 Work Performed by: YW

e or Purpose: DET. of AMMONIA Continued From: p55

#204 (Composite #1) OUTLET TO SCRUBBER NESSLER FRACTION

O.DILUTION

	%T	A
204-1	28.6	.544
204-2	27.9	.554
204-3	28.8	.540

– TOOK 10 ml of NORMAL PROCEDURE SOLN. AND DILUTED TO 1000 ml

~~– TOOK 10 ml of THIS SOLN AND DILUTED TO 1000 ml~~

TOOK 2 ml of ABOVE SOLN: AND TRANSFERRED TO 25 ml FLASKS for ANALYSIS

#205 (COMPOSITE #2) INLET TO SCRUBBER NESSLER FRACTION

NO DILUTION

	%T	A
205-1	71.0	.149
205-2	71.2	.147
205-3	69.0	.161

– TOOK 10 ml of NORMAL PROCEDURE SOLN: AND TRANSFERRED TO 100 ml FLASK AND DILUTED

– TOOK 2 ml of THIS SOLN AND TRANSFERRED TO 25 ml FLASK for ANALYSIS

ued To: Disclosed To And Understood By Me:

d By: Date:

Date:

Project No. 446818 Date of Work: 3/16/79 Work Performed by: [illegible]

Title or Purpose: Det. of NH_3 Continued From: p56

#206 ✓ COMPOSITE #2 OUTLET TO SCRUBBER NO DILUTION

	%T	A
206-1	30.4	.517
206-2	29.4	.531
206-3	29.3	.533

DILUTED 10ml to 1000ml → TOOK 2 ml of THIS FOR ANALYSIS

#218 ✓ (SCRUBBER OUTLET COMPOSITE RUN #5)

NESSLER FRACTION

		%T	A
NO DILUTION	218-1	~~30.~~ 31.9	.496
FILTERED AND	218-2	~~[illegible]~~ 30.8	.511
SALT	218-3	~~[illegible]~~ 32.2	.492

DILUTION SAME AS #206 & 205

#210 ✓ (SCRUBBER COMPOSITE OUTLET) RUN #3 NO DILUTION

NESSLER

	%T	A
210-1	41.3	.384
210-2	40.5	.392
210-3	42.5	.372

DILUTION SAME AS 206 & 205

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468L-18 Date of Work: 3/16/79 Work Performed by: JW

Title or Purpose: Det of Ammonia Continued From: p 57

#211✓ SCRUBBER COMPOSITE (3-I) NESSLER FRACTION NO DILUTION

	%T	A
211-1	65.7	.182
211-2	65.1	.186
211-3	63.0	.201

SAME DILUTION & ANALYSIS AS #205

#215✓ SCRUBBER COMPOSITE OUTLET Run 4-O
NESSLER FRACTION NO DILUTION
SAME DILUTION AS #205

	%T	A
#215-1	32.2	.492
#215-2	34.5	.462
215-3	37.0	.431

#220✓ SCRUBBER INLET COMPOSITE Run (5)
FILTERED SPLIT NO DILUTION
SAME DILUTION AS #205

	%T	A
#220-1	77.3	.112
220-2	80.5	.094
220-3	79.7	.098

#213✓ SCRUBBER COMPOSITE INLET (4-I)
NESSLER FRACTION NO DILUTION
DILUTION SAME AS #205

	%T	A
#213-1	75.6	.122
213-2	73.0	.137
2-13-3	67.8	.169

#194 (7-C)✓
...D FRACTION
...O 500ml

	%T	A
194-1	100+	
194-2	100+	
194-3	99.0	.004

Normal procedure p44

...inued To:

...red By:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-18 Date of Work: 3/16/79 Work Performed by: JW

Title or Purpose: DET of AMMONIA Continued From: p 5

			%T	A
#152	AUDIT	152-1	83.8	.077
		152-2	95.2	.021
AN-1		152-3	85.4	.069

NORMAL DILUTION p44
ALSO DILUTED 100 TIMES BEFORE GIVEN TO ANALYST

			%T	A
#153	AN-3	153-1	47.9	.319
		153-2	47.6	.322
AN-3		153-3	44.9	.348

NORMAL DILUTION p44
ALSO DILUTED 100 TIMES BEFORE GIVEN TO ANALYST

Continued To:
Entered By:
Date:
Disclosed To And Understood By Me:
Date:
Date:

G-4 LABORATORY WEIGHING DATA

TABLE 1-G-4

TABLE 1-G-4. GRAVIMETRIC ANALYSIS OF METHOD 5 FILTERS

Project 4468-L(18) Relative humidity 40.0% 2-22-79	Filter No.		First weighing (g)	Second weighing (g)	Third weighing (g)	Average weight (g)
MRI Laboratory	A-1	(Blank)	0.1966	0.1966	0.1965	0.1966
By Tom Walker	A-1	*	0.1965	0.1968	0.1967	0.1967
	A-2	(Blank)	0.1947	0.1948	0.1947	0.1947
	A-2	*	0.1948	0.1950	0.1950	0.1949
	A-3	(Blank)	0.1944	0.1944	0.1944	0.1944
	A-3	*	0.1946	0.1946	0.1946	0.1946
	A-4	(Blank)	0.1924	0.1926	0.1925	0.1925
	A-4	*	0.1927	0.1928	0.1929	0.1928
	A-4	(Blank)	0.1900	0.1900	0.1900	0.1900
	A-5	*	0.1902	0.1901	0.1901	0.1901
	A-6		0.1924	0.1926	0.1926	0.1925
	A-6	*	0.2081	0.2082	0.2082	0.2082
	A-7		0.1935	0.1934	0.1934	0.1934
	A-7	*	0.2367	0.2368	0.2365	0.2367
	A-8		0.1980	0.1979	0.1980	0.1980
	A-8	*	0.2665	0.2691	0.2687	0.2681
	A-9		0.1958	0.1958	0.1955	0.1957
	A-9	*	0.2219	0.2217	0.2218	0.2218
	A-10		0.1982	0.1981	0.1980	0.1981
	A-10	*	0.2070	0.2069	0.2070	0.2070
	A-11		0.1941	0.1941	0.1940	0.1941
	A-11	*	0.5080	0.5079	0.5081	0.5080
	A-12		0.1952	0.1952	0.1952	0.1952
	A-12	*	0.2682	0.2682	0.2684	0.2683
	A-13		0.1899	0.1899	0.1899	0.1899
	A-13	*	0.1974	0.1793	0.1973	0.1973

(continued)

TABLE 1-G-4. (continued)

Project 4468-L(18 Relative humidity 40.5% 2-22-79	Filter No.		First weighing (g)	Second weighing (g)	Third weighing (g)	Average weight (g)
MRI Laboratory	A-14		0.1963	0.1964	0.1964	0.1964
By Tom Walker	A-14	*	0.2180	0.2181	0.2181	0.2181
	A-15		0.1925	0.1925	0.1925	0.1925
	A-15	*	0.2025	0.2028	0.2027	0.2027
	A-16		0.1931	0.1932	0.1932	0.1932
	A-16	*	0.2046	0.2043	0.2043	0.2044
	A-17		0.1924	0.1925	0.1927	0.1925
	A-17	*	0.4737	0.4739	0.4738	0.4738
	A-18		0.1898	0.1899	0.1898	0.1898
	A-18	*	0.2743	0.2743	0.2741	0.2742
	A-19		0.1938	0.1937	0.1938	0.1938
	A-19	*	0.2159	0.2159	0.2158	0.2159
	A-20		0.1968	0.1968	0.1968	0.1968
	A-20	*	0.2070	0.2069	0.2063	0.2067
	A-21		0.1934	0.1935	0.1935	0.1935
	A-21	*	0.4261	0.4261	0.4262	0.4261
	A-22		0.1887	0.1888	0.1887	0.1887
	A-22	*	0.3140	0.3139	0.3142	0.3140
	A-23		0.1935	0.1937	0.1936	0.1936
	A-23	*	0.2000	0.2000	0.2000	0.2000
	A-24		0.1900	0.1901	0.1900	0.1900
	A-24	*	0.2085	0.2084	0.2084	0.2084
	A-25		0.1957	0.1957	0.1958	0.1957
	A-25	*	0.5362	0.5362	0.5363	0.5362
	A-26		0.2004	0.2002	0.2004	0.2003
	A-26	*	0.2966	0.2966	0.2967	0.2966

TABLE 1-G-4. (continued)

Project 4468-L(18) Relative humidity 39.0% 2-22-79	Filter No.	First weighing (g)	Second weighing (g)	Third weighing (g)	Average weight (g)
MRI Laboratory	A-27	0.2015	0.2016	0.2015	0.2015
By Tom Walker	A-27 *	0.6438	0.6438	0.6440	0.6439
	A-28	0.1874	0.1875	0.1875	0.1875
	A-28 *	0.2566	0.2568	0.2567	0.2567
	A-29	0.1882	0.1883	0.1882	0.1882
	A-29 *	0.2173	0.2174	0.2171	0.2173
	A-30	0.1885	0.1884	0.1884	0.1884
	A-30 *	0.1983	0.1984	0.1984	0.1984

* Second series of 3 weighings performed on 3-28-79 by Tom Walker. Humidity was 48% at the beginning of the weighings and was 54% at the completion of the weighings.

* Also designates the weight of the filter plus the particulate catch.

Note: The balance was moved from the constant temperature/humidity room and placed in another lab. For "*" weighings the balance was returned to the original room of first series of weighings. This may have some affect on final analysis.

(continued)

TABLE 1-G-4. (concluded)

Project 4468-L(18) 3-28-79 MRI laboratory	Filter No.	Weight of material (g)	
By Tom Walker	A-1 (Blank)	0.0001	
	A-2 (Blank)	0.0002	
	A-3 (Blank)	0.0002	Average = 0.0002 g
	A-4 (Blank)	0.0003	
	A-5 (Blank)	0.0001	
	A-6	0.0157	
	A-7	0.0433	
	A-8	0.0701	
	A-9	0.0261	
	A-10	0.0089	
	A-11	0.3138	
	A-12	0.0731	
	A-13	0.0074	
	A-14	0.0217	
	A-15	0.0102	
	A-16	0.0112	
	A-17	0.2813	
	A-18	0.0844	
	A-19	0.0221	
	A-20	0.0099	
	A-21	0.2326	
	A-22	0.1253	
	A-23	0.0064	

TABLE 1-G-4. (concluded)

Project 4468-L(18) 3-28-79 MRI laboratory	Filter No.	Weight of material (g)
By Tom Walker	A-24	0.0184
	A-25	0.3405
	A-26	0.0963
	A-27	0.4424
	A-28	0.0298
	A-29	0.0291
	A-30	0.0100

Note: 1. Weight of material = (Average weight of filter plus sample)-(Average weight of filter).

2. The blanks increased in weight an average of 0.0002 g. This is due to either a greater moisture content of the air in the weighing room or because of a change in the balance because it was moved.

3. The average weight increase of the blanks was not subtracted from the weight of material collected.

APPENDIX H PROJECT PARTICIPANTS

MIDWEST RESEARCH INSTITUTE
GCA CORPORATION/TECHNOLOGY DIVISION
SWIFT CHEMICAL COMPANY
U.S. ENVIRONMENTAL PROTECTION AGENCY

PROJECT PARTICIPANTS

Midwest Research Institute

Douglas E. Fiscus, Head, Field Programs Section - Project Manager

Bruce C. DaRos, Associate Chemist - Project Engineer/Crew Chief

Robert C. Stultz, Associate Engineer - Team Leader

Jeffrey C. Thomas, Junior Scientist - Team Leader

Mark D. Hansen, Associate Environmental Scientist - Team Member

Daniel Vogel, Technician - Team Member

Ronald Jones, Senior Technician - Field Laboratory

Christopher Cole, Junior Chemist - Visible Emissions

Thomas Walker, Junior Chemist - Analytical Chemistry

George R. Cobb, Assistant Chemist - Analytical Chemistry

George W. Scheil, Associate Chemist - Assistant Project Scientist

GCA Corporation/Technology Division

Stephen A. Capone, Environmental Engineer - Process Engineer

Timothy L. Curtin, Environmental Engineer - Process Engineer

Swift Chemical Company

Terry Sparkman, Chief Chemist

Ron E. Ashcroft, Plant Manager

Dwain Adcock, Production Supervisor

PROJECT PARTICIPANTS (continued)

U.S. EPA Emission Measurement Branch

Clyde E. Riley, Technical Manager

U.S. EPA Industrial Studies Branch

Eric A. Noble - Test Process Project Engineer

APPENDIX I SAMPLING LOGS

I-1 FIELD SAMPLING TASK LOGS

I-1-1 MODIFIED EPA METHOD 5 TESTS

I-1-2 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TESTS

I-1-3 SCRUBBER LIQUOR GRAB SAMPLES

I-1-4 INLET AND OUTLET ROTARY DRUM COOLER PRODUCT GRAB SAMPLES

I-1-5 UNSCREENED ROTARY DRUM GRANULATOR PRODUCT GRAB SAMPLES

I-2 FIELD SAMPLE IDENTIFICATION LOG

I-1 FIELD SAMPLING TASK LOGS

I-1-1 MODIFIED EPA METHOD 5 TESTS

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-5-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test 1	1	Port #1 Inlet	Particulate	1535	1553		
Stop Test				1553	1554		
Resume Test	1	Port #1	Particulate	1554	1605		
Stop Test				1605	1609		
Resume Test	1	Port #1	Particulate	1609	1611		
Stop Test				1611	1621		
Resume Test	1	Port #1	Particulate	1621	1629		
Stop Test				1629	1631		
Resume Test	1	Port #1	Particulate	1631	1632		
Stop Test				1632	1633		
Resume Test	1	Port #1	Particulate	1633	1654		
Stop Test - Incomplete, Plant Process Problems	1	Port #1	Particulate	1654			

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-6-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Probe heater on at 0900	2	Inlet, Port 1		0900			
Begin Test 2	2	Inlet, Port #1	Particulate	0940	1028		
Change Ports				1028	1104		
Resume Test	2	Inlet Port #2	Particulate	1104	1209		
Test 2 Complete				1209			

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test	3	Inlet Port #1	Particulate	1031	1119		
Change Ports				1119	1139		
Resume Test	3	Inlet Port #2	Particulate	1139	1142		
Stop Test – Unplug Probe				1142	1149		
Resume Test	3	Inlet Port #2	Particulate	1149	1234		
Test Complete				12	34		

SAMPLING TASK LOG

Plant Swift Chemical Company

Date 3-7-79

Project No. 4468-L(18)

Plant Location Beaumont, Texas

Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test	4	Inlet Port #1	Particulate	1500	1548		
Change Ports				1548	1610		
Resume Test	4	Inlet Port #2	Particulate	1610	1613		
Stop Test - Unplug Probe				1613	1617		
Resume Test	4	Inlet Port #2	Particulate	1617	1625		
Stop Test - Unplug Probe				1625	1630		
Resume Test	4	Inlet Port #2	Particulate	1630	1707		
Test Complete				17	07		

SAMPLING TASK LOG

Plant Swift Chemical Company

Date 3-8-79

Project No. 4468- L(18)

Plant Location Beaumont, Texas

Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test	5	Inlet Port #1	Particulate	0919	1007	48	
Change Ports				1007	1028		
Resume Test	5	Inlet Port #2	Particulate	1028	1116	48	
Test Complete				11	16		

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-5-79
Project No. 4468 - L(18)

Plant Location Beaumont, Texas
Recorded by J. Thomas

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Iced down & prepared sample box	1	Scrubber Outlet - south	NH_4, NH_3NO_3	1430	1535		1
Start run	1	Scrubber Outlet - South	NH_4, NH_3NO_3	1535	1537		
Stop - Inlet probe plugged	1	Scrubber Outlet-South		1537	1540		
Start	1	Scrubber Outlet-South	NH_4, NH_3NO_3	1540	1640		
Stop - Port 2	1	Scrubber Outlet-south		1640			
Only Port 2 was sampled							
due to upset in process							

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-6-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Pre-Test Leak check	2	Scrubber Outlet		0930			
Begin Test – (Probe Thermocouple	2	Scrubber Outlet,	NH_4, NH_3NO_3	0944	1044	60	
doesn't Function)		Port #1					
Change Ports	2			1044	1104	60	
Resume Test (Sample Box	2	Scrubber Outlet,	NH_4, NH_3NO_3	1104	1204		
thermocouple doesn't Function)		Port #2					
Test Complete	2			12	04		
Post Test Leak check	2			1215			
(Meter Leak test was performed							
using field lab console)							

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Leak check Initial	3	Scrubber Outlet	NH_4, NH_3, NO_3	1010			
	3	Port 1 - Scrubber Outlet	"	1030	1130	60	Run 3
Port change	3	Port 2 - Scrubber Outlet	"	1138	1238	60	Run 3
Thermocouple in sample box does	3		"				
not seem to be functioning properly							
on Port II. Box does feel							
hot and is probably actually							
at a higher temperature than							
indicated on data sheet							
Leak Check - final	3	Scrubber Outlet	"	1245			

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Initial-Leak check	4	Scrubber Out	AN	1445			
Sample	4	" Port 1 "	"	1501	1601	60	Run 4
Sample	4	Port 2	"	1605	1705	60	Run 4
Final-Leak Check				1710			

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-8-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Initial - Leak check	5	Scrubber Outlet	AN	0850			
Sample	5	Port 1	AN	0911	1011	60	Run 5
Sample	5	Port 2	AN	1023	1123	60	Run 5
Final - Leak check	5		AN	1130			
Moisture accumulated on rear							
end of probe when set on							
100°F Port 1.							
Temperature increased to							
130°F on Port 2.							

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-8-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by DAROS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Start 1405	1			1405	1413		
Stop @ end of point 8 - plugged pitot/changed probe tip to 3/16							
Start				1431	1446		
Complete traverse Port 1				1446			
Start Port 2 @				1452	1512		
Test Complete				1512			

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-9-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by DAROS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
2½ inch. of powder buildup in	2			0920			
bottom of duct							
Pretest Leak Check	2			0930			
Begin Test	2	Cooler Outlet Port #1	NH_4, NH_3NO_3	0945	1013		
Change Ports				1013	1015		
Resume Test	2	Cooler Outlet Port #2	NH_4, NH_3NO_3	1015	1042		
Post Test Leak check				1042			
Test Complete					1042		
Note: Damper 3/4 open, Pressure							
Drop across cyclone ≅ 5.0 in.							
(Velocity and stack Temp. average							
taken from Run 1 Data)							

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-9-79
Project No. 4468-LC(18)

Plant Location Beaumont, Texas
Recorded by BD JT

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Pretest Leak Check	3			1510			
Begin Test	3	Cooler Outlet Port #1	NH_4, NH_3NO_3	1515	1543		
Change Ports				1543			
Resume Test	3	Cooler Outlet Port #2	NH_4, NH_3NO_3	1543	1605		
Post Test Leak Check	3			1605			
Test Complete				1605			

I-1-2 BRINK IMPACTOR PARTICLE SIZE DISTRIBUTION TESTS

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-LC(8)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Preheat Brink Impactor	1			1307			
Begin Test	1	Scrubber Inlet,	Particulate	1330			
		Port #2, point #					
		2-14					
Stop-Test Complete	1				1340	10	

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-7-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Preheat Brink Impactor	2			1730			
Begin Test	2	Scrubber Inlet,	Particulate	1755			
		Port #2, point					
		# 2-14					
Stop, Test Complete	2				1807	12	

SAMPLING TASK LOG

Plant Swift Chemical Company

Date 3-8-79

Project No. 4468-L(18)

Plant Location Beaumont, Texas

Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Preheat Brink Impactor	3			1340			
Begin Test	3	Scrubber Inlet,	Particulate	1400			
		Port #2, point					
		#2-14					
Stop - Test Complete	3				1410	10	

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-8-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test - Brink Impactor	4	Cooler Outlet,	Particulate	1705			
		Port #2, point					
		# 2-10 (Test #1					
		at this location)					
Stop - Test Complete	4				1719	14	

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-9-79
Project No. 4468-L(18)

Plant Location Beaumont, Texas
Recorded by RCS

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test- Brink Impactor	5	Cooler Outlet,	Particulate	0834			
		Port #2, point					
		#2-10 (Test #2					
		at this location)					
Stop - Test Complete	5				0848	14	
Note: Vent opened during sampling.							

SAMPLING TASK LOG

Plant Swift chemical Company
Date 3-9-79
Project No. 4468 - L (18)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Begin Test - Brink Impactor	6	Cooler Outlet,	Particulate	1058			
		Port #2, point					
		#2-10 (Test #3					
		at this location)					
Stop - Test Complete	6				1112	14	

I-1-3 SCRUBBER LIQUOR GRAB SAMPLES

SAMPLING TASK LOG

Plant Swift Chemical, Beaumont, Tx
Date 3-5-79
Project No. 4468-L(18)

Plant Location Beaumont, Tx
Recorded by RJ

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
no color, cloudy liquid	1	Inlet	Scrubber liquor	1536	Temp =	135°F, PH =	7.15 @ 30°c
Light Brownish yellow, cloudy liquid	1	Outlet	Scrubber liquor	1544	Temp =	99°F, PH =	5.20 @ 31°c
no color, cloudy liquid	1	Inlet	Scruber liquor	1607	Temp =	139°F, PH =	7.2 @ 31°c
Light Brownish yellow, cloudy liquid	1	Outlet	"	1609	Temp =	99°F, PH =	5.21 @ 30°c
no color, cloudy liquid	1	Inlet	"	1636	Temp =	139°F, PH =	7.26 @ 31°c
Light Brownish yellow, cloudy liquid	1	Outlet	"	1643	Temp =	99°F, PH =	5.28 @ 30°c
Temp = ~~236°F~~	1	Granulator	"	1630	~~Temp~~ =		
(Told to stop sampling @ ~1650							
due to plant difficulties.)							

