BE-660

United States
Environmental Protection
Agency

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

EMB Report 78-NHF-7
October 1979

Air

EPA

Ammonium Nitrate

Emission Test Report Union Oil Company of California Brea, California

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

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

RADIAN LIBRARY
DURHAM, N.C.

BE-660

AIR POLLUTION EMISSIONS TEST OF AN AMMONIUM NITRATE FERTILIZER PLANT

Contract No. 68-02-2815
Work Assignment No. 26

Submitted to

U.S. ENVIRONMENTAL PROTECTION AGENCY
Emission Standards and Engineering Division
Emissions Measurement Branch
Research Triangle Park, North Carolina 27711

May 1980

Prepared by

ENGINEERING-SCIENCE
125 West Huntington Drive
Arcadia, California 91006

RADIAN LIBRARY
DURHAM, N.C.

PREFACE

The work reported herein was conducted by personnel from Engineering-Science, Inc., Arcadia, California and McLean, Virginia (ES), the GCA/Technology Division (GCA), the Union Oil Co., Brea, California, and the U.S. Environmental Protection Agency (EPA).

The scope of work issued under EPA Contract No. 68-02-2815, Work Assignment No. 26 was under the supervision of the ES Technical Director, Mr. John T. Chehaske. Mr. Dennis Becvar of ES Arcadia served as Project Manager and was responsible for summarizing the test and analytical data in this report. Analysis of the samples was performed at the ES labs located in Arcadia, California, under the direction of Ms. Stefanie Fullmer and at the McLean, Virginia lab, under the direction of Mr. Scott Lambert.

Mr. Mark Bornstein and Mr. Steve Harvey of GCA were responsible for monitoring the process operations during the testing program. GCA personnel were also responsible for writing the Process Description and Operations Section, along with Appendix H of this report.

Members of Union Oil Co., Brea, California, whose assistance and guidance contributed greatly to the success of the test program, include Mr. Robert W. Waddell, Process Control Superintendent, and Mr. Mark Halderman, Process Engineer.

Mr. Eric A. Noble, Office of Air Quality Planning and Standards, Industrial Studies Branch, EPA, served as Test Process Project 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.

ENGINEERING-SCIENCE

D. P. Becvar,
Project Manager

J. T. Chehaske,
Technical Director

May 9, 1980

TABLE OF CONTENTS

		Page
SECTION I	INTRODUCTION	I-1
SECTION II	SUMMARY AND DISCUSSION OF RESULTS	II-1
SECTION III	PROCESS DESCRIPTION AND OPERATION	III-1
SECTION IV	LOCATION OF SAMPLING POINTS	IV-1
SECTION V	SAMPLING AND ANALYTICAL PROCEDURES	V-1
Appendix A	Particulate Test Results Example Calculations Part I - Particulate Test Results Part II - Particulate Calculations Terminology and Nomenclature Part III - Example Calculations	
Appendix B	Particle Size Results Part I - Discussion Part II - Computer Printout Part III - Field Data Sheets Part IV - Lab Weight Sheets	
Appendix C	Field Data Sheets Part I - Traverse Location for Circular Ducts Part II - Preliminary Velocity Traverse Data Part III - Nomograph Part IV - Field Data Sheets Part V - Field Lab Sheets Part VI - Sampling Summary Sheets	
Appendix D	Nitrate Analysis and Data Part I - Discussion of Analytical Methods Part II - Laboratory Data Part III - Laboratory Notebook	
Appendix E	Product Sample Data Part I - Discussion of Bulk Density and Sieve Analysis Part II - Bulk Density and Sieve Analysis Data Part III - Product Sample Laboratory Analysis Part IV - Relative Humidity and Ambient Temperature Data	
Appendix F	Sampling Train Calibrations	
Appendix G	Sampling Task Logs	

TABLE OF CONTENTS

Appendix H	Process Data (GCA) Part I - Summary of Recorded Data Part II - Correspondence Part III - Field Notebook
Appendix I	Part I - Sampling and Analytical Procedures Part II - Ammonia Part III - Ammonium Nitrate Part IV - Bulk Density Part V - Sieve Analysis
Appendix J	Clean-up Results
Appendix K	Audit Sample Results
Appendix L	Project Participants
Appendix M	Project Authorization

LIST OF FIGURES

Number	Title	Page
I-1	Ammonium Nitrate Process Flow Diagram	I-2
II-1	Particle Size Distribution - Ammonium Nitrate Predryer	II-15
II-2	Particle Size Distribution - Ammonium Nitrate Dryer	II-17
II-3	Particle Size Distribution - Ammonium Nitrate Cooler	II-19
III-1	Ammonium Nitrate Process Flow Diagram	III-2
IV-1	Sampling Point Location - Predryer & Dryer	IV-3
IV-2	Sampling Point Location - Cooler	IV-4
IV-3	Ammonium Nitrate Cross-Sectional Traverse Point Locations	IV-5
IV-4	Product Sample, Relative Humidity and Temperature Sampling Point Location	IV-6
V-1	Ammonium Nitrate Sampling Train	V-2

LIST OF TABLES

Table	Title	Page
I-1	Daily Summary Log for Testing on March 29, 1979	I-4
I-2	Daily Summary Log for Testing on March 30, 1979	I-5
I-3	Daily Summary Log for Testing on March 31, 1979	I-7
II-1	Summary of Emission Test Results in English and Metric Units, Predryer Scrubber Inlet	II-2
II-2	Summary of Emission Test Results for Predryer Scrubber Inlet	II-3
II-3	Summary of Ammonia and Ammonium Nitrate Emissions Calculated from Collected Ammonia at the Predryer Scrubber Inlet	II-4
II-4	Summary of Emission Test Results in English and Metric Units, Dryer Scrubber Inlet	II-6
II-5	Summary of Emission Test Results for Dryer Scrubber Inlet	II-7
II-6	Summary of Ammonia and Ammonium Nitrate Emissions Calculated from Collected Ammonia at the Dryer Scrubber Inlet	II-8
II-7	Summary of Emission Test Results in English and Metric Units, Cooler Scrubber Inlet	II-10
II-8	Summary of Emission Test Results for Cooler Scrubber Inlet	II-11
II-9	Summary of Ammonia and Ammonium Nitrate Emissions Calculated from Collected Ammonia at the Cooler Scrubber Inlet	II-12
II-10	Summary of Ammonium Nitrate Predryer Particle Sizing Test Results	II-14
II-11	Summary of Ammonium Nitrate Dryer Particle Sizing Test Results	II-16
II-12	Summary of Ammonium Nitrate Cooler Particle Sizing Test Results	II-18
II-13	Summary of March 29 and 30, 1979 Ambient Temperature, Relative Humidity, and Barometric Pressure for the Predryer, Dryer and Cooler	II-21
II-14	Summary of March 29 and 30, 1979 Sieve and Bulk Density Measurement on the Predryer Inlet of the Ammonium Nitrate Plant	II-23
II-15	Summary of March 29 and 30, 1979 Sieve and Bulk Density Measurement on the Dryer Inlet of the Ammonium Nitrate Plant	II-24
II-16	Summary of March 29 and 30, 1979 Sieve and Bulk Density Measurement on the Cooler Inlet of the Ammonium Nitrate Plant	II-25
II-17	Summary of March 29 and 30, 1979 Sieve and Bulk Density Measurement on the Cooler Outlet of the Ammonium Nitrate Plant	II-26
III-1	Average Values and Ranges for Process Equipment Operating Parameters	III-4
III-2	Ammonium Nitrate Production Rate During Testing	III-6

SECTION I

INTRODUCTION

SECTION I

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 assemble this background information, EPA utilizes emission data obtained from uncontrolled and controlled sources involved in the particular industry under consideration.

Based on the above criteria, EPA's Office of Air Quality Planning and Standards (OAQPS) selected the Union Oil Company's ammonium nitrate manufacturing plant at Brea, California as a site for an emission test program. The test program was designed to quantify and characterize the uncontrolled emissions from the predryer, dryer, and cooler operations associated with the production of ammonium nitrate. This report presents the results of a test program conducted during the week of March 26, 1979.