SAMPLING TASK LOG

Plant: Swift
Date: 3-6-79
Project No.: 4468-c(18)

Plant Location: Beaumont
Recorded by: RJ
Bar. Pressure = 30.30" Hg

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
no color, cloudy liquid	2	Inlet	Scrubber Liquor	0930	Temp =	129°F, PH =	6.6 @ 38°C
Light Brownish yellow, cloudy liquid	2	Outlet	"	0935	Temp =	100°F, PH =	5.15 @ 28°C
no color, cloudy liquid	2	Inlet	"	1005	Temp =	130°F, PH =	6.5 @ 40°C
Light Brownish yellow, cloudy liquid	2	Outlet	"	1010	Temp =	100°F, PH =	5.23 @ 31°C
no color, cloudy liquid	2	Inlet	"	1040	Temp =	136°F, PH =	6.65 @ 40°C
Light Brownish yellow, cloudy liquid	2	Outlet	"	1044	Temp =	100°F, PH =	5.55 @ 30°C
no color, cloudy liquid	2	Inlet	"	1120	Temp =	130°F, PH =	6.85 @ 38°C
Light Brownish yellow, cloudy liquid	2	Outlet	"	1124	Temp =	100°F, PH =	5.55 @ 30°C
no color, cloudy liquid	2	Inlet	"	1207	Temp =	134°F, PH =	7.05 @ 30°C
Light Brownish yellow, cloudy liquid	2	Outlet	"	1210	Temp =	100°F, PH =	5.48 @ 26°C

SAMPLING TASK LOG

Plant: *Swift*
Date: *3-7-79*
Project No. *4468-C (18)*

Plant Location: *Beaumont*
Recorded by: *RA*

Inlet

	Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
1.	No color, cloudy soln.	3	Inlet	Scrubber Liquor	(Sample taken		1030,	Temp = 136°F,
	Began PH analysis @ 1113 in	Lab.,	PH = 6.65 @ 36°c,	PH analysis	ended @		1118.)	
2	No color, cloudy soln.	3	Inlet	Scrubber Liquor	(Sample taken		@ 1105,	Temp = 120°F,
	Began PH analysis @ 1201 in lab,	PH	= 6.70 @ 36°c,	PH analysis	ended @		1204)	
3.	No color, cloudy soln.	3	Inlet	Scrubber Liquor	(Sample taken		@ 1140,	Temp = 121°F,
	Began PH analysis @ 1223 in lab,	PH =	6.60 @ 40°c,	PH analysis	ended @		1225)	
4	No color, cloudy soln.	3	Inlet	Scrubber Liquor	(Sample taken	@ 1215,	Temp	= 123°F,
	Began PH analysis @ 1253 in lab,	PH =	6.52 @ 40°c,	PH analysis	ended @	1257)		
5	No color, cloudy soln.	3	Inlet	Scrubber liquor	(Sample taken		@ 1243	Temp = 122°F
	Began PH analysis @ 1332 in lab,	PH =	6.51 @ 30°c,	PH analysis	ended @		1335.	
	No explanation for change in PH		temperature compared	with	rest.)			

SAMPLING TASK LOG

Plant: Swift
Date: 3-7-79
Project No.: 4468-C (16)
Outlet

Plant Location: Beaumont
Recorded by: RJ

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
1 no color, cloudy soln.	3	Outlet	Scrubber Liquor	(Sample	taken	1034 ~~1019~~, Temp	= 92°F
~~PH~~ Began PH analysis in lab	at 1119,	PH = 5.49 @	29°C	PH analysis	ended	@ 1123.)	
2 no color, cloudy soln.	3	Outlet	Scrubber Liquor	(Sample	Taken	@ 1108, Temp	= 94°F
Began PH analysis in lab @	1206,	PH = 5.80 @ 29°C,	PH analysis	ended	@	1211).	
3 no color, cloudy soln.	3	Outlet	Scrubber Liquor	(Sample	taken	@ 1143, Temp	= 94°F,
Began PH analysis in lab @	1226,	PH = 6.18 @ 30°C,	PH analysis	ended	@	1229).	
4 no color, cloudy soln.	3	Outlet	Scrubber soln.	(Sample	taken	@ 1219,	Temp = 94°F,
Began PH analysis in lab @	1258,	PH = 5.74 @ 30°C,	PH analysis	ended	@	1259).	
5 no color, cloudy soln.	3	Outlet	Scrubber Soln	(Sample	taken	@ 1245,	Temp = 94°F,
Began PH analysis in lab @	1336,	PH = 6.55 @ 40°C,	PH	analysis	ended	@ 1340.	
(No explanation for change	in	PH temp. compared	with	the others)			

SAMPLE HANDLING LOG

Project Number 4468-L(18)

Source Identification Scrubber liquor samples (Inlet + Outlet)

Test Run Number 3

Pollutant(s) in Sample Scrubber liquor

Task	Date	Time	Personnel	Remarks
Sampling	3-7-79	start: 1030 end: 1245	RG	
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
Train Disassembly	3-7-79	2000	[illegible]	filtered, split
Train Cleanout				
Packing and Storage	3-7-79	1355	RG	Transferred 100 ml aliquots of each sample into a composite sample.
Shipment to Analysis Site	3-7-79	1400	RG	carried to other lab.
Lab Analysis				
Write Up				

SAMPLING TASK LOG

Plant: Swift
Date: 3-7-79
Project No.: 4468-L(18) Inlet

Plant Location: Beaumont
Recorded by: RJ

	Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
1.	No Color, cloudy soln	4	Inlet	scrubber liquor	(Sampling began @ 1500,			Temp = 121°F,
	Began PH analysis in lab @	1543,	PH = 6.59 @ 40°c,	PH analysis ended @ 1547.)				
2.	No Color, cloudy soln.	4	Inlet	scrubber liquor	(Sampling began @ 1537,			Temp = 124°F,
	Began PH analysis in lab @	1615,	PH = 6.55 @ 40°c,	PH analysis ended @ 1619)				
3.	No Color, cloudy soln.	4	Inlet	scrubber liquor	(Sampling began @ 1610,			Temp = 127°F,
	Began Ph analysis in lab @	1651,	Ph = 6.57 @ 40°c,	Ph analysis ended @ 1654)				
4.	No Color, cloudy soln.	4	Inlet	scrubber liquor	(Sampling began @ 1645,			Temp = 128°F,
	Began Ph analysis in lab @	1777,	Ph = 6.55 @ 43°c,	Ph analysis ended @ 1721)				
5.	No Color, cloudy soln.	4	Inlet	scrubber liquor	(Sampling began @ 1710,			Temp = 126°F,
	Began Ph analysis in lab @ 1750	[illegible]	Ph = 6.60 @ 40°c,	Ph analysis ended @ 1754).				

SAMPLING TASK LOG

Plant: Swift
Date: 3-7-77
Project No.: 4468-L(18)
Outlet

Plant Location: Beaumont
Recorded by: RG

	Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
1.	No Color, cloudy soln.	4	Outlet	scrubber liquor	(Sampling	began @	150	4, Temp = 98°F,
	Began PH analysis in lab @	1548,	PH = 5.23 @ 32°c	, PH analysis	ended @		1552.)	
2.	No Color, cloudy soln.	4	Outlet	scrubber liquor	(Sampling	began @	154	0, Temp = 98°F,
	Began Ph analysis in lab @	1621,	Ph = 5.00 @ 32°c,	Ph analysis	ended	@	1624.)	
3.	No Color, cloudy soln.	4	Outlet	scrubber soln.	(Sampling	began @	16	13, Temp = 99°F,
	Began Ph analysis in lab @	1655,	Ph = 5.11 @ 32°c,	Ph analysis	ended	@	1659.)	
4.	No Color, cloudy soln.	4	Outlet	scrubber soln.	(Sampling	began @	1648	, Temp = 99°F,
	Began Ph analysis in lab @	1722,	Ph = 5.30 @ 32°c	, Ph analysis	ended @		1724)	
5.	No Color, cloudy soln.	4	Outlet	scrubber soln.	(Sampling	began @	1714	, Temp = 99°F,
	Began Ph analysis in lab @	1755,	Ph = 5.29 @ 31°c	, Ph analysis	ended @		1758.)	

SAMPLE HANDLING LOG

Project Number 4468-L(18)

Source Identification Scrubber liquor sampled (Inlet + Outlet)

Test Run Number 4

Pollutant(s) in Sample Scrubber liquor

Task	Date	Time	Personnel	Remarks
Sampling	3-7-79	start: 1500 end = 1714	RG	[illegible]
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
Train Disassembly	3-7-79	2000	[illegible]	filtered, split
Train Cleanout				
Packing and Storage	3-7-79	1803	RG	transferred 100 ml aliquots of each sample into a composite sample
Shipment to Analysis Site	3-7-79	1805	RG	carried to other lab.
Lab Analysis				
Write Up				

SAMPLING TASK LOG

Plant: Swift
Date: 3-8-79
Project No.: 4468-c (19)
Inlet

Plant Location: Beaumont
Recorded by: RG

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
1. No Color, cloudy soln.	5	Inlet	scrubber liquor	(Sampling		began @ 0	915, Temp = 140°F,
Began Ph analysis in lab @	0958,	Ph = 7.35 @ 40°c,	Ph analysis ended @			100	3.)
2. No Color, cloudy soln.	5	Inlet	scrubber liquor	(Sample Taken		@ 095	0, Temp = 143°F,
Began Ph analysis in lab @	1025,	Ph = 7.30 @ 43°c,	Ph analysis ended @			1047.)	
3 No Color, cloudy soln.	5	Inlet	scrubber liquor	(Sample Taken		@ [illegible] 1025	, Temp = 140°F,
Began Ph analysis in lab @	1104,	Ph = 7.10 @ 46°c,	Ph analysis ended @			1107).	
4. No Color, cloudy soln.	5	Inlet	scrubber liquor	(Sample Taken		@ 1100	, Temp = 144°F,
Began Ph analysis in lab @	1136,	PH = 6.99 @ 48°c,	Ph analysis ended @			1138).	
5. No Color, cloudy soln.	5	Inlet	scrub. liquor	(Sample Taken		@ 112	7, Temp = 150°F,
Began Ph analysis in lab @	1215,	Ph = 7.10 @ 46°c,	Ph analysis ended @			1218.)	

SAMPLING TASK LOG

Plant Swift
Date 3-8-79
Project No. 4468-L(18)
Outlet

Plant Location Beaumont
Recorded by RJ

	Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.	
1.	No Color, cloudy soln.	5	Outlet	scrubber liquor	(Sample	taken	@ 0919,	Temp =	99°F,
	Began Ph analysis in lab @	1007,	Ph = 6.0 @ 29°F,	Ph analysis	ended	@ 1009.)			
2.	No Color, cloudy soln.	5	Outlet	scrubber liquor	(Sample	taken	@ 0959,	Temp =	100°F,
	Began Ph analysis in lab @	1046,	Ph = 5.95 @ 30°c,	Ph analysis	ended	@ 1048.)			
3.	No Color, cloudy soln.	5	Outlet	scrubber liquor	(Sample	taken	@ 1029,	Temp =	100°F,
	Began Ph analysis in lab @	1108,	Ph = 5.80 @ 32°c,	Ph analysis	ended	@ 1110.)			
4.	No Color, cloudy soln.	5	Outlet	scrubber liquor	(Sample	taken	@ 1103,	Temp =	100°F,
	Began Ph analysis in lab @	1139,	Ph = 5.76 @ 32°c,	Ph analysis	ended	@ 1142.			
5.	No Color, cloudy soln	5	Outlet	S.L.	(Sample	taken	@ 1129,	Temp =	100°F,
	Began Ph analysis in lab @	1219,	Ph = 5.71 @ 31°c,	Ph analysis	ended	@ 1222.)			

I-1-4 INLET AND OUTLET ROTARY DRUM COOLER PRODUCT GRAB SAMPLES

SAMPLING TASK LOG

Plant Swift
Date 3-8-79
Project No. 4468-L (18)
Inlet

Plant Location Beaumont
Recorded by RJ

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
White pellets	1	Inlet	Cooler Product	1425	1430	5	
Temperature = 126°F							

SAMPLING TASK LOG

Plant Swift
Date 3-8-79
Project No. 4468-L (18)
Outlet

Plant Location Beaumont
Recorded by RA

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
White Pellets	1	Outlet	Cooler Product	1418	1421	3	
Temperature = 92°F							

SAMPLE HANDLING LOG

Project Number 4468-C(18)

Source Identification Cooler Prod. (Inlet)

Test Run Number 2

Pollutant(s) in Sample Cooler Prod.

Task	Date	Time	Personnel	Remarks
Sampling	3-9-79	Start: 1028 end: 1033	RJ	Sample put in bread pan and temp read.
Probe Technician				Temp = 138°F
Meter Technician				
Other				
Transport of Train to Cleanup Site				
~~Train Disassembly~~ transport	3-9-79	Start: 1033	RJ	covered w. foil and delivered to Schiel in lab
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	3-9-79	1200	[illegible]	Sieve, Density, #16 pass, to composite
Write Up				

SAMPLE HANDLING LOG

Project Number 4468-L(18)

Source Identification Cooler Prod. (outlet)

Test Run Number 2

Pollutant(s) in Sample Cooler Prod

Task	Date	Time	Personnel	Remarks
Sampling	3-9-79	Start: 1023 end: 1026	RJ	Sample put in bead pan and temp. read.
Probe Technician				Temp = 92°F
Meter Technician				
Other				
Transport of Train to Cleanup Site				
~~Train Disassembly~~ transport	3-9-79	1033	RJ	covered w. aluminum foil and took to Schil in lab.
Train Cleanout				~~Temp~~
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	3-9-79	1230	MmN	Density, sieve, #16 pass to composite
Write Up				

SAMPLE HANDLING LOG

Project Number 4468-L(18)

Source Identification Cooler (Inlet)

Test Run Number 3

Pollutant(s) in Sample Cooler Prod.

Task	Date	Time	Personnel	Remarks
Sampling	3-9-79	Start 1537 Stop 1542	RG	put sample in tread pan & measured temp.
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
~~Train Disassembly~~ transfer	3-9-79	1542	RG	covered pan w. foil & shipped to Schied in lab
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	3-9-79	1800	G W Schied	Density, Sieve, #16 pass; final aliquot to composite
Write Up				

SAMPLE HANDLING LOG

Project Number 4468-L(18)

Source Identification Cooler (Outlet)

Test Run Number 3

Pollutant(s) in Sample Cooler product.

Task	Date	Time	Personnel	Remarks
Sampling	3-9-79	Start: 1546 Stop: 1549	RJ	took sample in bread pan & measured temp.
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
~~Train Disassembly~~ transfer	3-9-79	1542	RJ	covered w/ foil and took to Schail in lab.
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	3-9-79	1800	[illegible]	Sieve, density, #16 pass-final aliquot to composite
Write Up				

I-1-5 UNSCREENED ROTARY DRUM GRANULATOR PRODUCT GRAB SAMPLES

SAMPLING TASK LOG

Plant Swift Chemical Company
Date 3-6-79
Project No. 4468-L(8)

Plant Location Beaumont, Texas
Recorded by Hansen

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
AN melt to granulator	2	Granulator		1130			301

SAMPLING TASK LOG

Plant Swift
Date 3-7-79
Project No. 4468-L(18)
Unscreened Granulater product

Plant Location Beaumont Tx
Recorded by RJ

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
White pellets	3	Granulator	Unscreened Granulater product	1153	1302 / emp	= 130°	F

SAMPLE HANDLING LOG

Project Number 4468-L(18)

Source Identification ~~[illegible]~~ Granulator

Test Run Number 3

Pollutant(s) in Sample Unscreened Granulator product

Task	Date	Time	Personnel	Remarks
Sampling	3-7-79	start: 1153 end: 1202	R9	temp. = 130°F
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
Train Disassembly				
Train Cleanout				
Packing and Storage	3-7-79	~~start~~ end: 1202	R9	bread pan covered w alum. foil
Shipment to Analysis Site	3-7-79	1203	Schiel	carried from granulator to lab
Lab Analysis	3-7-79	1350	Schiel	bulk density, sieve 6-20, #16 fraction to composite
Write Up				

SAMPLING TASK LOG

Plant: Swift
Date: 3-7-79
Project No.: 4468-L(18) ~~Unfiltered~~ Unscreened Granulator Product

Plant Location: Beaumont
Recorded by: RJ

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
White pellets	4	granulator	(Unscreened granulator product)	1600	1606	6 min	
				Temp =		136°F	

SAMPLE HANDLING LOG

Project Number 4468-C(12)

Source Identification ~~Granulator~~ Product Sample

Test Run Number 4

Pollutant(s) in Sample Unscreened granulator product

Task	Date	Time	Personnel	Remarks
Sampling	3-7-79	start = 1600 end = 1606	RJ	temp = 136°F
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
Train Disassembly				
Train Cleanout				
Packing and Storage	3-7-79	1606	RJ	bread pan covered w. alum. foil
Shipment to Analysis Site	3-7-79	1607	RJ	carried from granulator to lab.
Lab Analysis	3-7-79	1830	D. [illegible]	bulk density, 6-20 sieve, #16 fraction to composite
Write Up				

SAMPLING TASK LOG

Plant Swift
Date 4-8-79
Project No. 4468-L (18)
Unscreened Granulater product

Plant Location Beaumont
Recorded by RA

Comments	Run	Sampling Location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
~~[illegible]~~	~~[illegible]~~						
White pellets	5	granulater	(Unscreened granulater product)	1031	1037		
				Temp = 136°F			

I-2 FIELD SAMPLE IDENTIFICATION LOG

SAMPLE IDENTIFICATION LOG

Plant Swift Chemical

Location Beaumont, Tx

MRI Project No. 4468-L18

Collected and Recorded by [signature]

MRI Technical Record Book No. 79-47

Page 1 of 2

Sample trains

MRI No.	Date	Run No.	Sample Description	Remarks
151	3/8	—	Plant-distilled H_2O blank	
152	3/8	—	Audit sample AN-1	1:100 dilution
153	3/8	—	Audit sample AN-3	" "
154	3/6	1	Outlet-H_2O/NO_3^-	
155	3/6	1	Outlet-H_2O/Nessler	
156	3/6	1	Outlet-Acid half	
157	3/6	1	Inlet-Acid half	
158	3/6	1	Inlet-H_2O/Nessler	
159	3/6	1	Inlet-H_2O/NO_3^-	
160	3/6	2	Outlet-H_2O/NO_3^-	
161	3/6	2	Outlet-H_2O/Nessler	
162	3/6	2	Outlet-Acid half	
163	3/6	2	Inlet-H_2O/Nessler	
164	3/6	2	Inlet-H_2O/NO_3^-	
165	3/6	2	Inlet-Acid half	
166	3/7	3	Inlet-Acid fraction	
167	3/7	3	Inlet-NO_3^- "	
168	3/7	3	Inlet-Nessler	
169	3/7	3	Outlet-Nessler	
170	3/7	3	Outlet-Acid	
175	3/7	4	Outlet-NO_3^-	
176	3/7	4	Outlet-Nessler	
177	3/7	4	Outlet-Acid	
178	3/8	5	Inlet-Acid	

SAMPLE IDENTIFICATION LOG

Plant Swift Chemical
Location Beaumont, Tx
MRI Project No. 4468-L18

Collected and Recorded by [signature]
MRI Technical Record Book No. 79-42
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Sample trains

MRI No.	Date	Run No.	Sample Description	Remarks
179	3/8	5	Inlet - NO_3^-	
180	3/8	5	Inlet - Nessler	
181	3/8	5	Outlet - Nessler	
182	3/8	5	Outlet - NO_3^-	
183	3/8	5	Outlet - Acid	
184	3/8	6	Cooler - Nessler	
185	3/8	6	Cooler - Acid	
186	3/8	6	Cooler - NO_3^-	
187	3/6	Blank	Nessler #3	
188	3/6	Blank	Acid #3	
189	3/6	Blank	NO_3^- #3	
190	3/6	Blank	Acid - #1	
191	3/6	Blank	Nessler #1	
192	3/6	Blank	NO_3^- #1	
193	3/9	7	Cooler - NO_3^-	
194	3/9	7	Cooler - Acid	
195	3/9	7	Cooler - Nessler	
196	3/9	8	Cooler - Acid	
197	3/9	8	Cooler - NO_3^-	
198	3/9	8	Cooler - Nessler	
171	3/7/79	3	Outlet - NO_3^-	
172	3/7	4	Inlet - NO_3^-	
173	3/7	4	Inlet - Nessler	
174	3/7	4	Inlet - Acid	

SAMPLE IDENTIFICATION LOG

Plant *Swift* Collected and Recorded by *RJ*
Location *Beaumont* MRI Technical Record Book No. ____
MRI Project No. *4468-L(15)* Page *1* of *1*

301- *Product Samples*

MRI No.	Date	Run No.	Sample Description	Remarks
301	3/6/79	2	Melt to granulator	Time taken: 1130
302	3/8/79	2	Unscreened granulator product	
303	3/8/79	3+4+5	Unscreened granulator product	Composite
304	3/8/79+	6+7+8	Cooler Inlet Composite	
305	3/8/79+	6+7+8	Cooler Outlet Composite	

SAMPLE IDENTIFICATION LOG

Plant Swift Chemical
Location Beaumont, Tx
MRI Project No. 4468-L18

Collected and Recorded by [illegible signature]
MRI Technical Record Book No. 79-42
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201 -

Scrubber Samples

MRI No.	Date	Run No.	Sample Description	Remarks
201	3/6	1	Scrubber Outlet - NO_3^-	
202	3/6	1	Scrubber Inlet - Nessler	
203	3/6	1	Scrubber Inlet - NO_3^-	
204	3/6	1	Scrubber outlet - Nessler	
205	3/6	2	Scrubber Inlet - Nessler	
206	3/6	2	Scrubber Outlet - Nessler	check pH
207	3/6	2	Scrubber Inlet - NO_3^-	
208	3/6	2	Scrubber Outlet - Nessler	check pH
209	3/7	3	Scrubber Outlet - NO_3^-	
210	3/7	3	Scrubber Outlet - Nessler	
211	3/7	3	Scrubber Inlet - Nessler	
212	3/7	3	Scrubber Inlet - NO_3^-	
213	3/7	4	Scrubber Inlet - Nessler	
214	3/7	4	Scrubber Inlet - NO_3^-	
215	3/7	4	Scrubber Outlet - Nessler	
216	3/7	4	Scrubber Outlet - NO_3^-	
217	3/8	5	Scrubber Outlet - NO_3^-	
218	3/8	5	Scrubber outlet - Nessler	
219	3/8	5	Scrubber inlet - NO_3^-	
220	3/8	5	Scrubber inlet - Nessler	

SAMPLE IDENTIFICATION LOG

Plant Swift
Location Beaumont
MRI Project No. 4468-L(18)

Collected and Recorded by RG
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3C1-

Process Samples

MRI No.	Date	Run No.	Sample Description	Remarks
3Ci	3-6-79	2	Unfiltered granulator product	Time of Sample = 11:10, Temp = 139°F

APPENDIX J SAMPLING TRAIN CALIBRATION DATA

J-1	SAMPLE ORIFICE CALIBRATION
J-2	NOZZLE MEASUREMENTS
J-3	PITOT TUBE CALIBRATION

J-1 SAMPLE ORIFICE CALIBRATION

CONSOLE NO. 6 DATE 10-6-78 INITIAL R. Jones

BAROMETRIC PRESSURE 29.402

Time M S.	Man. Inches H_2O	CFd	CFw	ITd	OTd	Tw
749.5	.5		0	~~94~~ 94	84	74.5
			1	94	84	74.5
		Finish 424.433	2	94	84	74.5
		Start 419.300	3	95	85	74.5
		Total 5.133	4	95	85	74.5
			~~6~~	95	85	74.5
12.49		Average	5.001	94.5	84.5	74.5
544.5	1		0	95	81	74.5
			1	96	82	74.5
			2	96	82	74.5
		Finish 418.798	3	96	83	74.5
		Start 413.600	4	97	83	74.5
		Total 5.198	~~7~~	97	83	74.5
9.08		Average	5.001	96.2	82.3	74.5
288.1	4		0	~~95~~ 95	~~84~~ 85	~~74.~~ 74.4
			1	97	86	74.4
			2	99	86	74.4
		Finish 430,848	3	100	86	74.4
		Start 425.700	4	101	87	74.4
		Total 5.148	5.000	102	87	74.4
4.80		Average		99	86.2	74.4
			0			
			1			
		Finish	2			
		Start	3			
		Total	4			
			10			
		Average				

29.540
− .137
29.402
@ 79°F

CALIBRATION-ORIFICE AND METER

ΔH and ΔY

Console No. 6

Operator R. Jones

Date 10-6-78

Use This Sample to Test Program Once, After Loading

OT_d	P_b	Man. Orifice	T_w	t	CF_w	ΔH
86	28.80	1.0	75.3	9.1	5	Answer 1.90
84.5	29.402	0.5	74.5	12.49	5.001	1.76
82.3	29.402	1.0	74.5	9.08	5.001	1.87
		2.0				
86.2	29.402	4.0	74.4	4.80	5.000	2.08
		6.0				
		8.0				

Use This Sample to Test Program Once, After Loading

Man. Orifice	P_i	CF_i	T_w	IT_i	OT_d	P_b	CF_w	ΔY
1.0	28.80	[illegible]	75.7	87	86	28.80	5	Answer 1.00
0.5	29.402	5.133	74.5	94.5	84.5	29.402	5.001	1.00
1.0	29.402	5.188	74.5	96.2	82.3	29.402	5.001	.99
2.0								
4.0	29.402	5.148	74.4	99.0	86.2	29.402	5.000	.99
6.0								
8.0								

Tolerances

ΔY	0.99	1.00	1.01
ΔH	1.6	1.84	2.1

MRI - Form C2

CONSOLE NO. 6 DATE 12-20-78 INITIAL J. THOMAS

BAROMETRIC PRESSURE 28.865

Time M S.	Man. Inches H_2O	CFd	CFw	ITd	OTd	Tw
549.4	1		0	114	100	65.6
			1	113	100	65.6
	Finish	661.668	2	112	100	65.6
	Start	656.259	3	113	100	65.6
	Total	5.409	4	113	99	65.6
9.16 min.			5	113	99	65.6
		Averages	4.994	113	99.6	65.6
			0			
			1			
	Finish		2			
	Start		3			
	Total		4			
			5			
		Averages				
			0			
			2			
	Finish		4			
	Start		6			
	Total		8			
			10			
		Averages				
			0			
			2			
	Finish		4			
	Start		6			
	Total		8			
			10			
		Averages				

29.000
- .135

28.865

@ 80°F

CALIBRATION-ORIFICE AND METER

ΔH and ΔY

Console No. 6

Operator J. THOMAS

Date 12-20-78

Use This Sample to Test Program Once, After Loading

86	28.90	1.0	75.3	9.1	5	Answer 1.90
OT_d	P_b	Man. Orifice	T_w	t	CF_w	ΔH
[illegible]		0.5				
99.6	28.865	1.0	65.6	9.16	4.994	1.82
		2.0				
		4.0				
		6.0				
		8.0				

Use This Sample to Test Program Once, After Loading

1.0	28.90	5.13	75.3	97	86	28.90	5	Answer 1.00
Man. Orifice	P_b	CF_d	T_w	IT_d	OT_d	P_b	CF_w	ΔY
0.5								
1.0	28.865	5.409	65.6	113	99.6	28.865	4.994	.99
2.0								
4.0								
6.0								
8.0								

Tolerances

ΔY	0.99	1.00	1.01
ΔH	1.6	1.84	2.1

MRI - Form C2

CONSOLE NO. 5 DATE 1-11-79 INITIAL DC

BAROMETRIC PRESSURE 29.287 in.

Time M	(S)	Man. Inches H_2O	CFd	CFw	Td	Tic	Tw
734.4 sec		.5		0	92	84	70
				1	92	84	70
		Finish	711.238	2	92	84	70
		Start	706.000	3	92	84	70
		Total	5.238	4	92	84	70
				5	92	84	70
12.24 min			Average		92	84	70
520.0 sec		1			95	84	70
					95	84	70
					94	84	70
		Finish	705.713		94	84	70
		Start	700.500	4	94	84	70
		Total	5.213	5	94	84	70
8.83 min			Average		94.33	84	70
277.6 sec		4		0	94	83	70
				1	95	84	70
				2	96	84	70
		Finish	699.964	3	96	84	70
		Start	694.800	4	97	84	70
		Total	5.164	5	98	84	70
4.63 min			Average		96	83.83	70
227.4 sec		6		0	93	82	70
				1	93	83	70
				2	94	83	70
		Finish	694.23	3	95	83	70
		Start	~~688.90~~ 689.10	4	96	84	70
		Total	5.13	5	97	84	70
3.79 min			Average		94.67	83.17	70

CALIBRATION-ORIFICE AND METER

ΔH and ΔY

Console No. 5

Operator [illegible]

Date 1-11-79

Use This Sample to Test Program Once, After Loading

86	28.90	1.0	75.3	9.1	5	Answer 1.90

CT_d	P_b	Man. Orifice	T_w	t	CF_w	ΔH
84	29.289	0.5	70	12.24	5	1.67
84	29.289	1.0	70	8.83	5	1.74
		2.0				
83.83	29.289	4.0	70	4.63	5	1.92
83.17	29.289	6.0	70	3.79	5	1.93
		8.0				

Use This Sample to Test Program Once, After Loading

[illegible]	28.90	[illegible]	75.[illegible]	97	86	28.90	5	Answer 1.00

Man. Orifice	P	CF_i	T_w	IT_i	CT_d	P_b	CF_w	ΔY
0.5	29.289	5.238	70	92	84	29.289	5	.99
1.0	29.289	5.213	70	94.33	84	29.289	5	.99
2.0								
4.0	29.289	5.164	70	96	83.83	29.289	5	.99
6.0	29.289	5.13	70	94.67	83.17	29.289	5	.99
8.0								

Tolerances

ΔY	0.99	1.00	1.01
ΔH	1.6	1.84	2.1

MRI - Form C2

J-2 NOZZLE MEASUREMENTS

We are unable to determine which nozzles were used for this work assignment (EPA Contract No. 68-02-2814, Work Assignment No. 18, MRI Project No. 4468-L(18)) at Swift Chemical Company, Beaumont, Texas, (March 5 to 9, 1979). Therefore, we have not included any calibration or measurement data. All nozzles to be used during this work assignment were checked for damage at MRI prior to the field test.

J-3 PITOT TUBE CALIBRATION

Shortly after this work assignment (EPA Contract No. 68-02-2814, Work Assignment No. 18, MRI Project No. 4468-L(18)) at Swift Chemical Company, Beaumont, Texas, (March 5 to 9, 1979), all MRI pitot tubes were recalibrated according to EPA standards (Federal Register, Thursday, August 18, 1977). These calibrations were performed at the University of Kansas wind tunnel. The wind tunnel is located in Lawrence, Kansas. It is not known which of these pitot tubes were used during this work assignment. All pitot tubes used on this work assignment were checked for damage at MRI prior to the field test.

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: MRI - 1

Calibrated by: RCS

Date: 6-6-79

C_{pstd} = 0.99

$\Delta P_{std} \approx$ 0.55 or as required

	Run No.	Side "A" (in. H_2O) — Flow →				Side "B" (in. H_2O) — Flow →			
		ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
Seal alignment	1	0.590	0.814	0.843	0.001	0.591	0.835	0.833	0.003
Full alignment	2	0.590	0.810	0.845	0.001	0.591	0.825	0.838	0.002
	3	0.590	0.810	0.845	0.001	0.591	0.825	0.838	0.002
			Average A	0.844			Average B	0.836	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd} \sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $\left|Average_A - Average_B\right|$ = .008 (must be ≤ 0.01)

$$\sigma \text{ (side A or B)} = \sum_{1}^{3} \frac{\left|C_{p(s)} - \bar{C}_p \text{ (A or B)}\right|}{3}$$

.001 for A
.002 for B

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: MRI-8 | Calibrated by: RCS

Date: 6-6-79 | C_{pstd} = 0.99

$\Delta P_{std} \approx$ 0.55 or as required

Run No.	Side "A" (in. H_2O) — FLOW ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	Side "B" (in. H_2O) — FLOW ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
1	0.567	0.792	0.834	0	0.568	0.788	0.841	.001
2	0.567	0.792	0.834	0	0.568	0.788	0.841	.001
3	0.567	0.798	0.834	0	0.568	0.790	0.839	.001
		Average A	0.834			Average B	0.840	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd}\sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $|\text{Average}_A - \text{Average}_B|$ = .006 (must be ≤ 0.01)

$$\sigma \text{ (side A or B)} = \sum_{1}^{3} \frac{|C_{p(s)} - \bar{C}_p \text{ (A or B)}|}{3}$$ 0 for A / .001 for B

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: MRI-9 Calibrated by: RCS

Date: 6-6-79 C_{pstd} = 0.99

"MRI-9" on side "A" ΔP_{std} ≈ 0.55 or as required

	Side "A" (in. H_2O)				Side "B" (in. H_2O)			
Run No.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
1	0.55	0.745	0.847	.002	0.55	0.755	0.841	.001
2	0.55	0.750	0.844	.001	0.553	0.755	0.843	.001
3	0.55	0.750	0.844	.001	0.553	0.755	0.843	.001
		Average A	0.845			Average B	0.842	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd}\sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $|\text{Average}_A - \text{Average}_B|$ = 0.003 (must be ≤ 0.01)

σ (side A or B) = $\sum_1^3 \frac{|C_{p(s)} - \bar{C}_p \text{ (A or B)}|}{3}$ .0013 for A / .0010 for B

Note: 1. This is the vel. traverse pitot.

2. Values for $\Delta P_{(s)}$ used in calculations have been corrected for differences in manometers. Correction factor = 1.0096

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: From ~~[illegible]~~ Probe # 4-2 MRI-31

Calibrated by: RCS

Date: 6-6-79

C_{pstd} = 0.99

$\Delta P_{std} \approx$ 0.55 or as required

	Side "A" (in. H_2O) FLOW →				Side "B" (in. H_2O) FLOW →			
Run No.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
1	0.565	0.810	0.827	0	0.569	0.825	0.822	.002
2	0.565	0.811	0.826	.001	0.570	0.820	0.825	.001
3	0.565	0.810	0.827	0	0.570	0.820	0.825	.001
		Average A	0.827			Average B	0.824	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd} \sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $\left| \text{Average}_A - \text{Average}_B \right|$ = 0.003 (must be ≤ 0.01)

$$\sigma \text{ (side A or B)} = \sum_{1}^{3} \frac{\left| C_{p(s)} - \bar{C}_p \text{ (A or B)} \right|}{3}$$

0.0003 for A

0.0013 for B

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: Probe 5-3   Calibrated by: RCS

Date: 6-6-79 C_{pstd} = 0.99

$\Delta P_{std} \approx$ 0.55 or as required

Flow →   Flow

	Side "A" (in. H_2O)				Side "B" (in. H_2O)			
Run No.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
1 (seal alignment)	0.550	0.780	0.831	.001	0.565	0.793	0.836	.004
2 (all alignment)	0.550	0.777	0.833	.001	0.565	0.782	0.842	.002
3 (all alignment)	0.550	0.777	0.833	.001	0.565	0.782	0.842	.002
		Average A	0.832			Average B	0.840	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd}\sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $\left|Average_A - Average_B\right|$ = 0.008 (must be ≤ 0.01)

$$\sigma \text{ (side A or B)} = \sum_{1}^{3} \frac{\left|C_{p(s)} - \bar{C}_p \text{ (A or B)}\right|}{3}$$ 0.0010 for A / 0.0027 for B

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: New Design #1 Calibrated by: RCS

Date: 6-6-79 C_{pstd} = 0.99

$\Delta P_{std} \approx$ 0.55 or as required

Flow →

	Side "A" (in. H_2O)				Side "B" (in. H_2O)			
Run No.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
1	0.558	0.818	0.818	.002	0.558	0.838	0.808	.003
2	0.558	0.806	0.824	.004	0.558	0.825	0.814	.003
3	0.558	0.818	0.818	.002	0.558	0.833	0.810	.001
		Average A	0.820			Average B	0.811	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd}\sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $|\text{Average}_A - \text{Average}_B|$ = 0.009 (must be ≤ 0.01)

σ (side A or B) = $\sum_1^3 \frac{|C_{p(s)} - \bar{C}_p \text{ (A or B)}|}{3}$ 0.0027 for A; 0.0023 for B

MIDWEST RESEARCH INSTITUTE

PITOT TUBE CALIBRATION FORM

Pitot Tube Number: New Design #1 Calibrated by: RCS

Date: 6-6-79 C_{pstd} = 0.99

FLOW →

$\Delta P_{std} \approx$ 0.55 or as required

→ Flow

	Side "A" (in. H_2O)				Side "B" (in. H_2O)			
Run No.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.	ΔP_{std}	$\Delta P_{(s)}$	$C_{p(s)}$	Dev.
1	0.592	0.871	0.816	.005	0.60	0.90	0.808	.009
2	1.34	1.92	0.827	.004	1.31	1.90	0.822	.005
3	3.40	4.90	0.825	.002	3.40	4.94	0.821	.004
		Average A	0.823			Average B	0.817	

C_{Pstd} = Pitot tube coefficient of standard type pitot tube

$$C_{p(s)} = C_{Pstd} \sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

Dev. = $C_{p(s)} - \bar{C}_p$ (must be ≤ 0.01)

C_p(difference) = $|\text{Average}_A - \text{Average}_B|$ = 0.006 (must be ≤ 0.01)

σ (side A or B) = $\sum_1^3 \frac{|C_{p(s)} - \bar{C}_p \text{ (A or B)}|}{3}$ = 0.0037 for A / 0.006 for B

Note: Both ΔP_{std} and $\Delta P_{(s)}$ measured on same manomet

APPENDIX K AUDIT SAMPLES ANALYSIS RESULTS

K-1 DISCUSSION AND SUMMARY PRESENTATION OF AUDIT SAMPLE RESULTS
TABLE 1-K-1

K-2 SUMMARY OF LABORATORY DATA
TABLE 1-K-2

K-3 COPY OF LABORATORY NOTEBOOKS

K-1 DISCUSSION AND SUMMARY PRESENTATION OF AUDIT SAMPLE RESULTS
TABLE 1-K-1

Discussion and Summary

Three ammonium nitrate audit samples were supplied to MRI by EPA for analysis using the same techniques as were used on the test samples. The purpose of these samples was to validate the EPA analytical methods and laboratory protocol employed during the period of field testing.

The ammonium nitrate audit samples were received in a liquid state. The samples were diluted to a volume of 100 mℓ and then prepared for analysis using the same solution and specific ion electrode as the samples collected during the field testing. The test method followed is the EPA method for the "Determination of Particulate (Ammonium Nitrate) Emission from Ammonium Nitrate Plants," (a complete copy of this method can be found in Appendix N).

Table 1-K-1 contains the results of the audit samples as analyzed by MRI. The percent error in the MRI results as compared to the EPA results is also tabulated. The error ranged from a low of 2.0% to -20.1%.

All audit samples were analyzed at the same time as the test samples.

TABLE 1-K-1. SUMMARY OF AUDIT SAMPLE ANALYSIS BY SELECTIVE ION ELECTRODE AND DIRECT NESSLER

Audit sample No.	Analysis No.	Actual conc. (μg/mℓ)	Lab conc. SIE (μg/mℓ)	Relative SIE % error	Lab conc. DN (μg/mℓ)	Relative % error	Field conc. SIE (μg/mℓ)
AN-1	152	12,760	12,500	2.08	10,200	25.1	13,800
AN-2[a]	-	26,500	-	-	-	-	30,000
AN-3	153	53,740	62,100	13.5	50,400	6.63	46,100

a Sample lost in transit from field to laboratory.

K-2 SUMMARY OF LABORATORY DATA
TABLE 1-K-2

TABLE 1-K-2. SUMMARY OF LABORATORY ANALYSIS OF AUDIT SAMPLES FOR AMMONIUM NITRATE AND AMMONIA

Location	Test No.	Sample No.	Specific ion electrode (NH_4NO_3) Dilution factor	Potential (mv)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Direct Nesslerization (NH_3) Dilution factor	Absorbance. (A.U.)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)
Audit sample	AN1	152	100	128	125	12,500	6,250	0.077	0.346	10,200
			100	129				0.021[a]		
			2,000	205				0.069		
Audit sample	AN3	153	2,000	164	621	62.100	6,250	0.319	1.71	50,400
			2,000	164				0.322		
			2,000	164				0.348		

a Excluded from average.

K-3 COPY OF LABORATORY NOTEBOOKS

Project No. 4468-L18 **Date of Work:** 3/16/79 **Work Performed by:** RJ

Title or Purpose: NO_3^- Analysis **Continued From:**

Stand. 10 ml = 116 mv

Contain #190, Blank #1, acid fract.
1) 149 mv

Contain. #185, run 6-C, acid fract.
1) 131 mv

Contain #194, run 7-C, acid fract.
1) 140 mv

Contain #183, run 5-O, acid fract.
1) 125 mv

Contain. #170, run 3-O, acid fract.
1) 147 mv

Contain #153, ~~run~~ audit AN3 → diluted 1:20
1) 164 mv

Contain #152, audit AN1
1) 128 mv

Stand 10 ml = 116 mv

Contain. #190, Blank #1, acid fract.
2) 149 mv

Contain. #185, run 6-C, acid fract.
2). 130 mv

Continued To: **Disclosed To And Understood By Me:**

Entered By: **Date:**

Date: **Date:**

Project No. 4468-218 Date of Work: 3/16/79 Work Performed by: Jones

Title or Purpose: NO_3^- Analysis Continued From:

Contain #194, 7-C, acid fract.
2) 139mv

Contain #183, 5-O, acid fract.
2) 124mv

Contain #170, 3-O, acid fract.
2) 147mv

Contain #153, audit AN3 → diluted 1:20
2) 164mv

Contain #152, audit AN1
~~130mv~~ 129mv

Contain #190, Blank #1, acid fract.
3) 149mv

Contain #185, 6-C, acid fract.
3) 131mv

Contain #194, 7-C, acid fract.
3) 140mv

Contain #183, 5-O, acid fract.
3) 124mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-L18 Date of Work: 3/16/79 Work Performed by: Jones

Title or Purpose: NO_3^- Analysis Continued From:

Contain #170, 3-0, acid fract.
3) 147mv

Contain #153, audit AN3 → diluted 1:20
3) 164mv

Contain. # 152, audit AN1
3) ~~Ran so~~ Ran out of 100 ml sample ~~sol~~ so diluted 1:20
= 205 mv

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-18 Date of Work: 3/16/79 Work Performed by: DW

Title or Purpose: DET of AMMONIA Continued From: p 58

			%T	A
#152	AUDIT	152-1	83.8	.077
		152-2	95.2	.021
AN-1		152-3	85.4	.069

NORMAL DILUTION p44

ALSO DILUTED 100 TIMES BEFORE GIVEN TO ANALYST

			%T	A
#153	AN-3	153-1	47.9	.319
		153-2	47.6	.322
		153-3	44.9	.348

NORMAL DILUTION p44

ALSO DILUTED 100 TIMES BEFORE GIVEN TO ANALYST

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. Date of Work: Work Performed by:

Title or Purpose: Calibration Curve Summary Continued From:

Reference ~~Series~~	E	F	G	H	I	J
P. #	43	45	48	52	54	72
slope	0.190	0.188	0.197	0.191	0.188	0.189
intercept	-0.003	-0.008	0.016	-0.002	0.008	0.001
corr coeff	0.9997	0.9996	0.9996	0.9999		0.9998

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

APPENDIX L PROCESS SAMPLE DATA

L-1 SUMMARY OF LABORATORY ANALYSIS OF PROCESS SAMPLES

L-1-1 ROTARY DRUM GRANULATOR AND ROTARY DRUM COOLER PRODUCT SAMPLES
TABLE 1-L-1-1

L-1-2 BULK DENSITY DETERMINATIONS DATA
TABLE 1-L-1-2

L-1-3 SIEVE ANALYSIS DATA
TABLE 1-L-1-3

L-1-4 ROTARY DRUM GRANULATOR SCRUBBER LIQUOR SAMPLES
TABLE 1-L-1-4

L-2 BULK DENSITY AND SIEVE ANALYSIS FIELD DATA SHEETS

L-3 BULK DENSITY AND SIEVE ANALYSIS DETERMINATION PROCEDURES

L-4 SCRUBBER LIQUOR SAMPLE ANALYSIS PROCEDURES

L-1 SUMMARY OF LABORATORY ANALYSIS OF PROCESS SAMPLES

L-1-1 ROTARY DRUM GRANULATOR AND ROTARY DRUM COOLER PRODUCT SAMPLES
TABLE 1-L-1-1

TABLE 1-L-1-1. SUMMARY OF LAB ANALYSIS DATA FOR AMMONIUM NITRATE AND AMMONIA - ROTARY DRUM GRANULATOR AND ROTARY DRUM COOLER PRODUCT SAMPLES

					Specific ion electrode (NH_4NO_3)					Direct Nesslerization (NH_3)				
Location	Test Nos.	Sample No.	Sample volume (mℓ)	Product sample weight (gm)	Dilution factor	Potential (mv)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)	Dilution factor	Absorbance (A.U.)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Granulator inlet	2	301	1,000	406.5						125,000	0.125 0.136 0.137	0.698	87,250	87,250
Granulator outlet	3, 4, 5	303[a]	1,000	22.8	-SIE analysis was not performed on these samples-					2,500	0.374 0.359 0.379	1.96	4,900	4,900
Cooler inlet	1, 2, 3	A-101[b] (304)	1,000	24.9						2,500	0.393 0.417 0.398	2.12	5,300	5,300
Cooler outlet	1, 2, 3	A-202[c] (305)	1,000	20.25						2,500	0.347 0.349 0.349	1.84	4,600	4,600

a Composite sample consisting of a separate sample collected during each of test runs 3, 4, and 5 at the rotary drum granulator.
b Composite sample consisting of a separate sample collected from the inlet to the cooler during each of test runs 1, 2, and 3 at the rotary drum cooler.
c Composite sample consisting of a separate sample collected from the outlet of the cooler during each of test runs 1, 2, and 3 at the rotary drum cooler.

L-1-2 BULK DENSITY DETERMINATIONS DATA
TABLE 1-L-1-2

TABLE 1-L-1-2. BULK DENSITY DETERMINATION OF AMMONIUM NITRATE PRODUCT

Run No.	Sample collection Date	Location	Grams/250 mℓ (volumetrically determined)	Bulk density (lb/ft^3)
1	3-5-79	Unscreened granulator product a/	a/	a/
2	3-6-79	Unscreened granulator product	218.1	54.46
3	3-7-79	Unscreened granulator product	216.0	53.94
4	3-7-79	Unscreened granulator product	218.1	54.46
5	3-8-79	Unscreened granulator product	221.8	55.38
6	3-8-79	Inlet to cooler: screened granulator product	214.5	53.56
6	3-8-79	Outlet of cooler: screened granulator product	223.9	55.91
7	3-9-79	Inlet to cooler: screened granulator product	210.8	52.64
7	3-9-79	Outlet of cooler: screened granulator product	222.1	55.46
8	3-9-79	Inlet to cooler: screened granulator product	212.7	53.11
8	3-9-79	Outlet of cooler: screened granulator product	221.7	55.36

a/ Sample lost.