The Union Oil Company's ammonium nitrate manufacturing plant at Brea produces prilled ammonium nitrate for industrial and fertilizer use. The prills are formed by spray-drying a concentrated solution down through a cooling tower. The prilling operation is followed by passing the newly formed prills through a predryer, dryer and cooler. Prills leaving the cooler are screened and transferred to a coating drum (see Figure I-1).

The predryer and dryer are large rotary drums with warm, dry air continuously flowing through them. The rotary drum cooler uses refrigerated air to condition the prills. The process operates continuously 24 hours per day and 7 days per week as production demands. Emissions sampling was conducted on the predryer, dryer, and cooler exhaust emissions while their production rates were approximately 200 tons/day.

AMMONIUM NITRATE PROCESS FLOW DIAGRAM
UNION OIL COMPANY OF CALIFORNIA, BREA, CALIFORNIA

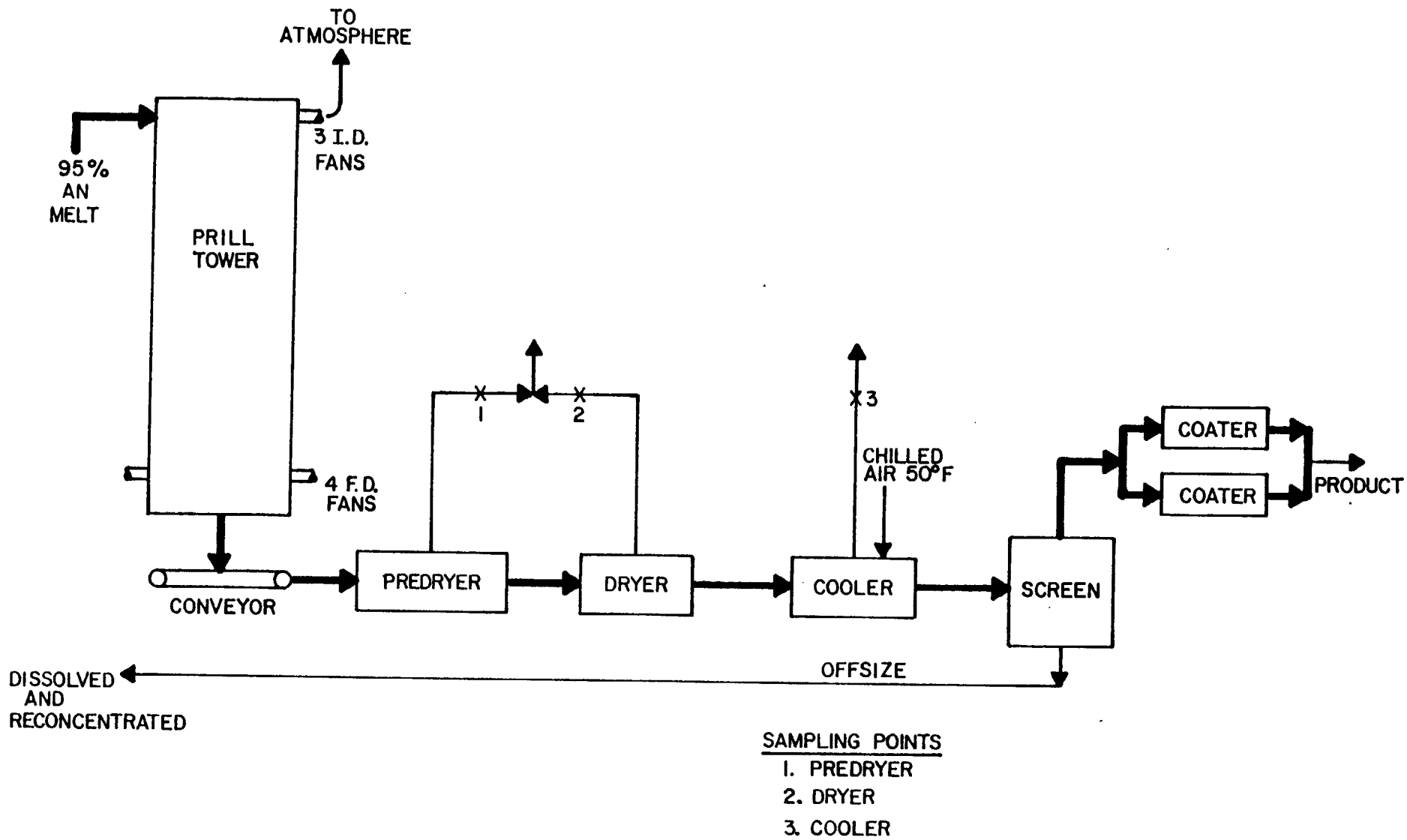


FIGURE I-1

The sampling data presented in this report were collected by concurrently sampling the outlet ducts of the predryer, dryer and cooler prior to their connection to emission control equipment. All emission tests conducted at this facility were performed only during times of normal operation as described in Section III, "Process Description and Operation". The emission testing program conducted at this facility consisted of the following:

(1) Particulate: Three repetitions of concurrent test runs were performed at the outlet ducts of the predryer, dryer and cooler. The tests were conducted using a modified EPA Method 5 sampling train which provided velocity, moisture and particulate data.

(2) Particle Size: Data were collected at the outlet ducts of the predryer, dryer and cooler. An Anderson six-stage Cascade impactor with pre-separator was used. Three particle size runs were made per process unit, i.e., three runs for the predryer, three runs for the dryer, etc.

(3) Process Samples: Grab samples of ammonium nitrate were collected once during each emission test run. They were collected at the conveyor prior to the predryer, dryer, cooler and cooler outlet. Bulk density and sieve analysis were performed by ES, while analysis for ammonia and ammonium nitrate concentrations of the product samples were conducted by Union Oil laboratory personnel. These analyses were performed on composite samples from the bulk density and sieve analyses.

(4) Relative Humidity and Ambient Temperature: The predryer and dryer operate using ambient air. In order to establish operating conditions for these, relative humidity data were collected during the sampling runs. Ambient temperature data were collected concurrently with the relative humidity.

ES personnel were responsible for collecting and measuring the above emission parameters. Simultaneously, GCA was responsible for monitoring and recording the necessary process equipment operating parameters.

Most of the test runs were discontinuous due to excessive loading at the sampling locations. These interruptions were encountered throughout the test program as indicated in Tables I-1 through I-3 (Daily Summary Log).

TABLE I-1

DAILY SUMMARY LOG FOR TESTING ON MARCH 29, 1979
UNION OIL COMPANY, AMMONIUM NITRATE PLANT, BREA, CALIFORNIA

Clock Time	Production Rate Tons/Hr	Ammonium Nitrate Particulate [a]			Particle Sizing	Temp.	RH	Bulk Density & Sieve Sampling			
		Predryer	Dryer	Cooler	Predryer	°F	%	Predryer	Dryer	Cooler-In	Cooler-Out
1030						62.0	55				
1045						64.0	52				
1100						64.0	52				
1112					Test 1 Begins						
1115						64.0	52				
1127					Test 1 Ends						
1130						64.0	52				
1145						63.0	57				
1200						67.0	50				
1215						68.0	50				
1230						67.0	50				
1245						67.5	50				
1300						69.0	48				
1315						68.0	48				
1330						67.5	50				
1345						66.5	53				
1400						66.5	53				
1409	8.33	Test 1A Begins	Test 1A Begins	Test 1A Begins							
1412								Grab			
1415						65.5	53				
1427		Plant Shutdown	Plant Shutdown	Plant Shutdown							
1430						65.5	53				
1432		Test 1A Resumes	Test 1A Resumes	Test 1A Resumes							
1444			Port Change	Port Change					Grab		
1445						66.5	53				
1459		Port Change									
1500						66.0	53				
1512										Grab	
1515						67.0	53				
1530						66.0	53				
1532											Grab
1545						66.0	53				
1600						67.0	53				
1632					Test 2 Begins						
1702					Test 2 Ends						
1715						65.5	50				
1730						65.5	53				
1745						65.5	53				
1800						65.5	53				
1815						64.0	58				
1820			Test 1B Begins	Test 1B Begins							
1823		Test 1B Begins									
1830						64.0	58				
1845						63.5	60				
1850				Test 1 Ends							
1853	8.33										
1900		Test 1 Ends				63.0	62				
1905			Test 1 Ends								
1915						62.0	68				
1951					Test 3 Begins						
2021					Test 3 Ends						