L-1-3 SIEVE ANALYSIS DATA
TABLE 1-L-1-3

TABLE 1-L-1-3. SIEVE ANALYSIS OF AMMONIUM NITRATE PRODUCT

Run No.	Sample collection		Percent of AN product retained versus sieve size						
	Date	Location	No. 6	No. 8	No. 12	No. 14	No. 16	No. 20	Pan
1	3-5-79	Unscreened granulator product a/	a/	a/	a/	a/	a/	a/	a/
2	3-6-79	Unscreened granulator product	18.6	21.3	33.5	12.0	7.8	6.0	1.0
3	3-7-79	Unscreened granulator product	10.0	23.2	37.8	12.9	8.4	6.7	1.3
4	3-7-79	Unscreened granulator product	18.0	27.2	34.0	10.5	5.8	3.6	0.5
5	3-8-79	Unscreened granulator product	21.9	18.4	31.2	12.2	8.2	6.9	1.3
6	3-8-79	Inlet to cooler: screened granulator product	2.9	48.0	41.3	6.2	1.4	0.1	0.04
6	3-8-79	Outlet of cooler: screened granulator product	3.8	52.7	37.8	4.7	1.1	0.2	0.0
7	3-9-79	Inlet to cooler: screened granulator product	4.6	59.3	33.3	2.7	0.3	0.04	0.08
7	3-9-79	Outlet of cooler: screened granulator product	5.7	63.0	28.9	2.1	0.2	0.1	0.0
8	3-9-79	Inlet to cooler: screened granulator product	8.0	58.4	28.8	3.8	0.8	0.04	0.07
8	3-9-79	Outlet of cooler: screened granulator product	7.9	57.7	28.9	4.4	1.0	0.09	0.14

a/ Sample lost.

L-1-4 ROTARY DRUM GRANULATOR SCRUBBER LIQUOR SAMPLES
TABLE 1-L-1-4

TABLE 1-L-1-4. SUMMARY OF LAB ANALYSIS DATA FOR AMMONIUM NITRATE AND AMMONIA - ROTARY DRUM GRANULATOR SCRUBBER LIQUOR SAMPLES

		Specific ion electrode (NH_4NO_3)					Direct Nesslerization (NH_3)					
Location	Test No.	Sample No.	Dilution factor	Potential (mv)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Sample No.	Dilution factor	Absorbance (A.U.)	conc. (μg/mℓ)	Aliquot conc. (μg/mℓ)
Scrubber inlet liquor	1-IS	203	4,000	156 157 157	41.5	1.66×10^5	202	6,250	1.13 1.10 1.16	5.97	3.73×10^4
Scrubber inlet liquor	2-IS	207	4,000	153 154 153	56.0	2.24×10^5	205	78,125	0.149 0.147 0.161	0.766	5.98×10^4
Scrubber inlet liquor	3-IS	212	4,000	147 147 147	60.0	2.40×10^5	211	78,125	0.182 0.186 0.201	0.966	7.55×10^4
Scrubber inlet liquor	4-IS	214	4,000	153 153 153	49.8	1.99×10^5	213	78,125	0.122 0.137 0.169	0.716	5.59×10^4
Scrubber inlet liquor	5-IS	219	4,000	159 158 158	39.3	1.57×10^5	220	78,125	0.112 0.094 0.098	0.496	3.89×10^4
Scrubber outlet liquor	1-OS	201	4,000	121 121 122	203	8.12×10^5	204	78,125	0.544 0.554 0.540	2.86	22.3×10^4
Scrubber outlet liquor	2-OS	208	4,000	119 119 119	195	7.79×10^5	206	78,125	0.517 0.531 0.533	2.76	21.6×10^4
Scrubber outlet liquor	3-OS	209	4,000	127 128 128	137	5.47×10^5	210	78,125	0.384 0.392 0.372	1.99	15.5×10^4
Scrubber outlet liquor	4-OS	216	4,000	125 125 125	176	7.04×10^5	215	78,125	0.492 0.462 0.431	2.41	18.8×10^4
Scrubber outlet liquor	5-OS	217	4,000	123 124 124	185	7.38×10^5	218	78,125	0.496 0.511 0.492	2.62	20.5×10^4

L-2 BULK DENSITY AND SIEVE ANALYSIS FIELD DATA SHEETS

Project No. 4468-L18 Date of Work: 3-6-79 Work Performed by: [signature]

Title or Purpose:

Continued From:

Granulator product sample in from R. Jones @ 0900 taken at 0855
temperature - 144°F. Bulk density run as practice
303.1 306.3
Initial 79.6 g. 79.5

Granulator product received 11:15 temperature = 139°F. Bulk density:
297.8
Initial 79.7
218.1 g. in 250 ml.

Sieve analysis	#6	#8	#12	#14	#16	#20	Pan
363.1 g.	571.2	546.7	510.0	448.7	442.9	442.2	342.1
170.9 g. tare	535.5 g.	505.7 g.	445.6	425.7 g.	427.9 g.	430.6 g.	340.1 g.
192.2	35.7 g	41.0 g.	64.4 g.	23.0 g.	15.0 g.	11.6 g.	2.0 g.

362.2 g. Material passing #16 sieve — 192.7 total.
− 170.5 g. 767.8 959.5 g. gross weight
191.7 945.7 g. after shaking
13.8 g. passes sieve #16

NO_3^- electrode std.

0	−212 mv		240 mv.	247		
1	−153 mv.	175 mv.	172 mv	178	2.072 mg/100	= 20.7 mg/l.
5	−112 mv		136 mv.	137.		104 mg/l
10	−99 mv.		119 mv.	120		207 mg/l.
15	−89 mv.		109 mv.	110		310 mg/l.
20	−105 mv?		101 mv. ✓			414 mg/l.
25	−96 mv.		96 mv. ✓			518 mg/l.

AN1 = 5.0 ml. ~~195~~ 203 mv. 204 mv.
AN2 = 5.0 ml. 185 mv. 188 mv.
AN3 = 5.0 ml. 169 mv. 169 mv
AN1 50 ml. added 149 mv = 60 mg/l. · 100/50 = 120 mg/l. NH_4NO_3 x100 = 12.0 mg/l
AN2 50 ml. added 132 mv. = 121 mg/l. · 100/50 = 242 mg/l. NH_4NO_3 = 24.2 mg/l.
AN3 50 ml. added 112 mv. = 280 mg/l. · 100/50 = 560 mg/l. NH_4NO_3 = 56.0 mg/l.

Continued To:

Disclosed To And Understood By Me:

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Date:

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Project No. Date of Work: 3-6-79 cont. Work Performed by:

Title or Purpose: Continued From:

Filtered sample 101 Blank - outlet front half, #1 train : Filter A-30; to 1.00 l.
Split into 101-P + 101-N : Preservative, 10 ml added, pH = 5 at start
sample 102 to 500 ml. Blank #1 - back
sample 104 to 500 ml. Blank #3 - back
Sample 103 filtered - Blank #3 front Filter A-29 to 1.0 l. Filter (from train)
disintegrating - adding weight. Split into 103-P + 103-N
Sample 106 Acid fraction To volumn VOL 500 ml Run 1-3-O
Sample 108 Acid fraction to volumn 500 ml Run 1-3-I
Sample Acid fraction to volumn 500 ml Run 2-3-O
~~Sample~~ A Run 2-3-I Acid fraction to volumn 500 ml
Inlet to Scrubber composite #1 filter # A-28 Nessler fraction
and Nitrate fraction No dilution made on either fraction
Inlet to Scrubber composite #2 filter # A26 Nessler fraction and Nitrate
fraction not diluted.
Outlet to Scrubber composite #1 filter A27 w/Nessler fraction and
Nitrate fraction Not diluted
outlet to Scrubber Composite #2 filter A25 w/Nessler fraction and
Nitrate fraction not diluted
Run 2 - outlet front Half Nessler and Nitrate fraction to 1.00 l and split
filter A 19 wt.
Run 1-1-O fronthalf Nessler and Nitrate fraction to 1.00 l and split
filter A 24
Run 2-1-I front half Nessler and Nitrate fraction to 2.00 l and split
filter A-23

Continued To: Disclosed To And Understood By Me:
Entered By: Date:
Date: Date:

Project No. Date of Work: Work Performed by:

Title or Purpose: Weight data from Sample Continued From:

Date Run # -- Initial wt. w/Impinger only and final wt.

3/4/79 Blank#1 Train #3 Container No 3 Backhalf.
3/5/79 1-3-0 Back half 93.3 g 393.8
3/5/79 1-3-I Backhalf 93.3 g 297.0 g
3/6/79 2-3-0 490.8 g
3/6/79 2-3-I Init 93.2 FN. —
3/6/79 2-1-0 Init 445.7 701.0 1121.6
3/4/79 Blank#1 Train #1 container No. 102 Backhalf
3/4/79 Blank#1 Train #1 Container #101 Initial 448.2 Final 859.2 Front Half
3/4/79 Blank#3 Train #3 " #103 " 447.2 - " 831.5 front Half

Composite Run 2 Initial Temp = 124°F Time = 0930 pH 6.6 @ 38°C
Run 2 Sample 2 Temp 130°F Time = 1005 pH = 6.5 @ 40°C
Run 2 Sample 3 Temp 136°F Time 1040 pH = 6.65 @ 40°C — Inlet — Inlet to Scrubber
Run 2 Sample 4 Temp 130°F Time 1120 pH 6.85 @ 38°C
Run 2 Sample 5 Temp 134°F Time 1208 pH 7.08 @ 30°C

3/5/79 1-1-I Fronthalf ~~4~~ Initial wt 182.2 Impinger 448.9 Final 626.2
Container 107

Run 1 composite Sample 1 Temp 135°F Time 1536 pH 7.15 @ 30°C
Run 1 " 1·2 " 139°F " 1607 " 7.2 @ 31°C — Inlet
1 3 139°F 1636 " 7.26 @ 31°C

Run 2 melt to granulator at time 11:20

Run 2 Sample 1 Temp 100°F Time 0935 pH 5.15 @ 28°C
" 2 " 2 " 100° " 1010 " 5.23 @ 30°C
" 2 " 3 " 100° 1044 5.55 @ 30°C — outlet to scrubber
" 2 " 4 " 100°F 1124 5.55 @ 30°C
" 2 " 5 " 100°F 1210 5.48 @ 26°C

Run 1 Sample 1 Temp 99°F Time 1544 pH 5.20 @ 31°C
Run 1 2 99°F 1607 5.21 @ 30°C — outlet to Scrubber
1 3 99 1643 5.28 @ 30°C

3/5/79 1-1-0 container 105 Init 448.6 w/Impinger 673.2 Fn 922.7

Continued To:

Entered By: Disclosed To And Understood By Me:

Date: Date:

Date:

Project No. Date of Work: Work Performed by:

Title or Purpose: Sample bottle information Continued From:

3/6/79 Run 2-1-I 1st Bottle In. 445.1 Impinger 960.4 Final 1314.3

3/6/79 Run 2-1-I 2nd Bottle In 443.1 Fn —

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. 4468-L18 Date of Work: 3-7-79 Work Performed by: G. Schiel

Title or Purpose: Run #3 Sieve Data Continued From:

Sieve analysis:	#6	#8	#12	#14	#16	#20	Pan
gross wt. 429.6 g.	562.1	565.9	543.9	459.4	449.8	448.0	343.5
~~total~~ gross tare 168.9 g.	536.0 g.	505.3 g.	445.4 g.	425.7 g.	428.0 g	430.6 g.	340.1 g.
gross sample 260.7 g.	26.1	60.6	98.5	33.7	21.8	17.4	3.4

261.5 g. total

Bulk density 295.7
tare 79.7 g.
216.0 g. transfered to granulator Product Composite

Run #3 sample received @ 1200 130°F. split x4 sample whiter than Run 2

#16 sieve
391.9 g. 990.6 g. pan + sample
− 168.8 970.8 g.
223.1 g. 19.8 g. passes #16

Bulk density Run #4 @ 1620
297.8
tare 79.7
218.1 g.

Sieve analysis Run #4

	#6	#8	#12	#14	#16	#20	Pan
gross wt. 417.4 g.	582.9	569.9	531.9	452.3	442.6	440.0	341.3
tare 169.1 g	535.4	505.1	445.9	425.5	428.1	430.9	340.3
248.3 g.	47.5	64.8	86.0	26.8	14.5	9.1	1.0

249.7 total.

#16 sieve
379.0 978.2 g.
− 168.8 − 968.8 g
210.2 g. 9.4 g.

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. Date of Work: 3-7-79 cont. Work Performed by:

Title or Purpose: Continued From:

Sieve analysis Run #4 repeat

Gross	#6	#8	#12	#14	#15	#20	pan
388.4	575.3	565.5	520.0	448.7	440.9	438.8	341.2
169.3 g.	535.8 g.	505.8	445.5	425.8	428.1 g.	430.9	340.0
219.1 g.	39.5	59.7	74.5	22.9	12.8	7.9	1.2

218.5 total

Inlet to scrubber Run 3 composite - split to NO_3^- + Nessler - no dilution; Filter A-22
Outlet to scrubber Run 3 composite - " " " " Filter A-21
Inlet to scrubber Run 4 composite - " " " " Filter A-18
Outlet to scrubber Run 4 composite - " " " " Filter A-17
Run 3 Acid fraction - Inlet to 500 ml.
Run 3 Acid fraction - outlet to 500 ml.
Run 3 H_2O fraction - Inlet to 2.00 l. split to NO_3^- + Nessler fractions; Filter A-15
Run 3 H_2O fraction - outlet to 1.00 l., split to NO_3^- + Nessler fractions; Filter A-16
Run 4 H_2O fraction - Outlet to 1.00 l., split to NO_3^- + Nessler fractions; Filter A-14
Run 4 H_2O fraction - Inlet to 2.00 l., split to NO_3^- + Nessler fractions; Filter A-13
Run 4 Acid fraction Inlet to 500 ml.
Run 4 Acid fraction Outlet to 500 ml.

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 1468-L18 **Date of Work:** March 8, 1979 **Work Performed by:** G. Schiel

Title or Purpose: **Continued From:**

Sieve analysis Run #5 - Received 1030

		#6	#8	#12	#14	#16	#20	Pan
~~gross~~								
~~tare~~ gross	489.1 g.	604.7	563.1	548.4	464.8	454.2	452.7	344.4
tare	168.9 g.	535.5	505.6	445.2	425.6	427.8	430.6	340.2
	320.3 g.	69.2	57.5	103.2	39.2	26.4	22.1	4.2

Bulk density 301.5
79.7
221.8 g.

326.8

Repeat sieve analysis Run #5

		#6	#8	#12	#14	#16	#20	Pan
gross	475.4	602.7	561.5	540.9	462.8	453.1	451.5	344.1
tare	169.3	535.8	505.3	445.4	425.5	428.0	430.5	340.1
	306.1	66.9	56.2	95.5	37.3	25.1	21.0	4.0

306.0 g. total

pass #16 sieve

490.5 g.	1087.9 g.
- 170.0 g.	- 1059.7
320.5 g total.	28.2

Samples of Cooker product in & out received 1445 Run #6

Inlet Bulk density
293.8
79.3
214.5 g.

Scrubber samples 201-16 boxed up 206 & 8 both soy nessler fraction - must be checked

Blank of Jeb's distilled water supply taken #151 - all samples from Run 1 up use this water

Train samples 154-165 boxed up

Am1 + Am3 (1:100 dilution sealed as 152 + 3

Continued To: **Disclosed To And Understood By Me:**

Entered By: **Date:**

Date: **Date:**

Project No. Date of Work: 3-8-79 cont. Work Performed by:

Title or Purpose: Continued From:

Sieve analysis - Cooler inlet Run 5

		#6	#8	#12	#14	#16	#20	Pan
gross	424.0	543.1	627.8	550.9	441.6	431.5	431.1	340.2
tare	168.8	535.6	505.4	445.4	425.7	428.0	430.8	340.1
	255.2 g.	~~8.5~~ 7.5 (MOH 4-23-79)	122.4	105.5	15.9	2.5	0.3	0.1

255.2 g. total → 3.5 (MOH 4-23-79)

Inlet - Run 6
#16 pass

394.1 − 168.9 = 225.2 g.

993.5 g − 992.7 g. = 0.8 g.

Sieve analysis of outlet cooler sample #5 Run

Bulk analysis - density

303.5
− 78.6
223.9 g.

		#6	#8	#12	#14	#16	#20	Pan
gross	365.5	543.3	609.2	519.7	434.9	430.0	431.2	340.0
tare	~~168.8~~	535.9	505.6	445.4	425.7	427.9	430.9	340.0
	196.7	7.4	103.6	74.3	9.2	2.1	0.3	0.0

196.9 total

Outlet #16 sieve pass Run 6

gross 397.6 − 168.8 = 228.8 g.

996.5 − 996.0 = 0.5

Composite - Inlet to scrubber Run 5 - filtered, split, no dilution ; Filter A-12
" Outlet " " " " ; Filter A-11

Run 5 - Inlet - Acid fraction to 500 ml
Run 5 - Outlet - " "
Run 6 - Cooler " "

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. Date of Work: 3-8-79 cont. Work Performed by:

Title or Purpose:

Continued From:

Run 5-Inlet-H_2O fraction (front) filtered to 1.00 l, split to NO_3^- + Nessler; Filter # 10

Run 5-Outlet-H_2O fraction (front) filtered to 1.00 l, split to NO_3^- + Nessler; Filter # 9

Run 6-Cooler " " " Filter # 8

Purple color to solid, large sand grains on filter

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468-L18 Date of Work: 3-9-79 Work Performed by: [signature]

Title or Purpose:

Continued From:

Sieve Analysis Run 7 Inlet

		#6	#8	#12	#14	#16	#20	Pan
Gross	410.3	546.7	648.8	525.6	432.1	428.6	430.8	340.2
Tare	168.9	535.7	505.7	445.3	425.6	427.9	430.7	340.0
	241.4 g.	11.0	143.1	80.3	6.5	0.7	0.1	0.2

Bulk density #16 pass 241.9 g. total

290.5	410.0 g.	1008.8 g.
79.7	168.7 g.	1008.7 g.
210.8 g.	241.3 g.	0.1 g.

Sieve analysis Run 7 Outlet

		#6	#8	#12	#14	#16	#20	Pan
Gross	399.6	549.0	651.1	512.2	430.4	428.5	430.9	340.0
Tare	168.7	535.8	505.6	445.4	425.5	428.0	430.6	340.0
	230.9 g.	13.2	145.5	66.8	4.9	0.5	0.3	0.0

Bulk density pass #16 231.2 g. total

301.8	359.6 g	958.0
79.7 g.	−168.8	957.9
222.1 g.	190.8	0.1

Sieve analysis Run 8 Inlet

		#6	#8	#12	#14	#16	#20	Pan
Gross	466.8	559.2	688.1	523.9	436.0	430.2	431.0	340.0
Tare	168.6	535.8	505.4	445.7	425.8	428.1	430.8	340.0
	298.2	23.4	182.7	78.2	10.2	2.1	0.2	0.0

Bulk density 296.8?

292.4
79.7
212.7

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. **Date of Work:** 3-9-79 cont **Work Performed by:**

Title or Purpose: **Continued From:**

Run 8 - Inlet - Sieve repeat

G		#6	#8	#12	#14	#16	#20	Pan
Gross	447.0	558.2	667.9	525.7	436.6	430.4	431.0	340.2
Tare	169.0	535.9	505.6	445.5	426.0	428.2	430.9	340.0
	278.0	22.3	162.3	80.2	10.6	2.2	0.1	0.2

#16 Pass 456.1 1054.9 277.9 total

168.8 1054.0

287.5 g. 0.9 g.

Run 8 - Outlet -

Bulk density 301.4 #16 Pass 396.6 994.4

79.7 169.6 993.7

221.7 g. 0.7 g.

Sieve analysis	#6	#8	#12	#14	#16	#20	Pan
391.8	553.2	633.2	509.2	435.6	430.3	431.3	340.5
170.7	535.7	505.6	445.4	425.8	428.1	431.1	340.2
221.1	17.5	127.6	63.8	9.8	2.2	0.2	0.3

221.4 total

Run 7 - Cooler - acid fraction to 500 ml.

Run 8 - Cooler - acid fraction "

Run 7 - Cooler - H_2O fraction, filtered, split, to 1.00 l. vol. + vessel; Filter #A-7

Run 8 - Cooler " " " " Filter #A-6

Continued To: **Disclosed To And Understood By Me:**

Entered By: **Date:**

Date: **Date:**

L-3 BULK DENSITY AND SIEVE ANALYSIS DETERMINATION PROCEDURES

Sample Collection Procedures - Bulk Density and Sieve Analysis

During the sampling, product samples were collected for bulk density and sieve analysis. These samples were taken at the inlet and outlet of the rotary drum cooler. These samples were taken from conveyor belts or free flowing vents depending on the location.

Conveyor belt samples were taken by scooping a collection container (1 quart capacity) across the flow on the conveyor belt. To insure the collection of a representative sample three scoops were made to fill the jar. Samples from the free flowing vents were taken by placing the collection container in the vent directly in the stream of product flow.

Bulk Density, Analytical Procedure

The bulk density of the ammonium nitrate was determined using a graduated cylinder and platform balance.

The sample was passed through a riffle and a 300 to 350 mℓ portion was obtained. The tare weight of the graduated cylinder was determined. The sample was then passed into the graduated cylinder until it overflowed the cylinder. The sample was then leveled with the top of the cylinder. The cylinder and contents were then reweighed. The bulk density was then determined by the following:

$$\text{Bulk density (lb/ft}^3\text{)} = \text{(weight of sample)(0.2497)}$$

Sieve Analysis, Analytical Procedure

Sieve analysis was performed to determine the particle size of the product. The equipment used includes a sieve shaker, timer, balance, and sieves (sieves 6, 8, 12, 14, 16, 20, and a pan were used). A sample of approximately 200 g is weighed on a single pan balance to $\pm$ 0.1 g and placed into the top sieve. The material is shaken for 20 min and the bottom pan is weighed. Following the initial weighing, the pan is returned to the shaker, the sample is shaken for an additional 10 min, and the pan is weighed a second time. This process is repeated for a second 10 min interval. At the conclusion of the shaking (a total of 40 min) all the sieves and the pan are weighed. The percent of material retained in each sieve is calculated according to the equation:

$$\text{\% retained} = \frac{\text{wt. of material on sieve x 100}}{\text{total wt. of material}}$$

L-4 SCRUBBER LIQUOR SAMPLE ANALYSIS PROCEDURES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

SUBJECT: Analysis of Scrubber Samples from NH_4NO_3 Plants DATE:

FROM: Gary McAlister, Test Support Section
Emission Measurement Branch, ESED (MD-19)

TO: C. E. Riley, Field Testing Section
Emission Measurement Branch, ESED (MD-13)

This is a brief outline of the procedure to follow in measuring the scrubber water samples.

1. pH. Allow the samples to cool to room temperature and measure the pH using a pH meter and electrode. If the samples crystalize upon cooling, they must be redissolved before measuring the pH. Redissolve the samples by adding the minimum amount of deionized distilled water necessary to dissolve all visible crystals. Allow the solution to return to room temperature and measure the pH as above.

2. Filter the sample through a tared glass fiber filter using a vacuum filtration apparatus. Retain the filter, dry, and weigh to determine the undissolved solids.