[a] Part[illegible]e s[illegible] alt[illegible] analyze[illegible] ammonia

TABLE I-2

DAILY SUMMARY LOG FOR TESTING ON MARCH 30, 1979
UNION OIL COMPANY, AMMONIUM NITRATE PLANT, BREA, CALIFORNIA

Clock Time	Production Rate Tons/Hr	Ammonium Nitrate Particulates[a]			Particle Sizing	Temp.	RH	Bulk Density & Sieve Sampling			
		Predryer	Dryer	Cooler	Cooler	°F	%	Predryer	Dryer	Cooler-In	Cooler-Out
0900						62.0	64				
0915						64.0	58				
0930						64.0	58				
0945	9.54					64.0	56				
0951			Test 2A Attempted								
1000						66.0	55				
1003				Test 2B Begins							
1015						65.0	57				
1030						66.0	55				
1033				Port Change							
1036								Grab			
1044		Test 2A Begins									
1045						66.0	55				
1054									Grab		
1100						66.5	53				
1114		Port Change									
1115						64.5	50			Grab	
1130						67.0	53				
1134											Grab
1145						67.0	53				
1200						67.5	56				
1215						67.0	53				
1230						68.5	57				
1231			Test 2A Begins								
1239					Test 1 Attempted						
1244					Test 1 Attempted						
1245						67.0	62				
1250					Test 1 Begins						
1305					Test 1 Ends						
1307			Port Change								
1315						68.5	50				
1330						67.0	53				
1332			Test 2B Begins								
1338		Test 2B Begins									
1345						67.0	50				
1347				Test 2A Begins							
1400						68.0	50				
1408		Test 2 Ends	Test 2 Ends								
1415						68.0	45				
1417				Test 2 Ends							
1427	9.54		Test 3B Begins								
1500						69.0	49				
1503			Port Change								
1515						68.5	47				
1523		Moisture Test									
1528		Begins			Test 2 Attempted						
1532					Test 2 Attempted						
1537					Test 2 Attempted						
1545						67.5	48				
1547					Test 2 Begins						
1553		Moisture Test									
1556		Ends			Test 2 Ends						

a) Particulate samples also analyzed for ammonia

TABLE 1-2 (Continued)

DAILY SUMMARY LOG FOR TESTING ON MARCH 30, 1979
UNION OIL COMPANY, AMMONIUM NITRATE PLANT, BREA, CALIFORNIA

Clock Time	Production Rate Tons/Hr	Ammonium Nitrate Particulate[a]			Particle Sizing Cooler	Temp. °F	RH %	Bulk Density & Sieve Sampling			
		Predryer	Dryer	Cooler				Predryer	Dryer	Cooler-In	Cooler-Out
1600											
1614						68.0	48				
1615								Grab			
1630						68.0	48				
1632						68.5	49				
1642	9.54	Test 3A Begins	Test 3A Begins						Grab		
1645				Test 3A Begins		67.5	50				
1648										Grab	
1651		Repair Glassware									
1658		Test 3A Resumes									
1700						67.5	51				
1704											Grab
1715				Port Change		66.5	53				
1718			Test 3A Ends								
1719		Port Change									
1727	9.54	Test 3B Begins									
1730	8.33					66.0	55				
1733				Test 3B Begins							
1745						64.5	57				
1757		Test 3 Ends									
1800						64.5	59				
1803				Test 3 Ends							
1815						64.5	59				
1842	8.33				Test 3 Begins						
1857					Test 3 Ends						

a) Particulate samples also analyzed for ammonia

TABLE I-3

DAILY SUMMARY LOG FOR TESTING ON MARCH 31, 1979
AT UNION OIL COMPANY, AMMONIUM NITRATE PLANT
BREA, CALIFORNIA

Clock Time	Production Rate Tons/Hr.	Particle Sizing Dryer
1007	7.17	Test 1 Begins
1022	↑	Test 1 Complete
1203		Test 2 Begins
1233		Test 2 Complete
1406	↓	Test 3 Begins
1430	7.17	Test 3 Complete

The following sections of this report cover the results, process description and operation, location of sampling points, and sampling and analytical procedures. In addition, Appendix J contains the summary of results for the cleanup evaluations performed on the sample collectors used for the test program. The Quality Assurance Audit samples analysis results supplied by the EPA are included in Appendix K. Detailed descriptions of methods and procedures, field and laboratory data, and calculations are presented in various appendices, as noted.

SECTION II

SUMMARY OF RESULTS

SECTION II

SUMMARY OF RESULTS

INTRODUCTION

This section presents the results of the testing program conducted during the week of March 26, 1979 at the Union Oil Company ammonium nitrate facility in Brea, California. Exhaust gas streams from the predryer, dryer and cooler were sampled concurrently during normal process conditions. These process conditions were considered to be similar to those used during normal plant operation. Process parameters were carefully observed by representatives from EPA and GCA.

Most of the test runs were discontinuous due to excessive loading of dust particles. This excessive amount of dust was found to produce material accumulation of up to 2 inches in the bottom sections of some of the test ducts. The heavy loading of large particles caused plugging of probe nozzles and pitot tubes, making the sampling extremely difficult.

AMMONIUM NITRATE AND AMMONIA RESULTS, PREDRYER

The summaries of the ammonium nitrate and ammonia results at the predryer are presented in Tables II-1 through II-3. Table II-1 presents the data summaries in English and Metric units.

The results of the insoluble particulates show that an average of 0.837 pounds per hour were emitted during the testing sequence. This is less than one percent of the total particulate ammonium nitrate. Table II-2 presents the results of the ammonium nitrate calculated from the measured moles of nitrate, and ammonium nitrate calculated from the moles of measured ammonia. The average ammonium nitrate particulate emission rates as determined from the nitrate and ammonia analyses were 177 pounds per hour and 114 pounds per hour, respectively. Comparison of these averages shows that the ammonium nitrate emission rates obtained from the nitrate analyses were approximately 55 percent greater than the ammonium nitrate emission rates obtained from the ammonia analyses.

Table II-3 presents a summary of the ammonia results. The average ammonia emission rate was 24.2 pounds per hour. The data showed that no excess ammonia was found in the sampled gas stream during the first two runs. During the third run, 25.8 pounds per hour of excess ammonia was detected.

TABLE II-1

SUMMARY OF EMISSION TEST RESULTS IN ENGLISH AND METRIC UNITS PREDRYER SCRUBBER INLET UNION OIL COMPANY, BREA, CALIFORNIA

	Units		Run 1		Run 2		Run 3		Average	
	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric
Date			3/29/79		3/30/79		3/30/79			
Volume of Gas Sampled	DSCF	Nm^3	48.93	1.39	45.28	1.28	33.77	0.96	42.66	1.21
Percent Moisture by Volume[a]			2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Average Stack Temperature	°F	°C	131	55.0	142	61.1	126	52.2	133	56.1
Stack Volumetric Flow Rate	DSCFM	Nm^3/min	8661	245	8188	232	5703	162	7517	213
Percent Isokinetic			93	93	92	92	98	98	94	94
Production Rate	Ton/hr	Mg/hr	8.33	7.56	9.54	8.65	8.88[b]	8.06	8.92	8.09
Insoluble Particulates										
Filter catch and collection water filtrate	mg		51.6		13.3		44.2		36.4	
	gr/DSCF	g/Nm^3	0.0163	0.0373	0.00453	0.0104	0.0202	0.0462	0.0137	0.0314
	lb/hr	kg/hr	1.21	0.549	0.318	0.144	0.987	0.448	0.837	0.380
	lb/ton	kg/Mg	0.145	0.0725	0.0333	0.0167	0.111	0.0555	0.0964	0.0482
Ammonium Nitrate Particulates	mg		10993		5877		5915		7595	
	gr/DSCF	g/Nm^3	3.47	7.94	2.00	4.58	2.70	6.18	2.72	6.22
	lb/hr	kg/hr	258	117	140	63.5	132	59.9	177	80.3
	lb/ton	kg/Mg	31.0	15.5	14.7	7.35	14.9	7.45	20.2	10.1
Total Particulate Insoluble and ammonium nitrate	mg		11045		5890		5959		7631	
	gr/DSCF	g/Nm^3	3.49	7.99	2.00	4.58	2.72	6.22	2.73	6.25
	lb/hr	kg/hr	259	117	140	63.5	133	60.3	178	80.7
	lb/ton	kg/Mg	31.1	15.57	14.7	7.37	15.0	7.50	20.3	10.15

a) Moisture determined by separate run.
b) Average production rate recommended by GCA for Run 3.