3. PLace the filtrate in a 1 liter volumetric flask (or larger if necessary) and dilute to exactly 1 liter with deionized distilled water. Analyze the sample for both NO_3^- and NH_3 using the same procedure as for the emission samples.

EPA Form 1320-6 (Rev. 6-72)

APPENDIX M	PROCESS OPERATIONS DATA
M-1	SUMMARY OF OPERATING PARAMETER VALUES
M-2	NOTES MADE AT SWIFT CHEMICAL COMPANY AMMONIUM NITRATE MANUFACTURING PLANT

M-1 SUMMARY OF OPERATING PARAMETER VALUES

SUMMARY OF OPERATING PARAMETER VALUES

Averages and standard deviations are presented for various parameters, which are indexed by plant guage codes. Temperatures are recorded as variations from a confidential value. Production rate calculations for each test are also presented here.

Note 1 - See Item 1, Confidential Addendum, Contact Eric Noble, (919) 541-4213.

Production Rates for Rotary Drum Granulator

$$\text{Product after screens} = \frac{\frac{R_2 - R_1}{200}}{\text{time (min)}} \times \frac{60 \text{ min}}{\text{hr}} = \text{tons/hour}$$

Test 1: Granulator Scrubber Particulate

$$\frac{\frac{612646 - 604676}{200}}{165 \text{ min}} \times 60 = 14.49 \text{ tph} = 347.8 \text{ tpd} = 13.15 \times 10^3 \text{ kg/hr}$$

Test 2: Granulator Scrubber Particulate

$$\frac{\frac{627821 - 619970}{200}}{135 \text{ min}} \times 60 = 17.44 \text{ tph} = 418.72 \text{ tpd} = 15.82 \times 10^3 \text{ kg/hr}$$

Test 3: Granulator Scrubber Particulate

$$\frac{\frac{695320 - 686062}{200}}{135 \text{ min}} \times 60 = 20.5 \text{ tph} = 493 \text{ tpd} = 18.6 \times 10^3 \text{ kg/hr}$$

Production Rates During Rotary Drum Cooler Tests

Test 1:

$$\frac{\frac{711948 - 705692}{200}}{90} \times 60 = 20.9 \text{ tph} = 500.48 \text{ tpd} = 18.96 \times 10^3 \text{ kg/hr}$$

Test 2:

$$\frac{\frac{788015 - 783850}{200}}{60} \times 60 = 20.8 \text{ tph} = 499.8 \text{ tpd} = 18.87 \times 10^3 \text{ kg/hr}$$

Test 3:

$$\frac{\frac{711948 - 705692}{200}}{90} \times 60 = 20.9 \text{ tph} = 500.5 \text{ tpd} = 18.96 \times 10^3 \text{ kg/hr}$$

Particle Size Tests on Rotary Drum Granulator Scrubber Inlet

Test 1:

$$\frac{\frac{615772 - 614961}{200}}{15} \times 60 = 16.22 \text{ tph} = 389.28 \text{ tpd} = 14.71 \times 10^3 \text{ kg/hr}$$

Test 2:

$$\frac{\frac{631032 - 630415}{200}}{12} \times 60 = 15.43 \text{ tph} = 370.2 \text{ tpd} = 13.99 \times 10^3 \text{ kg/hr}$$

Test 3:

$$\frac{\frac{706717 - 705692}{200}}{15} \times 60 = 20.5 \text{ tph} = 492.0 \text{ tpd} = 18.59 \times 10^3 \text{ kg/hr}$$

Particle Size Tests on Rotary Drum Cooler Outlet

Test 1: (NO DATA)

Test 2:

$$\frac{\frac{780916 - 779971}{200}}{15} \times 60 = 18.9 \text{ tph} = 453.6 \text{ tpd} = 17.15 \times 10^3 \text{ kg/hr}$$

Test 3:

$$\frac{\frac{790236 - 789124}{200}}{15} \times 60 = 22.24 \text{ tph} = 533.76 \text{ tpd} = 20.32 \times 10^3 \text{ kg/hr}$$

M-2 NOTES MADE AT SWIFT CHEMICAL COMPANY AMMONIUM NITRATE MANUFACTURING PLANT

NOTES MADE AT SWIFT CHEMICAL COMPANY AMMONIUM
NITRATE MANUFACTURING PLANT

Note 2 - See Item 2, Confidential Addendum, Contact Eric Noble, (919) 541-5213

APPENDIX N DETAILED SAMPLING AND ANALYTICAL PROCEDURES

N-1 SUMMARY AND DISCUSSION OF SAMPLING AND ANALYTICAL PROCEDURES

N-2 EPA SAMPLING AND ANALYTICAL METHODS

N-2-1 AMMONIUM NITRATE

N-2-2 AMMONIA

N-1 SUMMARY AND DISCUSSION OF SAMPLING AND ANALYTICAL PROCEDURES
FIGURE 1-N-1

Summary Discussion of Sampling and Analytical Procedures

This appendix presents the detailed sampling and analysis procedures used for the test at Swift Chemical Company, Beaumont, Texas.

Sampling Techniques - EPA Modified Method 5

Figure 1-N-1 is a schematic of the modified EPA Reference Method 5 train used to collect isokinetic ammonium nitrate samples at the rotary drum granulator scrubber inlet and outlet and at the uncontrolled rotary drum cooler exhaust. The sample probe used at the scrubber outlet was a conventional stainless steel sheath with heated glass liner connected directly to the impinger train box.

The scrubber inlet and uncontrolled cooler outlet sampling sites contained vertical traverse sample locations. A conventional sampling probe arrangement was not feasible at these two sites. The probe used for testing these sites was modified by attaching a 1/2-in OD flexible Teflon tube at the nozzle end inside a conventional probe sheath. The Teflon tube passed through the entire probe sheath and extended for approximately 15 ft, where it was adapted to a ball socket spherical joint for attachment to the glassware in the impinger train. An electrical heating tape wrapped around the Teflon tube inside the probe sheath and extended approximately 5 ft beyond the sheath to prevent moisture condensation in that portion of the sample line.

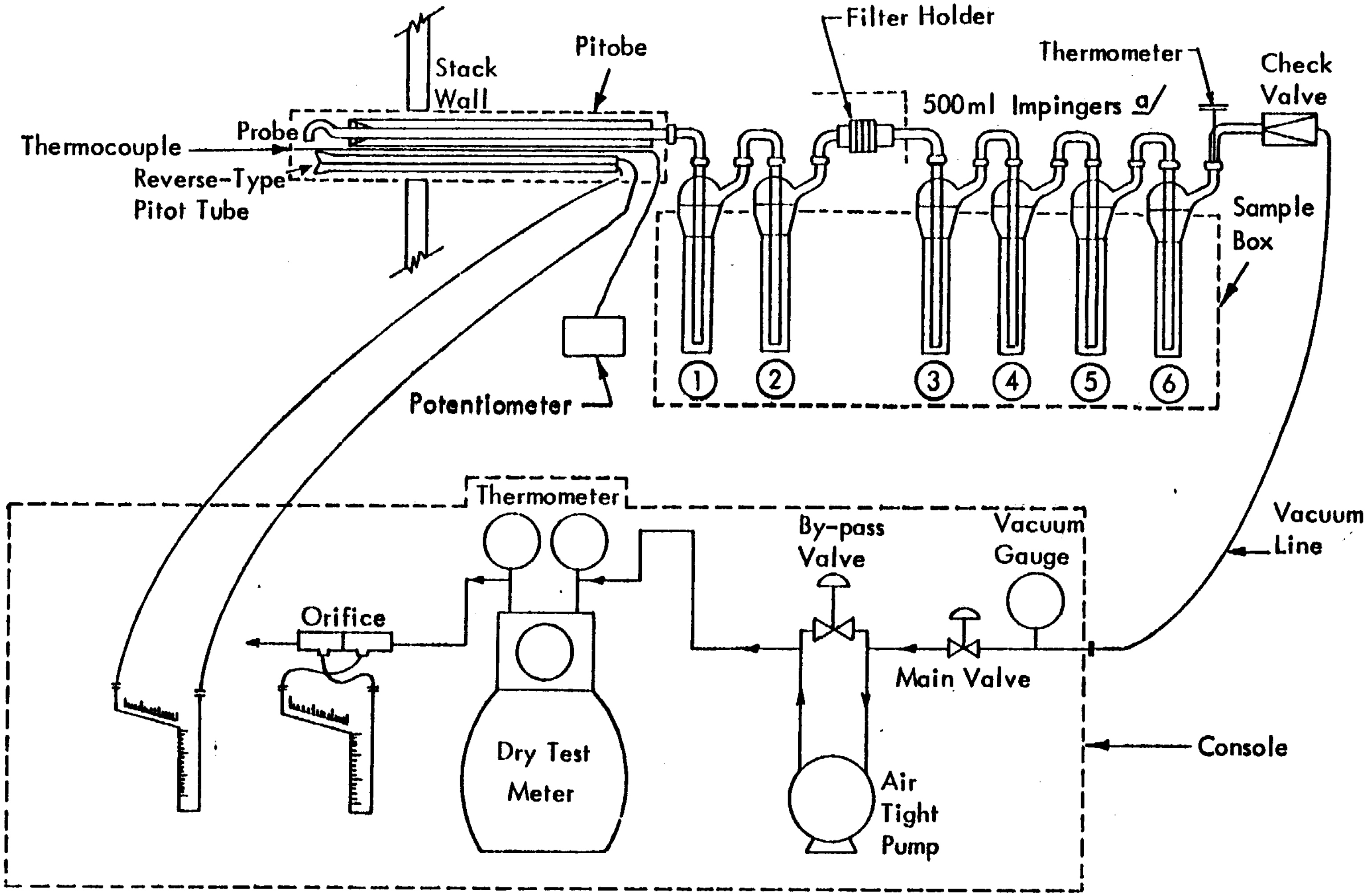
At all sampling locations (scrubber inlet, scrubber outlet, and uncontrolled cooler outlet) probe temperatures during sampling were maintained at approximately stack temperature plus 10°F.

The first, third, fifth, and sixth impingers used were of the modified Greenburg-Smith design, and the second and fourth impingers were the regular Greenburg-Smith units with orifice plates.

A glass-fiber (Gelman type A/E) filter with stainless steel backup frit and glass filter holder was placed between the second and third impingers. The filter was not weighed but was added to the impinger water collection at the conclusion of each test.

The sample train was prepared for testing by placing 100 mℓ of distilled, deionized water in impinger Nos. 1 and 2. Impinger Nos. 3 and 4 contained 100 mℓ of 1 Normal sulfuric acid (1 N H_2SO_4), and the fifth impinger was empty. The sixth impinger contained a weighed quantity (approximately 200 g) of indicating silica gel.

Sampling procedures were as described in EPA Reference Method 5, except that the filter was not heated and the probe was heated to the stack temperature plus 10°F.



a/ Impingers 1,3,5 and 6 are of the Modified Greenburg-Smith Type
Impingers 2 and 4 are of the Greenburg-Smith Design
Impinger 1 and 2 Contain 100ml Water
Impinger 3 and 4 contain 100ml $1N H_2SO_4$
Impinger 5 Empty
Impinger 6 Contains 200-300 Grams Silica Gel

Figure 1-N-1. Schematic of modified EPA reference Method 5 sampling train.

Sample Recovery - EPA Modified Method 5

Sample recovery at the conclusion of each test consisted of:

1. The sampling nozzle and probe (glass of Teflon as applicable) were brushed and washed three times into a collection flask using a nylon brush on a Teflon rod and washing with distilled, deionized water (DDW). The probe wash was then added to the collection from the first two impingers, along with the DDW rinse of all connecting glassware up to but not including the third impinger. The filter and the DDW rinse from the filter holder were also added to this collection, which was placed in a labeled, 32-oz, wide-mouthed jar.

2. The contents of the third, fourth, and fifth impingers were transferred to a sample bottle. The impingers and all connecting glassware were rinsed with 1 N H_2SO_4 and added to the second container collection.

As in EPA Method 5, the volume of the collection from the impingers was recorded and used to determine the moisture content. An exception to this method occurred involving the scrubber inlet tests. The heavy loading of ammonium nitrate in that part of the process caused periodic stoppage of the Teflon sample line. It was necessary to stop sampling when this occurred and flush out the obstruction into the impinger train using DDW. This addition of DDW to the impinger train made the sample collection appear to contain a much higher moisture content than actually existed. Therefore, instead of using the volume of impinger water collected to determine moisture content, an assumed value of 2% moisture by volume was used for all the scrubber inlet tests.

Sample Pretreatment - EPA Modified Method 5

Due to time limitations during the field test, the laboratory analyses of the modified EPA Method 5 samples was not conducted in the field laboratory. The two sample containers from each test run were pretreated in the following manner for subsequent analyses at MRI's laboratories in Kansas City, Missouri:

> The water content of the first sample container (front half, or water fraction) was filtered using a tared glass fiber filter and a vacuum filtration assembly to remove all traces of undissolved material. A vacuum flask, vacuum pump, Buchner funnel, and tared glass fiber filters were used for this filtration operation. The tared glass fiber funnel filter was stored in a petri dish for subsequent desiccation and weighing at MRI's Kansas City laboratories.
>
> The filtered water from the first sample container was then divided into two equal portions with concentrated H_2SO_4 being added to one portion until the pH was 6.0 or less. The second equal portion of the filtered water was not pretreated.
>
> The sample content of the second container from each test run (back half, or acid fraction) did not receive any pretreatment.

Sample Analysis - EPA Modified Method 5

All modified EPA Method 5 train samples were analyzed at MRI's Kansas City, Missouri laboratories. MRI used the detailed EPA methods provided in Section N-2 of this appendix to analyze the samples.

Only one sample train was collected for each set of analyses using the modified EPA Method 5 train described in Figure 1-N-1. The front half (water fraction) of the train was split into two equal portions. The untreated portion of the water fraction, including the Buchner funnel filter was analyzed for nitrate using an ion specific electrode. The pH treated portion of the water fraction was analyzed for ammonia using Direct Nessler techniques.

The back half (acid fraction) of the sampling train was analyzed first for nitrate with an ion specific electrode. The same solution was then analyzed for ammonia using Direct Nessler techniques.

The laboratory methods used in the analysis of the modified EPA Method 5 train samples is described in the following sections.

Specific Ion Electrode Measurements

The impinger contents were diluted to a known volume at the test site before transfer to the laboratory for analysis. At the laboratory a calibration curve for the electrode (Orion) and millivolt meter (Leeds and Northrup) were prepared by taking a 100 mℓ aliquot of standard solution, 2 mℓ of ISA solution, and 2 mℓ of boric acid preservative. The solution was placed on a magnetic stirrer and the electrode was inserted. After a stable reading was obtained, the results were recorded and the calibration curve was constructed.

Samples were treated in the same way. Concentrations were determined from the calibration curve. Three aliquots of each sample were measured. Where necessary, the samples were diluted prior to the measurement. The detailed techniques used in the analysis of the test samples for ammonium nitrate using an ion specific electrode are described in Section N-2-1 of this appendix.

Direct Nesslerization

The detailed techniques used in the analysis of the test samples for ammonia are described in Section N-2-2 of this appendix. The procedures described in Section 4.3 of the EPA methods were used exactly as described.

A colorimeter (B&L Spectronic 20) was calibrated using solutions of known concentration. Absorbances of each solution were measured following appropriate dilution to keep the absorbances within the range of the calibration.

This technique involves adjusting the pH of the solution to between 8 and 10, adding the Nessler reagent and diluting to known volume. The solution is allowed to stand for approximately 30 min before the absorbance is read. Three aliquots of each sample were measured and the average was used to calculate the concentration.

This technique was used on both the acid and water fractions obtained from the modified Method 5 train samples.

Insoluble Particulate Emissions

Insoluble particulates were determined by filtering the impinger solutions through tared Method 5 filters. Filtering occurred as the samples were transferred from the impingers into the sample bottles. The filters were rinsed, air dried, and returned to the laboratory where they were weighed under temperature and humidity controlled conditions.

N-2 EPA SAMPLING AND ANALYTICAL METHODS

N-2-1 AMMONIUM NITRATE

DRAFT
NOV 5 1979

APPENDIX A - REFERENCE TEST METHODS

* * * * *

METHOD 18 - DETERMINATION OF PARTICULATE EMISSIONS FROM AMMONIUM NITRATE PLANTS

1. Applicability and Principle

1.1 Applicability. This method applies to the determination of (ammonium nitrate) particulate emissions from dryers, granulators, evaporators, coolers, precoolers, and prilling towers in ammonium nitrate production facilities and other sources, only when specified in the regulations.

1.2 Principle. Ammonium nitrate particulate emissions are withdrawn isokinetically from the source, collected in water, and determined with a specific ion electrode (SIE).

2. Range and Sensitivity

2.1 Range. The range of the procedure is limited only by the lower nitrate concentration detection limit of the SIE. A typical linear measurement range is 6×10^{-6} to 1.0 M nitrate ion or about 8.0×10^{-5} to 13 g/scm (3.5×10^{-5} to 4.6 gr/scf) for a 3.0 m^3 sample.

2.2 Sensitivity. The sensitivity of the technique varies according to the particular combination of electrode and readout meter.

3. Interferences

The following ions and concentrations are reported by one vendor to cause a 10-percent error when measuring a 10^{-3} M nitrate concentration:

10^{-7} M ClO_4^-; 10^{-5} I^-; 10^{-4} ClO_3^-; 6 x 10^{-4} Br^-; 4 x 10^{-3} HS^-, CN^-; 2 x 10^{-3} NO_2^-; 4 x 10^{-2} HCO_3^-, Cl^-; 10^{-1} OAc^-.

4. Precision, Accuracy, and Stability

The precision and accuracy of the total technique and the stability of the samples have not been statistically determined. However, based on the limited amount of data collected during the initial method evaluation tests, the precision at the 95 percent confidence interval was 19.7 percent and the samples were stable for at least 30 days.

5. Apparatus

5.1 Sampling Train. A schematic of the sampling train is shown in Figure 18-1; it is similar in construction to Method 5. The sampling train consists of the following components:

5.1.1 Probe Nozzle, Probe Liner, Pitot Tube, Differential Pressure Gauge, Metering System, and Barometer. Same as Method 5, Sections 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.8, and 2.1.9, respectively. Stainless steel (316) probe liners may also be used.

5.1.2 Impingers. Five impingers connected in series as shown in Figure 18-1 with vacuum tight fittings. For the first, third, fourth, and fifth impingers, the tester may use the Greenburg-Smith design, modified by replacing the tip with a 1.25 cm (1/2 in.) ID glass tube extending to 1.25 cm (1/2 in.) from the bottom of the flask. For the second impinger, use the Greenburg-Smith design with a standard tip.

5.2 Sample Recovery. The following equipment is needed:

5.2.1 Probe-Liner and Probe-Nozzle Brushes, Graduated Cylinder and/or Balance, Plastic Storage Containers, and Rubber Policeman. Same as Method 5, Sections 2.2.1, 2.2.5, 2.2.6, 2.2.7, respectively.

5.2.2 Wash Bottle. Glass or polypropylene.

5.2.3 Sample Storage Containers. Polypropylene, 1-liter.

5.2.4 Funnel. Glass or polypropylene.

5.3 Analysis. For analyses, the following equipment is needed:

5.3.1 Beakers. Glass or polypropylene, 1000-ml, 250-ml.

5.3.2 Balance. Triple-bean or dual-pan, 1500-g capacity to measure ± 0.5 g.

5.3.3 Nitrate Ion Activity Sensing Electrode.

5.3.4 Reference Electrode. Double junction or equivalent suitable for use with the nitrate electrode and electrometer.

5.3.5 Electrometer. A pH meter with millivolt (mv) scale capable of ± 0.5-mv resolution, or a specific ion meter made especially for specific ion use.

5.3.6 Magnetic Stirrer. With TFE fluorocarbon-coated stirring bars.

5.3.7 Graduated Cylinder. 500-ml, graduated in divisions of 2 ml, capable of measuring volume to ± 1 ml.

6. <u>Reagents</u>

Use ACS reagent-grade chemicals or equivalent, unless otherwise specified. The reagent used in sampling and sample recovery are as follows:

6.1 Sampling and Sample Recovery.

6.1.1 Silica Gel, Crushed Ice, and Stopcock Grease. Same as Method 5, Sections 3.1.2, 3.1.4, 3.1.5, respectively.

6.1.2 Water. Deionized distilled, to conform to ASTM Specification D1193-74, Type 3. At the option of the analyst, the

$KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

6.1.3 Sulfuric Acid (H_2SO_4), 1 N. Add 56 ml of concentrated H_2SO_4 to 500 ml of deionized distilled water in an 1-liter volumetric flask. Dilute to exactly 1 liter with deionized distilled water.

6.1.4 Preservative Solution, 1 M Boric Acid. Dissolve 6.2 g of boric acid in 90 ml of boiling deionized distilled water in a 100-ml volumetric flask. Dilute to exactly 100 ml with deionized water.

6.2 Analysis. The reagents needed for analysis are listed below:

6.2.1 Water. Same as 6.1.2.

6.2.2 Ionic Strength Adjustor (ISA). Dissolve 26.4 g of ammonium sulfate in 50 ml of deionized distilled in a 100-ml volumetric flask. Dilute to exactly 100 ml with deionized distilled water.

6.2.3 Standard Ammonium Nitrate (NH_4NO_3) Solution, 1 mg/ml. Weigh exactly 1.290 g of NH_4NO_3 and transfer into an 1-liter volumetric flask. Add 500 ml of deionized distilled water and dissolve. Dilute to exactly 1 liter with deionized distilled water.

6.2.4 Reference Electrode Filling Solution. Add 2 ml of ISA to a 100-ml volumetric flask and dilute to exactly 100 ml with deionized distilled water.

7. <u>Procedure</u>

7.1 Sampling. Because of the complexity of this method, testers should be trained and experienced with the test procedure to ensure reliable results.

7.1.1 Pretest Preparation. Follow the general procedure given in Method 5, Section 4.1.1, except omit the directions for the filter.

7.1.2 Preliminary Determinations. Follow the general procedure given in Method 5, Section 4.1.2, except as follows: Select a nozzle size based on the range of velocity heads, in order to maintain isokinetic rates below 28 liters/min (1.0 cfm).

7.1.3 Preparation of Sampling Train. Follow the general procedure given in Method 5, Section 4.1.3, except place 100 ml of deionized distilled water in each of the first two impingers, place 100 ml of 1 N H_2SO_4 in the third impinger, leave the fourth impinger empty, and place the preweighed silica gel in the fifth impinger. Assemble the train as shown in Figure 18-1.

7.1.4 Leak-Check Procedures. Follow the leak-check procedures given in Method 5, Sections 4.1.4.1 (Pretest Leak-Check), 4.1.4.2 (Leak-Checks During Sample Run), and 4.1.4.3 (Post-Test Leak-Check).

7.1.5 Sampling Train Operation. Follow the general procedure given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in Method 5, Figure 5-2. Maintain isokinetic sampling rates at less than 28 liters/min (1.0 cfm).

7.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

7.2 Sample Recovery. Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period.

Move the impinger train to the cleanup area. Treat the impinger contents as follows:

7.2.1 Container No. 1. Measure and record the contents of the first two impingers to the nearest ± 1 ml. Transfer the liquid to Container No. 1.

Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particular matter or any condensate from the probe nozzle, probe fitting, and probe liner as follows (place the washes in Container No. 1):

Carefully remove the probe nozzle; and rinse the inside surface with deionized distilled water from a wash bottle and brush with a Nylon* bristle brush. Rinse and brush three times, after which make a final rinse of the inside surface with deionized distilled water.

While tilting and rotating the probe, squirt water into upper end of the probe so that all inside surfaces are wetted. Let the water drain from the lower end into the sample container. The tester may use a funnel to aid in transferring the washes to the container. Follow the rinse with a probe brush. Hold the probe in an inclined position, squirt water into the upper end as the probe brush is being pushed with a twisting action through the probe, hold the sample container underneath the lower end of the probe, and catch any water and particulate matter which is brushed from the probe. Run the brush through the probe three times or more until the probe liner appears clean on visual inspection. Rinse the brush with water, and quantitatively collect these washings in the sample container. After the brushing, make a final water rinse of the probe as described above.

It is recommended that two people clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

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* Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.

Add 2 ml of the boric acid preservative solution per 100 ml of sample to Container No. 1. Mark the liquid level of the container to determine later whether leakage occurred during shipment. Cap and seal the containers and return to the laboratory for analysis.

7.2.2 Impingers No. 3 and 4. Measure and record the contents of Impingers 3 and 4. Discard the liquid.

7.2.3 Container No. 2 (Silica Gel). Note the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from to its original container and seal. The tester may use a funnel and rubber policeman as aids in transferring the silica gel. It is not necessary to remove the small amount of particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, the tester may follow the procedure for this container in Analysis, Section 7.3.3.

7.3 Analysis. Treat the contents of the sample containers as described below:

7.3.1 Container No. 1. Transfer the contents of this container to a 500-ml volumetric flask and dilute to exactly 500 ml with deionized distilled water. Pipet 100-ml aliquots of sample into each of three 250-ml beakers. Add 2 ml of ISA to each beaker.

If ambient laboratory temperature differs by more than $\pm$ 2°C from the temperature at which the calibration standards were measured, condition the samples and standards in a constant temperature bath before measurement. Stir the sample with a magnetic stirrer during measurement to minimize electrode response time. If the stirrer generates enough heat to change solution temperature, place a piece of temperature insulating material such as cork, between the stirrer and the beaker.

Insert the nitrate and reference electrodes into the solution. When a steady mv reading is obtained, record it. Determine the concentration from the calibration curve. Between electrode measurements, rinse the electrodes with deionized distilled water and wipe dry. Report the average of the three aliquot determinations as the sample nitrate concentration in mg/ml.

7.3.2 Blank Determination. Treat three 100-ml aliquots of the deionized distilled water used for sampling and sample recovery as in 7.3.1. Report the average blank concentration in mg/ml.

7.3.3 Container No. 2 (Silica Gel). Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. (The tester may conduct this step in the field.)

8. Calibrations

8.1 Sampling Train. Calibrate the sampling train components according to the indicated sections of Method 5: Probe Nozzle (5.1); Pitot Tube (5.2); Metering System (5.3); Temperature Gauges (5.5); Leak-Check of the Metering system (5.6); and Barometer (5.7).

8.2 Standard Solutions. Add 0.0, 1.0, 5.0, 10.0, 15.0, 20.0, and 25.0 ml of the NH_4NO_3 standard solution (6.2.3) to a series of seven 100-ml volumetric flasks along with 2 ml of ISA and 2 ml of boric acid preservative. The concentrations of the calibration standards are 0, 10, 50, 100, 150, 200, and 250 μg NO_3^-/ml, respectively.

8.3 Calibration Curve. Zero and standarize the electrometer according to the manufacturer's instructions using the calibration standards in 8.2; treat as in 7.3.1. Begin with the most concentrated and proceed to the most dilute. Reverse the order and repeat the mv determination. Record the readings for each concentration. Prepare a calibration curve by plotting the mv reading on the linear scale of semi-logarithmic graph paper versus the concentration on the log scale. Calibrate the nitrate electrode daily and check hourly.

9. Calculations

9.1 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop, Dry Gas Volume, Volume of Water Vapor, Moisture Content, Isokinetic Variation, and Acceptable Results. Using data from this test, same as Method 5, Sections 6.2, 6.3, 6.4, 6.5, 6.11, and 6.12 respectively.

9.2 Mass of Ammonium Nitrate. Calculate the total weight of ammonium nitrate collected in the sample by Equation 18-1.

$$m_n = 1.29 \times 10^{-3} [V_t m_a - V_b m_b] \qquad \text{Eq. 18-1}$$

Where:

m_n = Weight of ammonium nitrate collected, g.

V_t = Total volume of mixed sample, ml.

m_a = Weight of nitrate in sample aliquot, mg.

V_b = Total volume of water initially placed in train plus all rinse volumes, ml.

m_b = Weight of nitrate in blank, mg.

1.29×10^{-3} = Conversion factor, (mg NH_4NO_3/mg NO_3^-) (g/mg)

9.3 Particulate Concentration. Calculate the particulate (ammonium nitrate) concentration as follows:

$$c_s = K \frac{m_n}{V_{m(std)}} \qquad \text{Eq. 18-2}$$

Where:

c_s = Particulate (ammonium nitrate) concentration at dry standard conditions, g/dscf (gr/dscf).

m_n = Weight of ammonium nitrate collected, g.

$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, correlated to standard condition, dscm (dscf).

K = 1.0 for metric units.

= 15.43 for English units.

10. Bibliography

10.1 Orion Research. Analytical Methods Guide. May 1975.

10.2 Same as Method 5, Citations 1 through 9 of Section 7.

N-2-2 AMMONIA

Gene Kelley

RECEIVED
JUN 19 1978

DETERMINATION OF AMMONIA

1. Principle and Applicability

1.1 Principle. A gas sample is extracted from the stack and the ammonia is collected in impingers containing sulfuric acid solution. The collected ammonia is reacted to form a colored complex whose intensity is measured by a spectrophotometer.

1.2 This method is applicable for the determination of ammonia emissions from nitrogen fertilizer plants. The minimum detectable ammonia concentration is 30 μg/l. The upper limit is 5000 μg/l, but this may be extended by diluting the sample.

Possible interferences are calcium, magnesium, iron and sulfide.

2. Apparatus

2.1 Sampling. The sampling train is shown in Figure 1 and component parts are discussed below.

DATA AVAILABLE TO SHOW EQUIVALENCY

The tester has the option of determining NH_3 simultaneously with particulate matter and moisture determination by replacing the water in a Method 5 impinger system with 1.0 N sulfuric acid.

2.1.1 Probe. Borosilicate glass, or stainless steel (other materials of construction may be used, subject to the approval of the Administrator), approximately 6-mm inside diameter, with a heating system to prevent water condensation and a filter (either in-stack or heated out-stack) to remove particulate matter, including sulfuric acid mist. A ½ inch plug of tightly packed glass wool is a satisfactory filter.

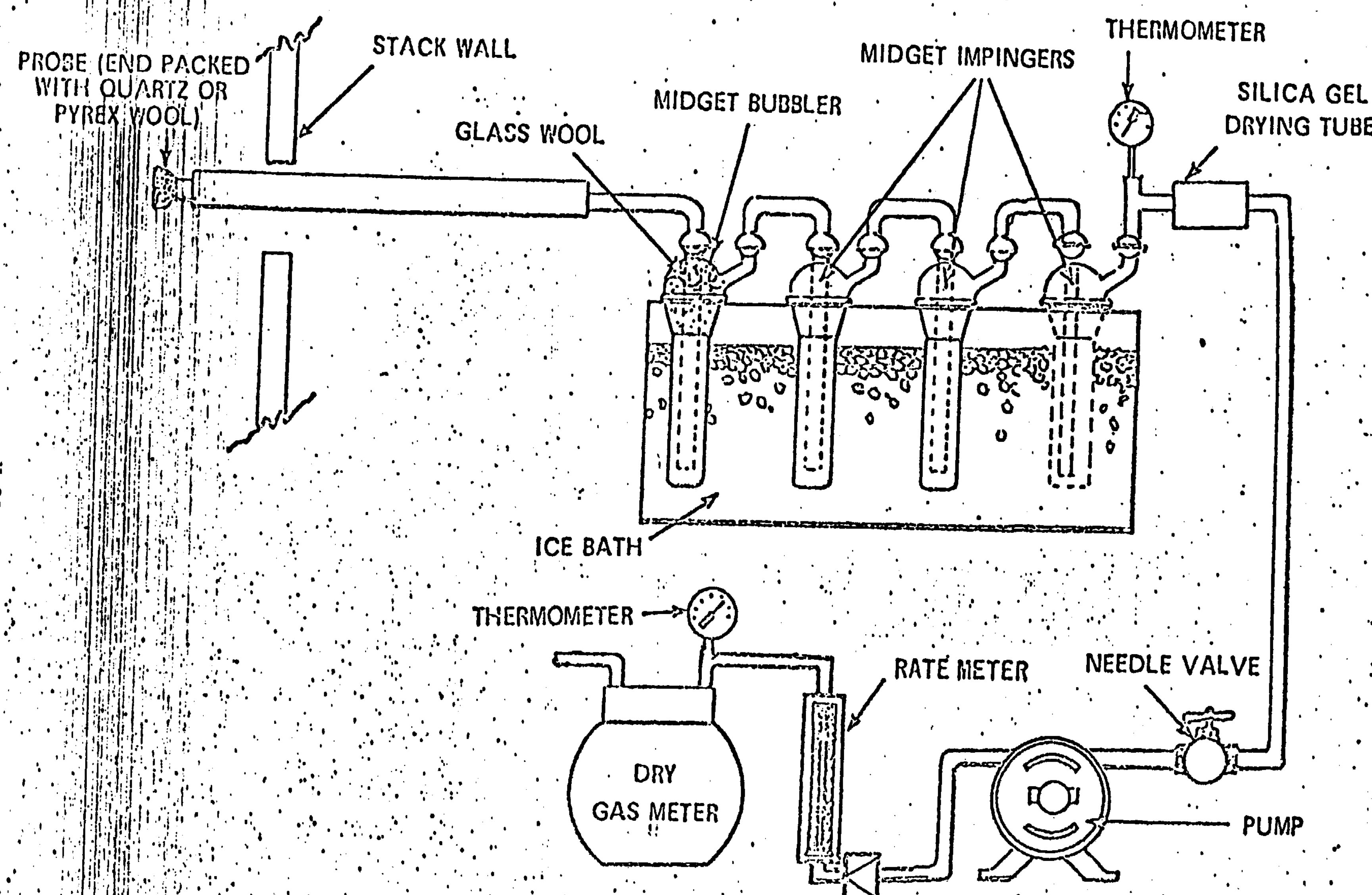

Figure 1, NH_3 sampling train.

2.1.2 Impingers. Four 30-ml midget impingers. The midget impingers must be connected in series with leak-free glass connectors. Silicone grease may be used, if necessary, to prevent leakage.

Other collection absorbers and flow rates may be used, but are subject to the approval of the Administrator. Also, collection efficency must be shown to be at least 99 percent for each test run and must be documented in the report. If the efficiency is found to be acceptable after a series of three tests, further documentation is not required. To conduct the efficiency test, an extra absorber must be added in series and analyzed separately. This extra absorber must not contain more than 1 percent of the total NH_3 mass.

2.1.3 Glass Wool. Borosilicate or quartz.

2.1.4 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease may be used, if necessary.

2.1.5 Temperature Gauge. Dial thermometer, or equivalent, to measure temperature of gas leaving impinger train to within 1°C (2°F).

2.1.6 Drying Tube. Tube packed with 6- to 16-mesh indicating-type silica gel, or equivalent, to dry the gas sample and to protect the meter and pump. If the silica gel has been used previously, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to approval of the Administrator.

2.1.7 Valve. Needle valve, to regulate sample gas flow rate.

2.1.8 Pump. Leak-free diaphragm pump, or equivalent, to pull gas through the train. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.1.9. Rate Meter. Rotameter, or equivalent, capable of measuring flow rate to within 2 percent of the selected flow rate of about 1000 cc/min.

2.1.10 Volume Meter. Dry gas meter, sufficiently accurate to measure the sample volume within 2 percent, calibrated at the selected flow rate and conditions actually encountered during sampling, and equipped with a temperature gauge (dial thermometer, or equivalent) capable of measuring temperature to within 3°C (5.4°F).

2.1.11 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.12 Vacuum Gauge and Votameter. At least 760 mm Hg (30 in. Hg) gauge and 0-40 cc/min rotameter to be used for leak check of the sampling train.

2.2 Sample Recovery.

2.2.1 Wash Bottles. Polyethylene or glass, 500 ml, two.

2.2.2 Storage Bottles. Polyethylene, 100 ml, to store impinger samples (one per sample).

2.3 Analysis.

2.3.1 Pipettes. Volumetric type 0.5-ml, 1-ml, 2-ml, 5-ml, 8.0-ml, 10.0-ml, 20-ml (one per sample), and 25-ml sizes.

2.3.2 Volumetric Flasks. 100-ml size (one per sample), 1000-ml size, and 25-ml size.

2.3.3 Graduated Cylinder. 100-ml size.

2.3.4 Spectrophotometer. To measure absorbance at 405 nanometers.

2.3.5 Sample Cells. Two matched absorbance cells to fit the spectrophotometer.

3. Reagents

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

3.1 Sampling.

3.1.1 Water. Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMNO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.1.2 Sulfuric Acid, 1.0 N. Dilute 28 ml of concentrated, ACS grade sulfuric acid to 1 liter with deionized, distilled water.

3.2 Sample Recovery.

3.2.1 Water. Deionized, distilled, as in 3.1.1.

3.2.2 Sulfuric Acid, 1.0 N. As in 3.1.2.

3.3 Analysis.

3.3.1 Water. Deionized, distilled, as in 3.1.1.

3.3.2 Annhydrous Mercuric Iodide (H_sI_2). ACS grade.

3.3.3 Potassium Iodide (KI). ACS grade.

3.3.4 Sodium Hydroxide (NaOH). ACS grade.

3.3.5 Stock Standard Ammonium Chloride Solution. Dissolve 3.141 g of ammonium chloride (NH_4Cl) in 1.0N H_2SO_4 in a 1-liter volumetric flask and dilute to exactly 1 liter with 1.0N H_2SO_4. One milliliter of this solution contains 1.0 mg of ammonia (NH_3).

3.3.6 Working Standard Ammonium Chloride Solution. Dilute 10 ml of the stock standard solution to 1 liter with 1.0 N H_2SO_4 in a 1-liter volumetric flask. One milliliter of this solution contains 10 μg of ammonia (NH_3).

3.3.7 Sodium Hydroxide, 10 N. Dissolve 40 grams of NaOH in a 100-ml volumetric flask and dilute exactly to 100-ml with deionized distilled water.

3.3.8 Nessler Reagent. Dissolve 160 g of NaOH in 500 ml of deionized distilled water in a 1-liter volumetric flask. Allow to cool. Dissolve 100 g of mercuric iodide and 70 g of potassium iodide in a small volume of deionized distilled water and while stirring add to the sodium hydroxide solution. Dilute to exactly 1 liter with deionized, distilled water. This reagent is stable up to 1 year.

4. Procedure

4.1 Sampling.

4.1.1 Preparation of Collection Train. Measure 15 ml of 1.0 N sulfuric acid into each of the first three midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 1. Adjust the probe heater to a temperature sufficient to prevent water condensation. Place crushed ice and water around the impingers.

4.1.2 Leak-check Procedure. A leak check prior to the sampling run is optional; however, a leak check after the sampling run is mandatory. The leak-check procedure is as follows:

Temporarily attach a suitable (e.g., 0-40 cc/min) rotameter to the outlet of the dry gas meter and place a vacuum gauge at or near the probe inlet. Plug the probe inlet, pull a vacuum of at least 250 mm Hg (10 in. Hg), and note the flow rate as indicated by the rotameter. A leakage rate not in excess of 2 percent of the average sampling rate is acceptable. Note: carefully release the probe inlet plug before turning off the pump.

It is suggested (not mandatory) that the pump be leak-checked separately, either prior to or after the sampling run. If done prior to the sampling run, the pump leak-check shall precede the leak check of the sampling train described immediately above; if done after the sampling run, the pump leak-check shall follow the train leak-check. To leak check the pump, proceed as follows: Disconnect the drying tube from the probe-impinger assembly. Place a vacuum gauge at the inlet to either the drying tube or the pump, pull a vacuum of 250 mm (10 in.) Hg, plug or pinch off the outlet of the flow meter and then turn off the pump. The vacuum should remain stable for at least 30 seconds.

4.1.3 Sample Collection. Record the initial dry gas meter reading and barometric pressure. To begin sampling, position the tip of the probe at the sampling point, connect the probe to the bubbler, and start the pump. Adjust the sample flow to a constant rate of approximately 1.0 liter/min as indicated by the rotameter. Maintain this constant rate (±10 percent) during the entire sampling run. Take readings (dry gas meter, temperatures at dry gas meter and at impinger outlet and rate meter) at least every 5 minutes. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 20°C (68°F) or less. At the conclusion of each run, turn off the pump, remove probe from the stack, and record the final readings. Conduct a leak check as in Section 4.1.2. (This leak check is mandatory.) If a leak is found, in excess of 2% of the avg sampling rate void the test run. Use procedures acceptable to the Administrator to adjust the sample volume for the leakage below 2% of the avg sample rate.

4.2 Sample Recovery. Disconnect the impingers after purging. Pour the contents of the midget impingers into a leak-free polyethylene bottle for shipment. Rinse the impingers and connecting glassware with deionized distilled water and add the washings to the same storage container. Mark the fluid level. Seal and identify the sample container.

4.3 Sample Analysis. Note the level of the liquid in the container and confirm whether or not any sample was lost during shipment; note this on the analytical data sheet. If a noticeable amount of leakage has occurred either void the sample or use methods, subject to the approval of the Administrator, to correct the final results.

Note level / not measure volume

Quantitatively transfer the contents of the shipping container to a 1-liter volumetric flask. Rinse the container and cap with several portions of 1.0N sulfuric acid and transfer to the flask. Dilute to exactly 1 liter with 1.0N sulfuric acid. Pipet 10 ml of the sample from the 1-liter flask into a 500 ml-volumetric flask and dilute to exactly 500 ml with 1.0 N H_2SO_4. Pipet 20 ml of this solution into a 25-ml volumetric flask. Add 10 N sodium hydroxide dropwise to the flask until the pH is between eight and ten. Then add 0.5 ml of Nessler reagent and dilute to exactly 25 ml with deionized distilled water. Mix well and allow to stand for the same amount of time as the standards used for calibration. Measure the absorbance at 405 nm using the blank solution as a zero reference. Dilute the sample and the blank with equal amounts of deionized distilled water if the absorbance exceeds that of the 100 µg NH_3 solution.

5. Calibration

5.1 Metering System.

5.1.1 Initial Calibration. Before its initial use in the field, first leak check the metering system (drying tube, needle valve, pump, rotameter, and dry gas meter) as follows: place a vacuum gauge at the inlet to the drying tube and pull a vacuum of 250 mm (10 in.) Hg; plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum shall remain stable for at least 30 seconds. CArefully release the vacuum gauge before releasing the flow meter end.

Next, calibrate the metering system (at the sampling flow rate specified by the method) as follows: connect an appropriately sized wet test meter (e.g., 1 liter per revolution) to the inlet of the drying tube. Make three independent calibration runs, using at least five revolutions of the dry gas meter per run. Calculate the calibration factor, Y (wet test meter calibration volume divided by the dry gas meter volume, both volumes adjusted to the same reference temperature and pressure), for each run, and average the results. If any Y value deviates by more than 2 percent from the average, the metering system is unacceptable for use. Otherwise, use the average as the calibration factor for subsequent test runs.

5.1.2 Post-Test Calibration Check. After each field test series, conduct a calibration check as in Section 5.1.1 above, except for the following variations: (a) the leak check is not to be conducted, (b) three, or more revolutions of the dry gas meter may be used, and (c) only two independent runs need be made. If the calibration factor does not deviate by more than 5 percent from the initial calibration factor (determined in Section 5.1.1), then the dry gas meter volumes obtained during the test series are acceptable. If the calibration factor deviates by more than 5 percent, recalibrate the metering system as in Section 5.1.1, and for the calculations, use the calibration factor (initial or recalibration) that yields the lower gas volume for each test run.

5.2 Thermometers. Calibrate against mercury-in-glass thermometers.

5.3 Rotameter. The rotameter need not be calibrated, but should be cleaned and maintained according to the manufacturer's instruction.

5.4 Barometer. Calibrate against a mercury barometer.

5.5 Determination of Spectrophotometer Calibration Factor K. Add 0.0, 1.0, 2.0, 5.0, 8.0, and 10.0 ml of working standard ammonium chloride solution to a series of six 25-ml volumetric flasks. Adjust the total volume of solution in each to 20 ml using 1.0 N H_2SO_4. Adding 10 N NaOH dropwise, adjust the pH to between 8 and 10. Pipette exactly 0.5 ml of Nersler reagent into each flask and filute to exactly 25 ml with deionized distilled water. Mix well and allow each to stand for 10 to 30 minutes for color development. Note the time allowed for color development of the standards and use the same time for the samples. Measure the absorbance of each standard at 405 nm. The calibration procedure must be repeated each day that samples are analyzed. Calculate the spectrophotometer calibration factor as follows:

$$K_c = 100 \frac{A_1 + 2A_2 + 5A_3 + 8A_4 + 10A_5}{A_1^2 + A_2^2 + A_3^2 + A_4^2 + A_5^2}$$

Where:

K_c = Calbiration factor.

A_1 = Absorbance of the 10 μg standard.

A_2 = Absorbance of the 20 μg standard.

A_3 = Absorbance of the 50 μg standard.

A_4 = Absorbance of the 80 μg standard.

A_5 = Absorbance of the 100 μg standard.

6. Calculation

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomenclature.

A = Absorbance of sample.

C_{NH_3} = Concentration of ammonia dry basis corrected to standard condition, mg/dscm (lb/dscf).

F = Dilution factor (i.é., 25/5, 25/10, etc. required only if sample dilution was needed to reduce the absorbance into the range of calibration).

K_c = Spectrophotometer calibration factor.

m = Mass of ammonia in gas sample, µg.

P_{bar} = Barometric pressure at the exit orifice of the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

T_m = Average dry gas meter absolute temperature, °K (°R).

T_{std} = Standard absolute temperature, 293°K (528°R).

V_a = Volume of sample aliquot analyzed, ml.

V_m = Dry gas volume as measured by the dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

V_{soln} = Total volume of solution in which the ammonia sample is contained, 1000 ml.

Y = Dry gas meter calibration factor.

6.2 Dry sample gas volume, corrected to standard conditions:

$$V_{m(std)} = V_m Y \frac{T_{std}}{T_m} \frac{P_{bar}}{P_{std}} = K_1 Y \frac{V_m P_{bar}}{T_m}$$

Equation 2

Where:

K_1 = 0.3858 °K/mm Hg for metric units.

= 17.64 °R/in. Hg for English units.