TABLE II-2
SUMMARY OF EMISSION TEST RESULTS FOR PREDRYER SCRUBBER INLET
AT THE UNION OIL COMPANY, BREA, CALIFORNIA

	Run 1		Run 2		Run 3		Average	
Date	3/29/79		3/30/79		3/30/79			
Volume of Gas Sampled - DSCF	48.95		45.28		33.77		42.67	
Percent Moisture by Volume[a]	2.24		2.24		2.24		2.24	
Average Stack Temperature - °F	131		142		126		133	
Stack Volumetric Flow Rate - DSCFM	8661		8188		5703		7517	
Percent Isokinetic	93		91		98		94	
Production Rate - Tons/Hr	8.33		9.54		8.88[b]		8.92	
Insoluble Particulates								
Filter catch and Collection water filtrate								
mg	51.6		13.3		44.2		36.4	
gr/DSCF	0.0163		0.00453		0.0202		0.0137	
lb/hr	1.21		0.318		0.987		0.837	
lb/ton	0.145		0.0333		0.111		0.0964	
Ammonium Nitrate Particulate	Measured as		Measured as		Measured as		Measured as	
Nitrate and ammonium nitrate measured as ammonia	Nitrate	Ammonia	Nitrate	Ammonia	Nitrate	Ammonia	Nitrate	Ammonia
mg	10993[c]	524	5877[c]	3176	5915[c]	11336	7595[c]	5012
gr/DSCF	3.47	0.165	2.00	1.08	2.70	5.18	2.72	2.14
lb/hr	258	12.3	140	76.0	132	253	177	114
lb/ton	31.0	1.47	14.7	7.96	14.9	28.5	20.2	12.6
Total Particulates								
Insoluble and ammonium nitrate								
mg	11045	576	5890	3189	5959	11380	7631	5048
gr/DSCF	3.49	0.181	2.00	1.08	2.72	5.20	2.73	2.15
lb/hr	259	13.5	140	76.3	133	254	178	115
lb/ton	31.1	1.62	14.7	7.99	15.0	28.6	20.3	12.7
Percent Insoluble Catch of Total Catch	0.5	9.0	0.2	0.4	0.7	0.4	0.5	3.3

a) Moisture determined by separate run.
c) Average production rate recommended by GCA for Run 3.
d) Nitrate data presented in Table II-7.

TABLE II-3

SUMMARY OF AMMONIA AND AMMONIUM NITRATE EMISSIONS
CALCULATED FROM COLLECTED AMMONIA AT THE PREDRYER SCRUBBER INLET
AT THE UNION OIL COMPANY, BREA, CALIFORNIA

	Run 1	Run 2	Run 3	Average
Date	3/29/79	3/30/79	3/30/79	
Volume of Gas Sampled - DSCF	48.95	45.28	33.77	42.67
Stack Volumetric Rate - DSCFM	8661	8188	5703	7517
Production Rate - Tons/hr	8.33	9.54	8.88[a]	8.92
Ammonia				
mg	111	676	2412	1066
gr/DSCF	0.0351	0.230	1.10	0.455
lb/hr	2.61	16.1	53.8	24.2
lb/ton	0.313	1.69	6.06	2.69
Ammonium Nitrate Calculated from moles of ammonia				
mg	524	3176	11336	5012
gr/DSCF	0.165	1.08	5.18	2.14
lb/hr	12.3	76.0	253	114
lb/ton	1.47	7.96	28.5	12.6
Excess Ammonia Not combined with ammonium nitrate				
mg	b	b	1153	b
gr/DSCF	b	b	0.527	b
lb/hr	b	b	25.8	b
lb/ton	b	b	2.90	b

a) Average production rate recommended by GCA for Run 3.
b) No data presented, negative difference.

Several sampling problems occurred during the pre-dryer testing. Large size particles caused plugging of the pitot tube, sample probe, and nozzle. This plugging resulted in several shut-downs throughout the three test runs. A process delay was encountered during the first run. During Run No. 2, the glass probe liner separated from the union connector and the prescribed leak check conducted after completion of the run failed. For Run No. 3, one of the glassware connectors broke. This connector was replaced and the run resumed.

AMMONIUM NITRATE AND AMMONIA RESULTS, DRYER

The summaries of the ammonium nitrate and ammonia results at the dryer are presented in Tables II-4 through II-6. Table II-4 presents the data summaries in English and Metric units.

The results of the insoluble particulates show that an average of 0.970 pounds per hour were emitted during the testing sequence. This is approximately 0.5 percent of the total particulate ammonium nitrate. Table II-5 presents the ammonium nitrate results calculated from independent analyses of nitrate and ammonium. The average ammonium nitrate particulate emission rates as determined from the nitrate and ammonium results were 206 pounds per hour and 256 pounds per hour, respectively. Comparison of these averages shows the nitrate based results to be approximately 20 percent less than the ammonia based results. This comparison result does not agree with the data obtained at the pre-dryer.

Table II-6 presents a summary of the ammonia results. The average ammonia emission rate for the three runs was 54.5 pounds per hour. No excess ammonia was detected during the first run. During the second and third runs an average of 37.4 pounds per hour of excess ammonia was detected.

Sampling problems that occurred during the dryer testing include the following:

(1) The concentration of large size particles caused plugging of the pitot tube, sample probe and nozzle. This plugging resulted in several shut-downs throughout the three test runs.

(2) A process delay was encountered during the first run.

TABLE II-4

SUMMARY OF EMISSION TEST RESULTS IN ENGLISH AND METRIC UNITS DRYER SCRUBBER INLET UNION OIL COMPANY, BREA, CALIFORNIA

	Units		Run 1		Run 2		Run 3		Average	
	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric
Date			3/29/79		3/30/79		3/30/79			
Volume of Gas Sampled	DSCF	Nm^3	58.89	1.67	40.58	1.15	71.03	2.01	56.83	1.61
Percent Moisture by Volume[a]			2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Average Stack Temperature	°F	°C	148	64.4	162	72.2	151	66.1	154	67.6
Stack Volumetric Flow Rate[b]	DSCFM	Nm^3/min	5888	167	4957	140	9060	257	6635	188
Percent Isokinetic			100	100	101	101	97	97	99	99
Production Rate	Ton/hr	Mg/hr	8.33	7.56	9.54	8.65	8.88[c]	8.06	8.92	8.09
Insoluble Particulates										
Filter catch and collection water filtrate	mg		57.1		84.0		46.9		62.7	
	gr/DSCF	g/Nm^3	0.0150	0.0355	0.0319	0.0730	0.0102	0.0233	0.0190	0.0435
	lb/hr	kg/hr	0.757	0.343	1.36	0.617	0.794	0.360	0.970	0.440
	lb/ton	kg/Mg	0.0909	0.0455	0.142	0.0710	0.0894	0.0447	0.107	0.0535
Ammonium Nitrate Particulates	mg		16018		22004		3044		13689	
	gr/DSCF	g/Nm^3	4.20	9.61	8.37	19.2	0.661	1.51	4.41	10.1
	lb/hr	kg/hr	212	96.1	356	161	51.4	23.3	206	93.4
	lb/ton	kg/Mg	25.4	12.7	37.3	18.7	5.79	2.90	22.8	11.4
Total Particulate										
Insoluble and ammonium nitrate	mg		16075		22088		3091		13751	
	gr/DSCF	g/Nm^3	4.22	9.66	8.40	19.2	0.671	1.53	4.43	10.1
	lb/hr	kg/hr	213	96.6	357	162	52.2	23.7	207	93.9
	lb/ton	kg/Mg	25.5	12.8	37.4	18.8	5.88	2.94	22.9	11.5

a) Moisture determined by separate run.
b) Approximately 4% of duct filled with ammonium nitrate particles.
c) Average production rate recommended by GCA for Run 3.

TABLE II-5
SUMMARY OF EMISSION TEST RESULTS FOR DRYER SCRUBBER INLET
AT THE UNION OIL COMPANY, BREA, CALIFORNIA

	Run 1		Run 2		Run 3		Average	
Date	3/29/79		3/30/79		3/30/79			
Volume of Gas Sampled - DSCF	58.89		40.58		71.03		56.83	
Percent Moisture by Volume[a]	2.24		2.24		2.24		2.24	
Average Stack Temperature - °F	148		162		151		154	
Stack Volumetric Flow Rate - DSCFM[b]	5888		4957		9060		6635	
Percent Isokinetic	100		101		97		99	
Production Rate - Tons/Hr	8.33		9.54		8.88[c]		8.92	
Insoluble Particulates								
Filter catch and Collection water filtrate								
mg	57.1		84.0		46.9		62.7	
gr/DSCF	0.0150		0.0319		0.0102		0.0190	
lb/hr	0.757		1.36		0.794		0.970	
lb/ton	0.0909		0.142		0.0894		0.107	
Ammonium Nitrate Particulate	Measured as		Measured as		Measured as		Measured as	
Nitrate and ammonium nitrate measured as ammonia	Nitrate	Ammonia	Nitrate	Ammonia	Nitrate	Ammonia	Nitrate	Ammonia
mg	16018[d]	725	22004[d]	39790	3044[d]	6834	13689[d]	15783
gr/DSCF	4.20	0.190	8.37	15.1	0.661	1.48	4.41	5.59
lb/hr	212	9.59	356	642	51.4	115	206	256
lb/ton	25.4	1.15	37.3	67.3	5.79	13.0	22.8	27.2
Total Particulates								
Insoluable and ammonium nitrate								
mg	16075	782	22088	39874	3091	6881	13751	15846
gr/DSCF	4.22	0.205	8.40	15.1	0.671	1.49	4.43	5.60
lb/hr	213	10.3	357	643	52.2	116	207	257
lb/ton	25.5	1.24	37.4	67.4	5.88	13.1	22.9	27.3
Percent Insoluable Catch of Total Catch	0.4	7.3	0.4	0.2	1.5	0.7	0.8	2.7

a) Moisture determined by separate run.
b) Approximately 4% of duct filled with ammonium nitrate particles.
c) Average production rate recommended by GCA for Run 3.
d) Nitrate data presented in Table II-4.

TABLE II-6

SUMMARY OF AMMONIA AND AMMONIUM NITRATE EMISSIONS
CALCULATED FROM COLLECTED AMMONIA AT THE DRYER SCRUBBER INLET
AT THE UNION OIL COMPANY, BREA, CALIFORNIA

	Run 1	Run 2	Run 3	Average
Date	3/29/79	3/30/79	3/30/79	
Volume of Gas Sampled - DSCF	58.89	40.58	71.03	56.83
Stack Volumetric Rate - DSCFM[a]	5888	4957	9060	6635
Production Rate - Tons/hr	8.33	9.54	8.88[b]	8.92
Ammonia				
mg	154.3	8466	1454	3358
gr/DSCF	0.0404	3.22	0.316	1.19
lb/hr	2.04	137	24.5	54.5
lb/ton	0.245	14.4	2.76	5.80
Ammonium Nitrate Calculated from moles of ammonia				
mg	725	39790	6834	15783
gr/DSCF	0.190	15.1	1.48	5.59
lb/hr	9.59	642	115	256
lb/ton	1.15	67.3	13.0	27.2
Excess Ammonia Not combined with ammonium nitrate				
mg	c	3784	806	c
gr/DSCF	c	1.44	0.175	c
lb/hr	c	61.2	13.6	c
lb/ton	c	6.41	1.53	c

a) Approximately 4% of duct filled with ammonium nitrate particles.
b) Average production rate recommended by GCA for Run 3.
c) No data presented, negative difference.

(3) A 2-inch layer of dust material was discovered on the bottom section of the dryer duct.

(4) Several glassware connectors were broken during the test runs. When this occurred, the sampling was stopped and the glass connector replaced.

AMMONIUM NITRATE AND AMMONIA RESULTS, COOLER

Data summaries of the ammonium nitrate and ammonia results at the cooler are presented in Tables II-7 through II-9. Table II-7 presents the data summaries in English and Metric units.

The results of the insoluble particulate show that an average of 1.13 pounds per hour were emitted during the testing sequence. This is less than one percent of the total particulate ammonium nitrate.

Table II-8 presents the ammonium nitrate results calculated from nitrate analyses, and ammonium nitrate calculated from moles of measured ammonia. The average ammonium nitrate particulate emission rates as determined from the nitrate and ammonia analytical results were 219 pounds per hour and 330 pounds per hour, respectively. Comparison of these averages shows the nitrate based results to be approximately 34 percent less than the ammonia based results. This comparison result agrees with the data obtained at the dryer.

Table II-9 presents a summary of the ammonia results. The average ammonia emission rate was 70.3 pounds per hour. No excess ammmonia was detected during the first run. An average of 58.9 pounds per hour of excess ammonia was detected during the second and third runs.

A process delay that occurred during the first run was the only problem experienced during the cooler testing.

PARTICLE SIZE RESULTS, PREDRYER

Particle size distribution tests were conducted on the predryer exhaust emissions on March 29, 1979. Summaries of the results are presented in Table II-10 and in Figure II-1.

Figure II-1 displays the distribution versus the aerodynamic particle size. These data show that particles larger than 11.96 micrometers (μm) accounted for more than 99 percent of the total mass.

TABLE II-7

SUMMARY OF EMISSION TEST RESULTS IN ENGLISH AND METRIC UNITS COOLER SCRUBBER INLET UNION OIL COMPANY, BREA, CALIFORNIA

	Units		Run 1		Run 2		Run 3		Average	
	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric
Date			3/29/79		3/30/79		3/30/79			
Volume of Gas Sampled	DSCF	Nm^3	43.98	1.25	54.54	1.54	50.26	1.42	49.59	1.40
Percent Moisture by Volume[a]			2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Average Stack Temperature	°F	°C	122	50.0	121	49.4	115	46.1	119	48.3
Stack Volumetric Flow Rate[b]	DSCFM	Nm^3/min	7359	217	9268	266	8666	249	8431	244
Percent Isokinetic			104	104	102	102	100	100	102	102
Production Rate	Ton/hr	Mg/hr	8.33	7.56	9.54	8.65	8.88[c]	8.06	8.92	8.09
Insoluble Particulates										
Filter catch and collection water filtrate	mg		36.1		94.3		20.9		50.4	
	gr/DSCF	g/Nm^3	0.0127	0.0291	0.0267	0.0611	0.00642	0.1470	0.0153	0.0350
	lb/hr	kg/hr	0.799	0.362	2.12	0.961	0.477	0.216	1.13	0.512
	lb/ton	kg/Mg	0.0959	0.0480	0.222	0.111	0.0537	0.0269	0.124	0.0620
Ammonium Nitrate Particulates										
	mg		10876		13971		4778		9875	
	gr/DSCF	g/Nm^3	3.82	8.74	3.95	9.04	1.47	3.36	3.08	7.05
	lb/hr	kg/hr	241	109	314	142	103	46.7	219	99.3
	lb/ton	kg/Mg	28.9	14.5	32.9	16.5	11.6	5.80	24.5	12.3
Total Particulate										
Insoluble and ammonium nitrate	mg		10912		14065		4799		9925	
	gr/DSCF	g/Nm^3	3.83	8.76	3.98	9.11	1.48	3.39	3.10	7.09
	lb/hr	kg/hr	242	110	316	143	103	46.9	220	99.8
	lb/ton	kg/Mg	29.0	14.5	33.1	16.6	11.7	5.85	24.6	12.3

a) Moisture determined by separate run.
b) Approximately 1% of duct filled with ammonium nitrate particles.
c) Average production rate recommended by GCA for Run 3.