6.3 Total μg NH_3 per sample.

$$m = 2\ K_c\ AF\ \frac{V_a}{V_{soln}} \qquad \text{Equation 3}$$

6.4 Sample concentration, dry basis, corrected to standard condition:

$$C = K_2 \frac{m}{V_{sc}}$$

Where:

$K_2 = 10^3\ \frac{mg/m^3}{\mu g/ml}$ for metric units.

$= 6.243 \times 10^{-5}\ \frac{lb/scf}{\mu g/ml}$ for English units.

7. Bibliography

1. Patton, W. F. and J. A. Brink, Jr. New equipment and Techniques for Sampling Chemical Process Gases. Air Pollution Control Association. 13:162, 1963.

2. Rom, J. J. Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment. Office of Air Programs, Environmental Protection Agency. Research Triangle Park, N. C. APTD-0576, March, 1972.

3. Standard Methods for the Examination of Water and Wastewater, 13th Edition. American Public Health Association. Washington, D.C., 1974. pp. 226-232.

APPENDIX O   CLEANUP EVALUATION DATA

O-1   DISCUSSION AND SUMMARY OF RESULTS - CLEAN IMPINGER WASHES
TABLE 1-O-1

O-2   SUMMARY OF LABORATORY DATA - SAMPLE BLANKS
TABLE 1-O-2

O-3   COPY OF LABORATORY NOTEBOOK

O-1 DISCUSSION AND SUMMARY OF RESULTS - CLEAN IMPINGER WASHES

TABLE 1-O-1

DISCUSSION AND SUMMARY OF RESULTS

Prior to sampling, the impingers used for the scrubber inlet and scrubber outlet at Swift Chemical Company, Beaumont, Texas, were rinsed with deionized distilled water and then charged with water or acid solution as called for in the test procedures. The impinger contents were then treated in the same fashion as the test samples except that no samples were drawn through the impingers. The analysis was performed on these blanks at the same time the samples were analyzed. A blank of the distilled water obtained from the plant was also analyzed.

The results of the analysis are presented in Table 1-0-1. Analysis data for one inlet and one outlet run have also been provided and the relative percent level of the blank compared to the test sample.

TABLE 1-0-1. RESULTS OF ANALYSIS ON CLEAN IMPINGER WASHES WITH RELATIVE PERCENT VALUES FROM TEST DATA

	Cleanup blank (mg)	Corrected conc. - total mg NH_4NO_3 Run 3 (mg)	Run 4 (mg)	Run 5 (mg)	Relative %
Inlet					
SIE (water)	1.45	50,555	55,529	56,772	<0.003
SIE (acid)	30.0	179.3	36.2	59.1	<83
DN (water)	0	128,941	57,882	67,768	0
DN (acid)	0	42,353[b]	0	4.7	0
Outlet					
SIE (water)	1.45[a]	139.3	98.2	129.1	<1.5
SIE (acid)	28.0	0[c]	25.8	45.7	<109
DN (water)	0	164.5	105.3	341.5	0
DN (acid)	0	163.3	31.3	407.0	0
Plant water					
SIE	0.829	-	-	-	-
DN	0	-	-	-	-

[a] Corrected to 1,000 mℓ sample volume.

[b] May have been sample carryover in impinger.

[c] This concentration was not used in determining relative percent.

O-2 SUMMARY OF LABORATORY DATA - SAMPLE BLANKS
TABLE 1-O-2

TABLE 1-O-2. SUMMARY OF LAB ANALYSIS OF BLANKS FOR AMMONIUM NITRATE AND AMMONIA

					Specific ion electrode (NH_4NO_3)				
Location	Test No.	Sample No.	Fraction	Sample volume (mℓ)	Dilution factor	Potential (mv)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Scrubber inlet	Blank	189	water	1,000	1	242 242 238	0.00145	0.00145	1.45
Scrubber outlet	Blank	192	water	500	1	245 244 243	0.00145	0.00145	0.725
Plant distilled water	Blank	151	water	1,000	1	247 261 253	0.00166	0.00166	0.829
Scrubber inlet	Blank	188	acid	500	1	151 149 149	0.060	0.060	30.0
Scrubber outlet	Blank	190	acid	500	1	149 149 149	0.056	0.056	28.0

(continued)

TABLE 1-0-2 (concluded)

Location	Test No.	Sample No.	Fraction	Sample volume (mℓ)	Direct Nesslerization (NH_3) Dilution factor	Absorbance (A.U.)	Aliquot conc. (μg/mℓ)	Sample conc. (μg/mℓ)	Mass (mg)
Scrubber inlet	Blank	187	water	1,000	1	0.014[b] 0.017 0.007	0	0	0
Scrubber outlet	Blank	191	water	500	1	1.92[c] 3.09 3.09	a	-	-
Plant distilled water	Blank	151	water	1,000	1	0 0 0	0	0	0
Scrubber inlet	Blank	188	acid	500	1	0 0 0	0	0	0
Scrubber outlet	Blank	190	acid	500	1	0.004[b] 0 0.009	0	0	0

a Solution turned cloudy green when Nessler reagent was added.
b Calibration curve gave negative intercept greater than the observed absorbance.
c Disregarded.

O-3 COPY OF LABORATORY NOTEBOOK

Project No. 4468-L(18) Date of Work: 3/14/79 Work Performed by: R.J.

Title or Purpose: NO_3^- Analysis Continued From:

Container # 154, Run 1, Outlet
3. 122 mv

Container # 175, Run 4, Outlet
3. 138 mv

Container # 189, Blank #3, NO_3^- from #103
1.) 242 mv

Container # 192, Blank #1, NO_3^- from #101
1.) 245 mv

Container # 166, Run 3, Inlet, Acid fraction
1.) 103 mv

Container # 174, Run 4, Inlet, Acid fraction
1.) 130 mv

Stand. 10 ml = 117 mv

Container # 165, Run 2, Inlet, Acid fract
1.) 131 mv

Container # 128, Run 5, Inlet, Acid fract.
1.) 124 mv

Container # 157, Run 1, Inlet, Acid fract.
1.) 138 mv

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. 4468-L18 **Date of Work:** 3/14/79 **Work Performed by:** R.J.

Title or Purpose: NO_3^- Analysis **Continued From:**

Container # 189, Blank #3, NO_3^- from # 103
2) 242 mv

Container # 192, Blank # 1, NO_3^- from # 101
2). 244 mv

Container # 166, Run 3, Inlet, acid fraction
2) 103 mv

Container # 174, Run 4, Inlet, acid fraction
2). 132 mv

Container # 165, Run 2, Inlet acid fract.
2) 131 mv

Container # 178, Run 5, Inlet acid fract.
2) 123 mv

Container # 157, Run 1, Inlet acid fract
2). 138 mv

Stand. 10ml = 119 mv

Container # 189, Blank # 3, NO_3^- from # 103
3). ~~248~~ 238 mv.

Container # 192, Blank # 1, NO_3^- from # 101
3). 243

Continued To: **Disclosed To And Understood By Me:**

Entered By: **Date:**

Date: **Date:**

Project No. 4468-C(8) Date of Work: 3/16/79 Work Performed by: JONES

Title or Purpose: NO_3^- analysis Continued From:

Stand 10ml = 118 mv no d.i.

Container # 188, Blank #3, acid fract, from # 104.
1). 149 mv

Container # 151, Plant H_2O-distilled Blank, run 1→n.
1). 247 mv

Container # 196, run 8-C, acid fract.
1). 147 mv

Container #162, run 2-3-0, acid fract.
1) 128 mv

Container # 156, run 1-0, acid fract.
1) 139 mv

Container # 177, run 4-0, acid fract.
1) 135 mv

Stand 10ml = 118 mv

Container # 188, Blank #3, acid fract., from # 104.
2). 151 mv

Container #. 151, Plant H_2O-distilled Blank, run 1→n.
2) 261 mv

Container # 196, run 8-C, acid fract.
2). 136

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. 4468-1(15) Date of Work: 3-16-79 Work Performed by: RJ

Title or Purpose: NO_3^- analysis Continued From:

Contain. #162, run 2-3-0, acid fract.
2) 127 mv

Contain #156, run 1-0, acid fract.
2) 138 mv

Contain. # 177, run 4-0, acid fract.
2) 133 mv

Stand 10 ml = 117 mv

Contain # 188, Blank # 3, acid fract, from #104

3) 149 mv

Contain #151, Plant H_2O, distilled Blank, run 1-p.
3) 253 mv

Contain # 196, run 8-c, acid fract.
3) 134 mv

Contain. # 162, run 2-3-0, acid fract.
3) 127 mv

Contain. # 156, run 1-0, acid fract.
3) 138 mv

Contain. # 177, run 4-0, acid fract.
3) 133 mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-L18 Date of Work: 3/16/79 Work Performed by: RJ

Title or Purpose: NO_3^- Analysis Continued From:

Stand. 10 ml = 116 mv

Contain # 190, Blank #1, acid fract.
1) 149 mv

Contain. # 185, run 6-C, acid fract.
1) 131 mv

Contain # 194, run 7-C, acid fract.
1) 140 mv

Contain # 183, run 5-0, acid fract.
1) 125 mv

Contain # 170, run 3-0, acid fract.
1) 147 mv

Contain # 153, ~~run~~ audit AN3 → diluted 1:20
1) 164 mv

Contain # 152, audit AN1
1) 128 mv

Stand 10 ml = 116 mv

Contain. # 190, Blank #1, acid fract.
2) 149 mv

Contain # 185, run 6-C, acid fract.
2) 130 mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 4468-L18 Date of Work: 3/16/79 Work Performed by: JONES

Title or Purpose: NO_3^- Analysis Continued From:

Contain #194, 7-C, acid fract.
2) 139mv

Contain #183, 5-O, acid fract.
2) 124mv

Contain #170, 3-O, acid fract.
2) 147mv

Contain #153, audit AN3 → diluted 1:20
2) 164 mv

Contain #152, audit AN1
~~130mv~~ 129mv

Contain #190, Blank #1, acid fract.
3) 149mv

Contain #185, 6-C, acid fract.
3) 131mv

Contain #194, 7-C, acid fract.
3) 140mv

Contain #183, 5-O, acid fract.
3) 124mv

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

Project No. 44686-18 Date of Work: 3-15-79 Work Performed by: DW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p48

#195 (7-C) ✓

	%T	A
195-1	90.7	.042
195-2	90.1	.045
195-3	92.5	.034

H_2O NESSLER TO 1.0 l AND SPLIT

10 ml - 1000 AFTER NORMAL PROCEDURE

#198 (8C) ✓ H_2O NESSLER TO 1.0 l AND SPLIT

	%T	A
198-1	91.5	.038
198-2	91.7	.037
198-3	89.3	.049

10 ml - 1000 AFTER NORM. PROCEDURE

#191 (BLANK #1) ✓ NESSLER FRACTION TO VOLUME

	%T	A
191-1	1.2	1.92
191-2	.08	3.09
191-3	.08	3.09

SAME AS PROCEDURE ~~of~~ ON p.44

NOTE: UPON ADDITION of THE NESSLER REAGENT THE SOLN. TURNED A CLOUDY GREEN

Continued To:

Entered By:

Date:

Disclosed To And Understood By Me:

Date:

Date:

Project No. 4468L-18 Date of Work: 3/15/79 Work Performed by: [signature]

Title or Purpose: Determination of Ammonia Continued From: p 49

#187 (BLANK #3) NESSLER FRACTION TO VOLUME

	%T	A
187-1	96.8	.014
187-2	96.1	.017
187-3	98.3	.007

SAME AS PROCEDURE on page 44.

#177 (ACID) (4-0)✓ TO 500 ml

	%T	A
177-1	87.8	.056
177-2	87.7	.057
177-3	86.7	.062

SAME AS PROCEDURE on p 44

#156 (ACID) (1-0)✓ TO VOLUME

	%T	A
156-1	84.1	.075
156-2	89.2	.049
156-3	89.2	.049

SAME AS PROCEDURE on (P 44)

#170 (ACID) (3-0)✓ TO 500 ml

	%T	A
170-1	59.2	.227
170-2	58.2	.235
170-3	57.5	.240

SAME AS PROCEDURE on (P 44)

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. 4468L-18 Date of Work: 3/15/79 Work Performed by: DW

Title or Purpose: DETERMINATION of AMMONIA Continued From: p52

#185 (6-C) (ACID) TO 500ml

	%T	A
185-1	96.2	.016
185-2	93.2	.030
185-3	94.0	.026

SAME PROCEDURE AS p.44

#188 (ACID, (BLANK) #3) TO 500ml

	%T	A
188-1	100+	
188-2	100+	
188-3	100+	

SAME PROCEDURE AS p44

#190 (BLANK #1) (ACID) TO VOLUME

	%T	A
190-1	99.1	.004
190-2	100+	
190-3	98.0	.009

#151 (PLANT DIST. H_2O BLANK)

	%T	A
151-1	100+	
151-2	100+	
151-3	100+	

Continued To:

Disclosed To And Understood By Me:

Entered By:

Date:

Date:

Date:

Project No. Date of Work: Work Performed by:

Title or Purpose: Calibration Curve Summary Continued From:

Reference Series	E	F	G	H	I	J
P. #	43	45	48	52	54	72
slope	0.190	0.188	0.197	0.191	0.188	0.189
intercept	-0.003	-0.008	0.016	-0.002	0.008	0.001
corr coeff	0.9997	0.9996	0.9996	0.9999		0.9998

Continued To: Disclosed To And Understood By Me:

Entered By: Date:

Date: Date:

APPENDIX P   SCOPE OF WORK

P-1   COPY OF U.S. EPA WORK ASSIGNMENT

P-2   COPY OF TECHNICAL DIRECTIVES AND ASSOCIATED CORRESPONDENCE

P-1 COPY OF U.S. EPA WORK ASSIGNMENT

WORK ASSIGNMENT ENVIRONMENTAL PROTECTION AGENCY Research Triangle Park, N.C. 27711	EPA CONTRACT NO.: 68-02-2814 CONTRACTOR: Midwest Research Institute ASSIGNMENT NO: 18 ASSIGNMENT CHANGE NO.:
TITLE: Conduct Emission Test Program at an Ammonium Nitrate Manufacturing Facility	DATE: JAN 8 1979

DESCRIPTION

The Contractor shall perform an emission test program in accordance with the basic contract scope of work for the Emission Measurement Branch, and as set forth in the attached "Source Sampling and Analysis Schedule" at the following site:

Company: Swift Chemical Company
Location: Beaumont, Texas
Industry: Ammonium Fertilizer
Project No.: 79-NHF-11

The Emission Measurement Branch's Technical Manager is Clyde E. Riley, Mail Drop 13, EMB, ESED, OAQPS, Research Triangle Park, North Carolina 27711.

Upon notification of approval of the proposed source test report, the Contractor shall provide 15 copies of the final report with appendices and 15 copies as a summary without appendices.

All pretest survey, proposed final, and final source test reports and SOTDAT Data Forms shall be submitted directly to J. E. McCARLEY, Emission Measurement Branch, ESED, Mail Drop 13, Research Triangle Park, North Carolina 27711.

All samples shall be shipped to: Clyde E. Riley, EPA, MD-13, Research Triangle Park, North Carolina 27711

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	300	
DURATION OF WORK	4 months	
COMPLETION DATE	August 31, 1979	

REQUESTER'S SIGNATURE	ORG. CODE	TELEPHONE	DATE
Clyde E. Riley C. E. Riley 12/28/78	ESED/EMB	(919) 541-5243	12/28/78

APPROVALS (as applicable)	SIGNATURE	DATE
[illegible]	[signature]	1/2/79
[illegible]	[signature]	1-3-79
[illegible] MANAGER	[signature]	1/3/79
CONTRACTING OFFICER	[signature]	1-8-79

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGEMENT

SIGNATURE	TITLE	DATE

Industry: Ammonium Nitrate Manufacturing

Plant: Swift Chemical Company, Beaumont, Texas

Process Step: Drum Granulator

Control Device: Joy "Type D" Turbulaire Scrubber

Rationale for Selection:

1. This is the newest (1977) installation of a drum granulator by C&I/Girdler and incorporates all the latest design improvements, it is thus representative of state-of-the-art ammonium nitrate drum granulation.

2. Scrubber inlet and outlet are amenable to testing.

Comments:

1. Test at maximum production rate, considering ambient conditions.

2. All composite samples should be a series of equal size grab samples.

3. Liquid grab samples should each be tested for temperature and pH immediately after collection.

4. Ammonium Nitrate particulate may be in a semi-molten state at TP-1.

5. All solid samples will be highly hygroscopic.

6. Plant will provide information on cut sizes of product being produced (size range of product passed by the screen). Alternatively, information will be provided on product specifications and on results of particle size tests.

7. Stack (AN) and scrubber water samples shall be analyzed within 24 hours after collection.

8. AN and ammonia analysis shall be performed at the plant site.

SOURCE SAMPLING AND ANALYSIS SCHEDULE

See Figure 1

Company Name: Swift Chemical Company

Company Location: Beaumont, Texas

Industry: Ammonium Fertilizer

Process: Ammonium Nitrate Drum Granulator

Control Equipment: Scrubber

Sampling Point Figure	Total No. of Samples	Sample Type	Sampling Method	Sample Collected By	Minimum Sampling Time	Minimum Gas Volume Sampled ft^3	Initial Analysis Type	Initial Analysis Method	Initial Analysis By**	Final Analysis Type	Final Analysis Method	
TP1*	1	Velocity Profile	EPA-2	CTR	N.A.	N.A.	Flow Profile	EPA-2	CTR			
TP2*	1	"	"	"	"	"	"	"	"			
TP1	1	Moisture Content	EPA-4	CTR	15 min	10	Percent Moisture	EPA-4	CTR			
TP2	1	"	"	"	"	"	"	"	"			
TP1	1	Cleanup Evaluation	Modified EPA-5	CTR	N.A.	N.A.	AN Mass	TBD	CTR	Ammonia	TBD	CTR
P2	1	"	"	"	"	"	"	"	"	"	"	"
P1*	3	Ammonium Nitrate Particulate	Modified EPA-5	CTR	2 hr	60	AN Mass	TBD	CTR	Ammonia	TBD	CTR
P2*	3	"	"	"	2 hr	60	"	"	"	"	"	"
P1	3	Particle Sizing	Brinks w/cyclone	CTR	10 min	N.A.	Particle Distribution	Gravimetric Weighing	CTR			
P2*	3	Visible Emissions	EPA-9	CTR	2 hr	N.A.	Summary of 6-min intervals	EPA-9	CTR			
W1	3	Scrubber Solution IN	Composite	CTR	2 hr	N.A.	Tempt pH % solids	pH meter Filtration	CTR CTR	AN Ammonia	TBD	CTR
W2	3	Scrubber Solution OUT	"	"	"	"	"	"	"	AN Ammonia	TBD	CTR
P5	1*	Melt to Granulator	Grab	CTR	N.A.	N.A.	pH	pH meter	CTR	% AN % NH_3	TBD	CTR
P6	1*	Unscreened Granulator Product	"	"	N.A.	N.A.	Moisture	TBD	CTR	% AN % NH_3	TBD	CTR
P6	3	"	Composite	CTR	N.A.	N.A.	Sieve Analysis	TBD	CTR	Bulk Density	TBD	CTR

N.A. - Not applicable
TBD - To be determined

*Simultaneous Sampling Required

REMARKS:

1. Sampling shall be performed with ± 10% isokinetic conditions.
2. Methods are EPA unless indicated otherwise.
3. Impingers and analysis of impinger ...

SOURCE SAMP[illegible] AND ANALYSIS SCHEDULE

Con't - See Figure 1

Company Name: Swift Chemical Compan[illegible]

Company Location: Beaumont, Texas

Industry: Ammonium Fertilizer

Process: Drum Granulator

Control Equipment: Scrubber

Sampling Point Figure	Total No. of Samples	Sample Type	Sampling Method	Sample Collected By	Minimum Sampling Time	Minimum Gas Volume Sampled ft^3	Initial Analysis Type	Initial Analysis Method	Initial Analysis By**	Final Analysis Type	Final Analysis Method
TP-1 / TP-2	3	Pressure Drop	U-Tube Manometer	CTR	Data shall be measured and recorded every 15 minutes during test periods						
TP7	3	Ambient air Tempt.	Thermometer	CTR	" "	" "	"	" "	" "	"	" "
TP7	3	Relative Humidity	Wet, Dry Bulb	CTR	" "	" "	"	" "	" "	"	" "

REMARKS:

1. Sampling shall be performed with ± 10% isokinetic conditions.
2. Methods are EPA unless indicated otherwise.
3. [illegible]

*Simultaneous Sampling Required

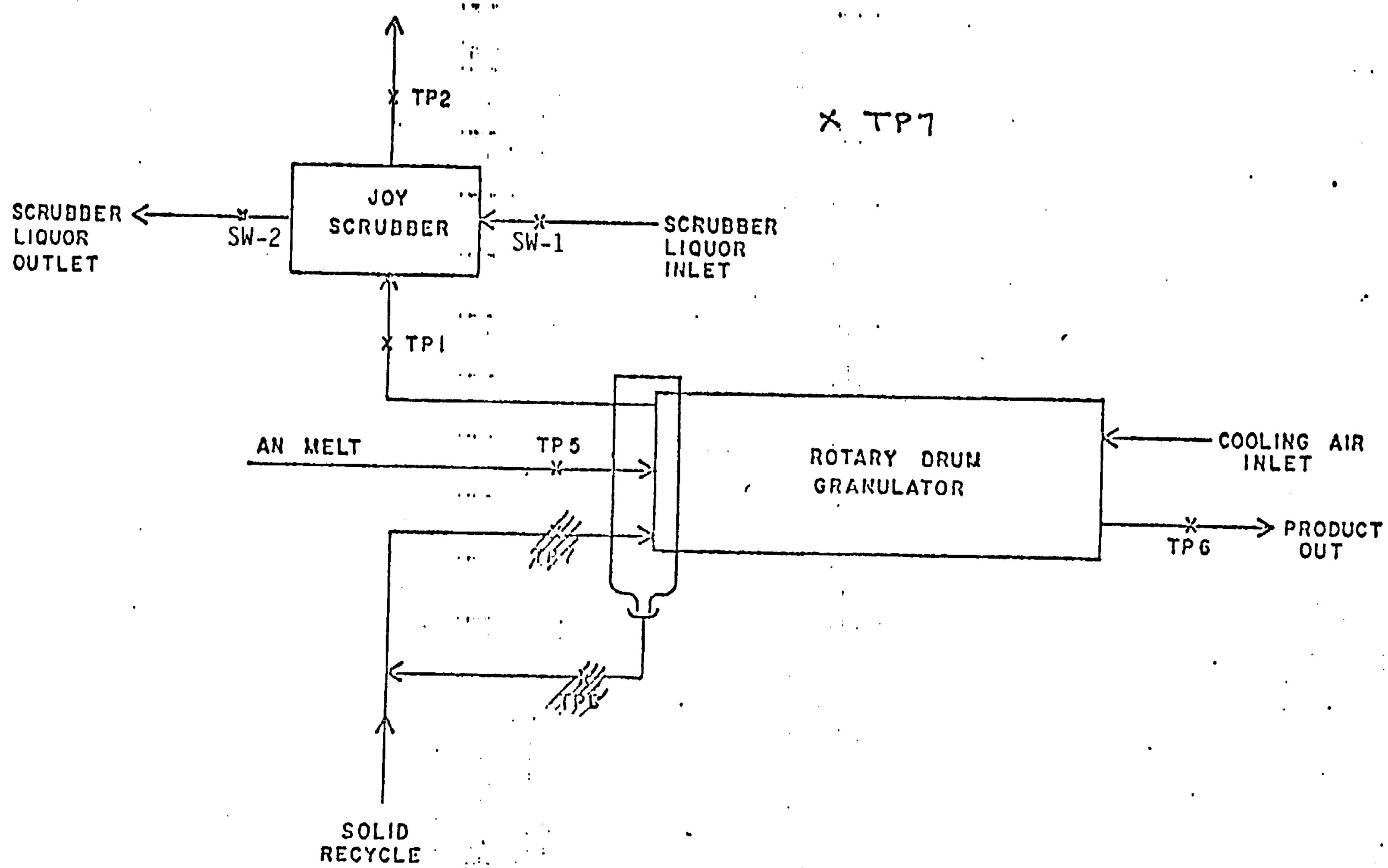

Figure 1. Rotary Drum Granulator, Swift Agricultural Chemicals, Beaumont, Texas.