TABLE II-8

SUMMARY OF EMISSION TEST RESULTS FOR COOLER SCRUBBER INLET AT THE UNION OIL COMPANY, BREA, CALIFORNIA

	Run 1		Run 2		Run 3		Average	
Date	3/29/79		3/30/79		3/30/79			
Volume of Gas Sampled - DSCF	43.98		54.54		50.26		49.59	
Percent Moisture by Volume[a]	2.24		2.24		2.24		2.24	
Average Stack Temperature - °F	122		121		115		119	
Stack Volumetric Flow Rate - DSCFM[b]	7359		9268		8666		8431	
Percent Isokinetic	104		102		100		102	
Production Rate - Tons/Hr	8.33		9.54		8.88[c]		8.92	
Insoluble Particulates								
Filter catch and Collection water filtrate								
mg	36.1		94.3		20.9		50.4	
gr/DSCF	0.0127		0.0267		0.00642		0.0153	
lb/hr	0.799		2.12		0.477		1.13	
lb/ton	0.0959		0.222		0.0537		0.124	
Ammonium Nitrate Particulate	Measured as		Measured as		Measured as		Measured as	
Nitrate and ammonium nitrate measured as ammonia	Nitrate	Ammonia	Nitrate	Ammonia	Nitrate	Ammonia	Nitrate	Ammonia
mg	10876[d]	586	13971[d]	21869	4778[d]	21272	9875[d]	14576
gr/DSCF	3.82	0.206	3.95	6.19	1.47	6.53	3.08	4.31
lb/hr	241	13.0	314	491	103	485	219	330
lb/ton	28.9	1.56	32.9	51.5	11.6	54.6	24.5	35.9
Total Particulates								
Insoluble and ammonium nitrate								
mg	10912	622	14065	21963	4799	21293	9925	14626
gr/DSCF	3.83	0.219	3.98	6.22	1.48	6.54	3.10	4.33
lb/hr	242	13.8	316	493	103	485	220	331
lb/ton	29.0	1.66	33.1	51.7	11.7	54.7	24.6	36.0
Percent Insoluble Catch of Total Catch	0.3	5.8	0.7	0.4	0.4	0.1	0.5	2.1

a) Moisture determined by separate run.
b) Approximately 1% of duct filled with ammonium nitrate particles.
c) Production rate recommended by GCA for Run 3.
d) Nitrate data presented in Table II-7.

TABLE II-9

SUMMARY OF AMMONIA AND AMMONIUM NITRATE EMISSIONS
CALCULATED FROM COLLECTED AMMONIA AT THE COOLER SCRUBBER INLET
AT THE UNION OIL COMPANY, BREA, CALIFORNIA

	Run 1	Run 2	Run 3	Average
Date	3/29/79	3/30/79	3/30/79	
Volume of Gas Sampled - DSCF	43.98	54.54	50.26	49.59
Stack Volumetric Rate - DSCFM[a]	7359	9268	8666	8431
Production Rate - Tons/hr	8.33	9.54	8.88[b]	8.92
Ammonia				
mg	125	4653	4526	3101
gr/DSCF	0.0437	1.32	1.39	0.918
lb/hr	2.76	105	103	70.3
lb/ton	0.331	11.0	11.6	7.64
Ammonium Nitrate Calculated from moles of ammonia				
mg	586	21869	21272	14576
gr/DSCF	0.206	6.19	6.53	4.31
lb/hr	13.0	491	485	330
lb/ton	1.56	51.5	54.6	35.9
Excess Ammonia Not combined with ammonium nitrate				
mg	c	1680	3509	c
gr/DSCF	c	0.475	1.08	c
lb/hr	c	37.8	80.0	c
lb/ton	c	3.96	9.01	c

a) Approximately 1% of duct filled with ammonium nitrate particles.
b) Average production rate recommended by GCA for Run 3.
c) No data presented, negative difference.

TABLE II-10

SUMMARY OF AMMONIUM NITRATE PREDRYER
PARTICLE SIZING TEST RESULTS
UNION OIL COMPANY, BREA, CALIFORNIA

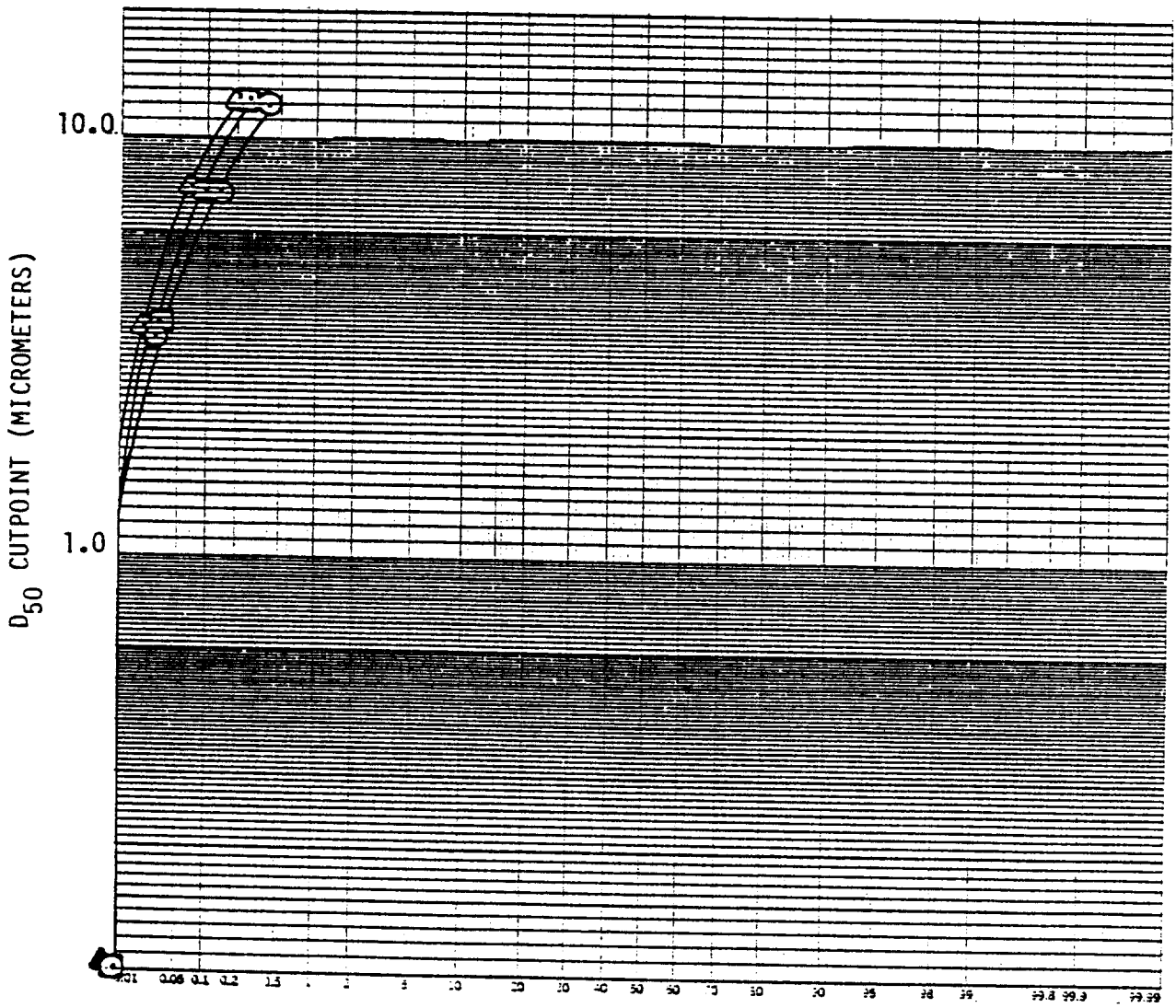
ES Test No.	Sampling Location	Test Date	Test Time	Particulate Concentration grains/dscf**	Aerodynamic* Size Range µm	Mass in Size Range %
AN-Pre-1	Predryer AN	3/29/79	1112-1127	1.47	>11.96	99.6
					7.46-11.96	0.3
					3.43-7.96	0.1
					2.20-3.43	Neg.
					1.09-2.20	-
					0.48-1.09	-
					<0.48	-
AN-Pre-2	Predryer AN	3/29/79	1632-1702	2.08	>12.71	99.8
					7.93-12.71	0.15
					3.66-7.93	Neg.
					2.34-3.66	Neg.
					1.17-2.34	-
					0.52-1.17	-
					<0.52	-
AN Pre-3	Predryer AN	3/29/79	1951-2021	2.07	>12.12	99.7
					7.56-12.12	0.16
					3.48-7.56	0.08
					2.23-3.48	Neg.
					1.11-2.23	Neg.
					0.49-1.11	-
					<0.49	-

* As unit density spheres
** Standard conditions are 20°C and 760 mm Hg.

PARTICLE SIZE DISTRIBUTION

UNION OIL, BREA CA.

AMMONIUM NITRATE PREDRYER



DENSITY = 1.00 gm/cm^3

⊙ AN-PRE-1
△ AN-PRE-2
⊡ AN-PRE-3

PARTICLE SIZE RESULTS, DRYER

Particle size distribution tests were conducted on the dryer exhaust emissions during March 31, 1979. Summaries of the results are presented in Table II-11 and in Figure II-2.

Figure II-2 displays the distribution versus the aerodynamic particle size. These data show that more than 99 percent of the total mass was contained in particles larger than 11.89 μm.

PARTICLE SIZE RESULTS, COOLER

Particle size distribution tests were conducted on the cooler exhaust emissions on March 30, 1979. Summaries of the results are presented in Table II-12 and in Figure II-3.

Figure II-3 presents the distribution versus the aerodynamic particle sizes. These data show that more than 99 percent of the total mass was contained in particles larger than 12.18 μm.

The particle size results reported for the predryer, dryer and cooler show the majority of the particles were collected in the first stage of the impactor. This was due to the large particle size encountered and the limitation of the impactor to fractionate these larger-sized particles.

RELATIVE HUMIDITY AND AMBIENT TEMPERATURE MEASUREMENTS

Relative humidity and ambient temperature measurements were recorded during 15 minute intervals throughout the test periods. These data are summarized in Table II-13.

PROCESS SAMPLE RESULTS, PRE-DRYER, DRYER AND COOLER

Process samples of the unscreened product entering and exiting the predryer, dryer and cooler units were collected during each of the tests. Tables II-14 through II-17 summarize the results of the bulk density and sieve analysis performed on these samples. Union Oil personnel performed ammonium nitrate and ammonia chemical analyses on composites of these samples. These data are not presented in this report as they are considered to be confidential.

TABLE II-11

SUMMARY OF AMMONIUM NITRATE DRYER
PARTICLE SIZING TEST RESULTS
UNION OIL COMPANY, BREA, CALIFORNIA

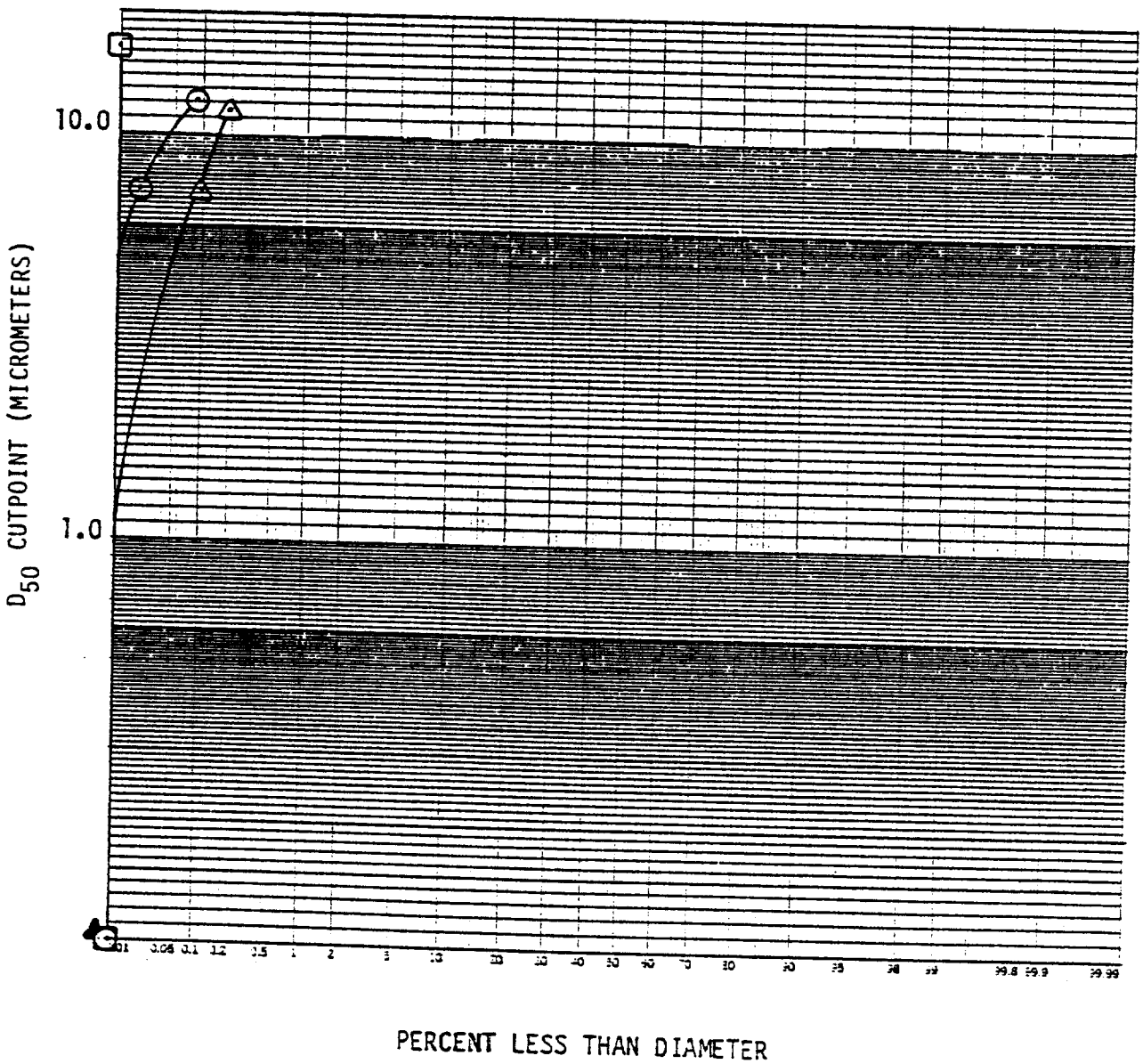
ES Test No.	Sampling Location	Test Date	Test Time	Particulate Concentration grains/dscf**	Aerodynamic* Size Range µm	Mass in Size Range %
AN-D-1	AN Dryer	3/31/79	1007-1022	2.09	>12.03	99.9
					7.50-12.03	Neg.
					3.45-7.50	Neg.
					2.21-3.45	-
					1.09-2.21	-
					0.48-1.09	-
					<0.48	-
AN-D-2	AN Dryer	3/31/79	1203-1233	0.87	>11.89	99.8
					7.41-12.89	0.1
					3.42-7.41	0.1
					2.19-3.42	-
					1.08-2.19	-
					0.48-1.08	-
					<0.48	-
AN-D-3	AN-Dryer	3/31/79	1406-1430	5.12	>16.16	100.00
					10.09-16.16	-
					4.67-10.09	-
					3.00-4.67	-
					1.50-3.00	-
					0.69-1.50	-
					<0.69	-

* As unit density spheres
** Standard conditions are 20°C and 760 mm Hg.