Industry: Ammonium Nitrate Manufacturing

Plant: Swift Chemical Company, Beaumont, Texas

Process Step: Rotary Drum Cooler

Control Device: Dry Cyclone (not to be tested)

Rationale for Selection:

1. The exhaust before control equipment is recommended for testing for the characterization of emissions from a drum cooler used in conjunction with a drum granulator.

Comments:

1. Test at maximum production rate, considering ambient temperature.

2. All composite samples should be a series of equal size grab samples taken throughout particulate mass testing.

3. All solid samples will be highly hygroscopic.

4. Stack (AN) samples shall be analyzed within 24 hours after collection.

5. AN and ammonia analysis shall be performed at the plant site.

SOURCE SAMPLING AND ANALYSIS SCHEDULE

See Figure 2

Swift Chemical Company

Industry: Ammonia Fertilizer

Company Location: Beaumont, Texas

Process: Ammonium Nitrate Cooler

Control Equipment: None

Sampling Point Figure	Total No. of Samples	Sample Type	Sampling Method	Sample Collected By	Minimum Sampling Time	Minimum Gas Volume Sampled ft^3	Initial Analysis Type	Initial Analysis Method	Initial Analysis By **	Final Analysis Type	Final Analysis Method	
TP1	1	Velocity Profile	EPA-2	CTR	N.A.	N.A.	Flow Profile	EPA-2	CTR			
TP1	1	Moisture	EPA-4	"	15 min	10	Percent Moisture	EPA-4	"			
TP1	3	Ammonium Nitrate Particulate	Modified EPA-5	CTR	1 hr	30	AN Mass	TBD	CTR	Ammonia	TBD	CTR
TP1	3	Particle Size	Brinks w/cyclone	CTR	10 min	N.A.	Particle Size Distribution	Gravimetric Weighing	CTR			
TP2	3	Cooler Product IN	Composite	CTR	N.A.	N.A.	Sieve Analysis	TBD	CTR	Bulk Density	TBD	CTR
TP3	3	Cooler Product OUT	Composite	CTR	N.A.	N.A.	"	"	"	"	"	"
TP2	1	Cooler Product IN	Grab	CTR	N.A.	N.A.	Tempt, pH Moisture	TBD	CTR	% AN % NH_3	TBD	CTR
TP3	1	Cooler Product OUT	Grab	CTR	N.A.	N.A.	"	TBD	CTR	"	"	"
TP4	3	Ambient air tempt.	Thermometer	CTR	Data shall be measured and recorded every 15 minutes during test period.							
TP4	3	Relative Humidity	Wet, Dry Bulb	CTR	" "	" "	"	" "	" "	"	"	

REMARKS:

1. Sampling shall be performed with ± 10% isokinetic conditions.
2. Methods are EPA unless indicated otherwise.
3. Impingers and analysis of impinger catch will be per the Federal Register, Volume 36, No. 159, Part II, Tuesday, Aug. 17, 1971, unless ...

* Simultaneous Sampling Required
**CTR-Contractor, EPA-Environmental Protection Agency.

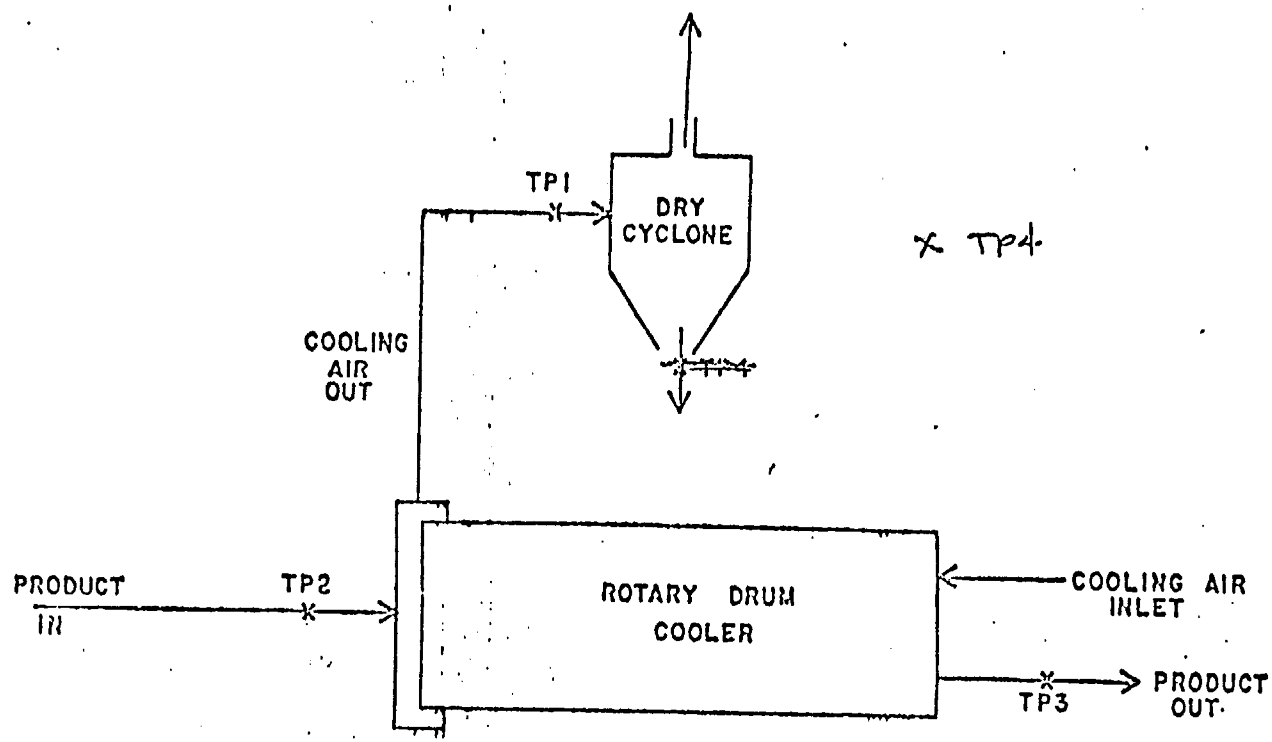

Figure 2. Rotary Drum Cooler, Swift Agricultural Chemicals, Beaumont, Texas.

WORK ASSIGNMENT

ENVIRONMENTAL PROTECTION AGENCY

Research Triangle Park, N.C. 27711

EPA CONTRACT NO.	68-02-2814
CONTRACTOR	Midwest Research Institute
ASSIGNMENT NO	18
ASSIGNMENT CHANGE NO.	1
DATE	12 JAN 1979

TITLE: Conduct an emission test program at an ammonium nitrate manufacturing facility

DESCRIPTION

Increase level of effort by 700 hours from 300 hours to 1000 hours

Company Name: Swift Chemical
Location: Beaumont, Texas
Industry: Ammonium Fertilizer
Project No.: 79-NHF-11

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	700 increase (300+700=1000)	
DURATION OF WORK	No change	
COMPLETION DATE	No change	

REQUESTER'S SIGNATURE	ORG CODE	TELEPHONE	DATE
Clyde E. Riley *C.E. Riley 1-3-79*	ESED/EMB	(919) 541-5243	1/3/79

APPROVALS (as applicable)	SIGNATURE	DATE
BRANCH CHIEF	[signature]	1/5/79
DIVISION CHIEF	[signature]	1-5-79
PROJECT MANAGER	*T.M. Bibb*	1/5/79
CONTRACTING OFFICER	[signature]	1-12-79

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGEMENT

SIGNATURE	TITLE	DATE

bcc: D. Fiscus (W/A)
~~K. Wilcox (W/A)~~
S. Lukon (W/O)
4468-L (W/A)

May 8, 1979

Environmental Protection Agency
Contracts Management Division (MD-33)
Research Triangle Park
North Carolina 27711

Attn: Ms. Kathy Aiken
NCCM-7

Subject: Contract No. 68-02-2814
Work Assignment No. 18, Change No. 2

Dear Ms. Aiken:

Enclosed please find one (1) copy of the subject task order executed on behalf of Midwest Research Institute. We have retained one copy for our file.

Very truly yours,

MIDWEST RESEARCH INSTITUTE

Sequin Lukon
Contract Administrator

SL:bm

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Research Triangle Park, North Carolina 27711

1 MAY 1979

Reply to: Mail Stop NCCM-7

Midwest Research Institute
Attention: Sequin Lukon
425 Volker Boulevard
Kansas City, Missouri 64110

Subject: Contract No. 68-02-2814, Work Assignment No. 18, Change No. 2

Gentlemen:

Transmitted herewith is the subject document for your acknowledgment. Please sign and date in the appropriate places.

You are requested to return one copy of the document to this office.

Sincerely yours,

C. J. FOSTER
Contracting Officer
Contracts Management Division (MD-33)

Enclosures

ESED # 78/13

WORK ASSIGNMENT ENVIRONMENTAL PROTECTION AGENCY Research Triangle Park, N.C. 27711	EPA CONTRACT NO: 68-02-2814 CONTRACTOR: Midwest Research Institute ASSIGNMENT NO.: 18 ASSIGNMENT CHANGE NO: 2
TITLE: Conduct an Emission Test Program at an Ammonium Nitrate Manufacturing Facility	DATE: 1 MAY 1979

DESCRIPTION

Increase level of effort by 250 hours from 1000 hours to 1250 hours.

Company Name: Swift Chemical
Location: Beaumont, Texas
Industry: Ammonium Fertilizer
Project No.: 79-NHF-11

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	250 increase (1000+250=1250)	250 increase (1000+250=1250)
DURATION OF WORK	No change	No change
COMPLETION DATE	No change	No change

REQUESTER'S SIGNATURE	ORG CODE	TELEPHONE	DATE
Clyde E. Riley C. E. Riley 4-25-79	ESED/EMB	(919) 541-5243	4/25/79

APPROVALS (as applicable)	SIGNATURE	DATE
BRANCH CHIEF	[signature]	4/26/79
DIVISION CHIEF	[signature]	4/27/79
PROJECT MANAGER	[signature]	[illegible]
CONTRACTING OFFICER	[signature]	5-1-79

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGMENT

SIGNATURE	TITLE	DATE
Robert Donaldson	Robert Donaldson Manager, Contract Department	5-7-79

EPA(RTP)395

WORK ASSIGNMENT ENVIRONMENTAL PROTECTION AGENCY Research Triangle Park, N.C. 27711	EPA CONTRACT NO: 68-02-2814 CONTRACTOR: Midwest Research Institute ASSIGNMENT NO: 18 ASSIGNMENT CHANGE NO: 3
TITLE: Conduct Emission Test Program at an Ammonium Nitrate Manufacturing Facility	DATE: 1_ MAR 1980

DESCRIPTION

Increase labor hours by 200 hours, from 1250 to 1450 hours.

Increase duration of work interval by 11 months.

Change completion date from August 31, 1979 to July 31, 1980.

Company Name: Swift Chemical Company
Location: Beaumont, Texas
Industry: Ammonium Nitrate
Project: 79-NHF-11

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	200 increase (1250 + 200 = 1450	
DURATION OF WORK	Increase by 11 months	
COMPLETION DATE	Change to July 31, 1980	

REQUESTER'S SIGNATURE	ORG CODE	TELEPHONE	DATE
Clyde E. Riley CER	ESED/EMB	(919) 541-5243	3-12-80

APPROVALS (as applicable)	SIGNATURE	DATE
BRANCH CHIEF	[signature]	3/13/80
DIVISION CHIEF	[signature]	3/14/80
PROJECT MANAGER	Thomas M. [signature]	3/14
CONTRACTING OFFICER	[signature]	3-19-80

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGEMENT

SIGNATURE	TITLE	DATE

EPA(RTP)325

WORK ASSIGNMENT

ENVIRONMENTAL PROTECTION AGENCY

Research Triangle Park, N.C. 27711

EPA CONTRACT NO	68-02-2814
CONTRACTOR	Midwest Research Institute
ASSIGNMENT NO	18
ASSIGNMENT CHANGE NO	4
DATE	16 APR 1980

TITLE
Conduct Emission Test Program at an Ammonium Nitrate Manufacturing Facility

DESCRIPTION

Increase labor hours by 200 hours, from 1450 hours to 1650 hours.

Company Name: Swift Chemical Company
Location: Beaumont, Texas
Industry: Ammonium Nitrate
Project No.: 79-NHF-11

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	200 increase (1450 + 200 = 1650)	
DURATION OF WORK	No change	
COMPLETION DATE	No change	

REQUESTER'S SIGNATURE	ORG CODE	TELEPHONE	DATE
Clyde E. Riley *C E Riley*	ESED/EMB	(919) 541-5243	4/10/80

APPROVALS (as applicable)	SIGNATURE	DATE
BRANCH CHIEF	[illegible signature]	4/10/80
DIVISION CHIEF	[illegible signature]	4/11/80
PROJECT MANAGER	T. M. Bibb	4/10/80
CONTRACTING OFFICER	[illegible signature]	4-16-80

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGMENT

SIGNATURE	TITLE	DATE

P-16

EPA(RTP)295

WORK ASSIGNMENT ENVIRONMENTAL PROTECTION AGENCY Research Triangle Park, N.C. 27711	EPA CONTRACT NO 68-02-2814 CONTRACTOR Midwest Research Institute ASSIGNMENT NO 18 ASSIGNMENT CHANGE NO 5
TITLE Conduct Emission Test Program at an Ammonium Nitrate Manufacturing Facility	DATE 24 JUN 1980

DESCRIPTION

Increase labor hours by 50 hours, from 1650 to 1700 hours.

Company Name: Swift Chemical Company
Location: Beaumont, Texas
Industry: Ammonium Nitrate
Project No.: 79-NHF-11

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	50 Increase (1650 + 50 = 1700)	
DURATION OF WORK	No change	
COMPLETION DATE	No change	

REQUESTER'S SIGNATURE	ORG CODE	TELEPHONE	DATE
Clyde E. Riley C.E.R.	EPA/OAQPS/ESED	541-5243	6/17/80

APPROVALS (as applicable)	SIGNATURE	DATE
BRANCH CHIEF	[signature]	6/17/80
DIVISION CHIEF	Don R. Goodwin	6/18/80
PROJECT MANAGER	Thomas M. Bibb	6/18
CONTRACTING OFFICER	[signature]	6/24/80

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGEMENT

SIGNATURE	TITLE	DATE

Wilcox
Schrag
4468-L

MIDWEST RESEARCH INSTITUTE
425 Volker Boulevard
Kansas City, Missouri 64110
Telephone (816) 753-7600

July 7, 1980

U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Attn: Mr. C. J. Foster, Contracting Officer (MD-33)

Subject: Contract 68-02-2814, Work Assignment 18, Change 5

Gentlemen:

One properly executed copy of the subject Change is enclosed. This document has been signed by Mr. Robert Donaldson, Manager, Contract Department.

If additional information is required, please contact the writer.

Sincerely,

MIDWEST RESEARCH INSTITUTE

Donald H. Stahlhut
Senior Contract Administrator

DHS:tmw

Enclosure

WORK ASSIGNMENT ENVIRONMENTAL PROTECTION AGENCY Research Triangle Park, N.C. 27711	EPA CONTRACT NO: 68-02-2814 CONTRACTOR: Midwest Research Institute ASSIGNMENT NO: 18 ASSIGNMENT CHANGE NO: 5
TITLE: Conduct Emission Test Program at an Ammonium Nitrate Manufacturing Facility	DATE: 24 JUN 1980

DESCRIPTION

Increase labor hours by 50 hours, from 1650 to 1700 hours.

Company Name: Swift Chemical Company
Location: Beaumont, Texas
Industry: Ammonium Nitrate
Project No.: 79-NHF-11

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	50 Increase (1650 + 50 = 1700)	1700
DURATION OF WORK	No change	N/C
COMPLETION DATE	No change	N/C

REQUESTER'S SIGNATURE	ORG CODE	TELEPHONE	DATE
Clyde E. Riley C.E.R.	EPA/OAQPS/ESED	541-5243	6/17/80

APPROVALS (as applicable)	SIGNATURE	DATE
BRANCH CHIEF	[signature]	6/17/80
DIVISION CHIEF	Don R. Goodwin	6/18/80
PROJECT MANAGER	Thomas M. Bibb	6/18
CONTRACTING OFFICER	[signature]	6/24/80

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGMENT

SIGNATURE	TITLE	DATE
Robert Donaldson	Robert Donaldson Manager, Contract Department	7/7/80

EPA/RTP/1394

P-2 COPY OF TECHNICAL DIRECTIVES AND ASSOCIATED CORRESPONDENCE

January 31, 1979

Mr. C. E. Riley
Field Testing Section
Emission Measurement Branch
Emission Standards and
Engineering Division
MD-13
U.S. Environmental Protection
Agency
Research Triangle Park, NC 27711

Subject: Needed Approval of EPA/EMB Technical Manager, EPA Contract No. 68-02-2814, Work Assignment No. 15 (Emission Test Program to Be Conducted at the Swift Chemical Company, Beaumont, Texas), for Cost Estimate of Proposed Modifications Necessary to Conduct Source Testing at Subject Job Site.

Dear Gene:

Enclosed please find one (1) copy of Mr. T. D. Sparkman's letter/cost estimate dated January 16, 1979. Note that in Mr. Sparkman's letter he mentions that he did not receive the prints sent to him showing the intended revisions; apparently they were lost in the mail. In view of this matter, I have sent Mr. Sparkman photocopies of the drawings and revisions so that he can confirm his cost estimate.

If there are any questions, please give me a call (816-753-7600).

Sincerely,

Bruce C. DaRos
Associate Chemist
Field Programs Section

BCD/jw

cc: Mr. J. E. McCarley, Jr., Chief
U.S. EPA ESED (MD-13)
Research Triangle Park, NC 27711

Mr. Terry D. Sparkman
Swift Agricultural Chemicals
P.O. Box 2175
Beaumont, Texas 77704

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

February 16, 1979

Mr. Bruce C. DaRos
Midwest Research Institute
425 Volker Boulevard
Kansas City, Missouri 64110

Reference: EPA Contract No. 68-02-2814, Assignment No. 18, Swift Chemical Company, Beaumont, Texas, EMB Report No. 79-NHF-11

Dear Bruce:

This correspondence is to document and clarify the details of sampling and analytical procedures required for the above ammonium nitrate work assignment.

The train configuration shall consist of a glass-lined probe connected by a flexible Teflon line to six(6) impingers. The first two impingers are to be prefilled with deionized, distilled water (100 mls each). The next two are to be prefilled with 1N H_2SO_4 (100 mls each). The fifth impinger shall remain empty while the sixth shall be prefilled with 200 grams of indicating silica gel (see enclosed diagram).

The first, third, fifth, and sixth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with an 1/2 inch glass tube extended to within 1/2 inch of the impinger's bottom.

The second and fourth impingers are of the regular design for the Greenburg-Smith units including tips with orifice plates located within 1/2 inch of the bottom.

A two or three inch fiber glass filter holder shall be positioned between the second and third impingers. The fiber glass filter does not have to be tared as it will be added to the water contents of the first two impingers.

Sample cleanup and recovery procedures include the following:

(1) The probe, flexible Teflon Line, first two impingers, filter holder, and their connecting glassware shall be rinsed with deionized, distilled water into one container with the glass fiber filter.

(2) The third, fourth and fifth impingers shall be rinsed with a 1N H_2SO_4 solution and placed in a second container.

The water contents of the first container shall be filtered using a tared glass fiber filter and a vacuum filtration setup to remove all traces of undissolved material (clay additive). A vacuum flask, vacuum pump, Buchner funnel, and tared glass fiber filters will be needed to perform this filtration operation. Carefully store the funnel filter in a petri dish for return to the lab for desiccation and weighing.

The water filtrate shall now be divided into two(2) equal portions with concentrated H_2SO_4 being added to one portion until the pH is six or less. The second portion shall be anlayzed as is.

The collector samples shall be analyzed as follows:

1. Analyze the untreated portion of the water sample with filter for NO_3^- using an ion specific electrode.
2. Analyze the pH treated portion of the water sample for ammonia by Nessler method.
3. Analyze the 1N H_2SO_4 impinger contents (impgs 3,4,5) for NO_3^- and ammonia by specific electrode and Nessler.
4. Dry the funnel filter, desiccate, and weigh to determine undissolved particulate.

For the scrubber solution, samples, aliquots shall be collected approximately every half hour during the test periods. (five aliquots for 2 hour period at each location). Temperatures shall be measured during each collection time and pH shall be measured on each aliquot sample as soon as it reaches room temperature (70°F). Afterward, the scrubber aliquots shall be combined to form composite samples (1 inlet-1 outlet). The samples shall be filtered through a tared glass fiber filter as described in the above impinger water analytical procedures. Details outlining the ammonia nitrate and ammonia analytical procedures for the scrubber solutions are presented in the enclosed memo from Mr. Gary McAlister. The tared filter shall be dried, desiccated, and weighed to determine percent solids.

The cleanup evaluation tests are designed to prepare the sample collectors for the test program, to establish blank values obtained from the test collectors, and to familiarize the cleanup personnel with the specified sample recovery procedures. The collector trains including the probes and flexible lines shall be prepared and properly precleaned before conducting the cleanup evaluation tests. The collector impingers are to be precharged as specified in the actual test program. Afterwards the collectors, including the probes and flexible lines are to be cleaned and the samples recovered and analyzed as specified in the actual test program.

Bruce, I have enclosed a copy of the "EPA Guidelines for Use of Method 9 For Determination of NSPS" to assist your visible emissions observer with data collection.

For the granulator melt sample, screened and unscreened product samples, and the cooler product in and out samples it will not be necessary to perform the percent ammonium nitrate and ammonia analysis at the plant site. These samples can be returned to the MRI labs for analysis at your conveinence. It will be necessary however to perform the sieve and bulk density determinations at the plant site.

If you have any questions regarding these instructions or require additional information, please do not hesitate to contact me.

Sincerely yours,

Clyde E. Riley

Clyde E. Riley
Emission Measurement Branch
Emission Standards and Engineering Division

Enclosures

cc: Mr. Eric Noble
Mr. Ronald E. Ashcroft

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Bruce

TRAIN CONFIGURATION
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