PARTICLE SIZE DISTRIBUTION

UNION OIL, BREA CA.

AMMONIUM NITRATE DRYER



DENSITY = 1.00 gm/cm^3

⊙ AN-DRYER-1
△ AN-DRYER-2
⊡ AN-DRYER-3

TABLE II-12

SUMMARY OF AMMONIUM NITRATE COOLER
PARTICLE SIZING TEST RESULTS
UNION OIL COMPANY, BREA, CALIFORNIA

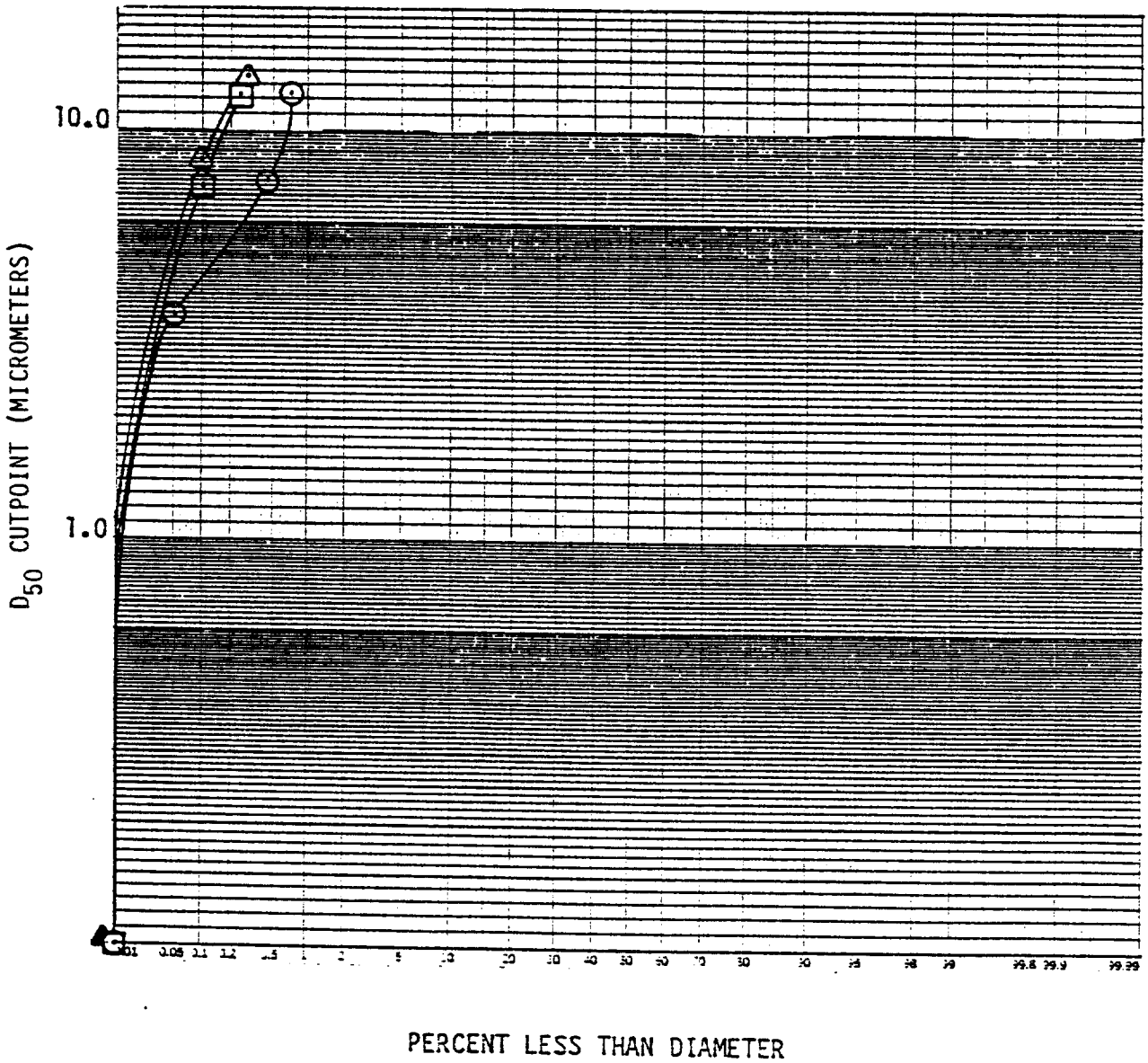
ES Test No.	Sampling Location	Test Date	Test Time	Particulate Concentration grains/dscf**	Aerodynamic* Size Range µm	Mass in Size Range %
AN-C-1	AN Cooler	3/30/79	1239-1305	4.80	>12.58	99.2
					7.85-12.58	0.3
					3.62-7.85	0.4
					2.32-3.62	0.1
					1.15-2.32	-
					0.52-1.15	-
					<0.52	-
AN-C-2	AN Cooler	3/30/79	1528-1556	3.49	>13.94	99.7
					8.70-13.94	0.2
					4.02-8.70	0.1
					2.58-4.02	-
					1.29-2.58	-
					0.59-1.29	-
					<0.59	-
AN-C-3	AN Cooler	3/30/79	1842-1857	2.46	>12.18	99.7
					7.60-12.18	0.2
					3.50-7.60	0.1
					2.24-3.50	Neg.
					1.12-2.24	-
					0.50-1.12	-
					<0.50	-

* As unit density spheres
** Standard conditions are 20°C and 760 mm Hg.

PARTICLE SIZE DISTRIBUTION

UNION OIL, BREA CA.

AMMONIUM NITRATE COOLER



DENSITY = 1.00 gm/cm^3

⊙ AN-COOLER-1
△ AN-COOLER-2
⊡ AN-COOLER-3

TABLE II-13

SUMMARY OF MARCH 29 AND 30, 1979
AMBIENT TEMPERATURE AND RELATIVE HUMIDITY
FOR THE PREDRYER, DRYER AND COOLER
AMMONIUM NITRATE PLANT
UNION OIL COMPANY, BREA, CALIFORNIA

Date	Sampling Time	Ambient Temperature	Relative Humidity
3/29/79	1030	62	55
	1045	64	52
	1100	64	52
	1115	64	52
	1130	64	52
	1145	63	57
	1200	67	50
	1215	68	50
	1230	67	50
	1245	68	50
	1300	69	48
	1315	68	48
	1330	68	50
	1345	67	53
	1400	67	53
	1415	67	53
	1430	66	53
	1445	67	53
	1500	66	53
	1515	67	53
	1530	66	53
	1545	66	53
	1600	67	53
	1715	66	50
	1730	66	53
	1745	66	53
	1800	66	53
	1815	64	58
	1830	64	58
	1845	64	60
	1900	63	62
	1915	62	68

TABLE II-13 (Cont'd.)

SUMMARY OF MARCH 29 AND 30, 1979
AMBIENT TEMPERATURE AND RELATIVE HUMIDITY
FOR THE PREDRYER, DRYER AND COOLER
AMMONIUM NITRATE PLANT
UNION OIL PLANT, BREA, CALIFORNIA

Date	Sampling Time	Ambient Temperature	Relative Humidity
3/30/79	0900	62	64
	0915	64	58
	0930	64	58
	0945	64	56
	1000	66	55
	1015	65	57
	1030	66	55
	1045	66	55
	1100	67	53
	1115	70	50
	1130	67	53
	1145	67	53
	1200	68	56
	1215	67	53
	1230	69	57
	1245	67	62
	1315	69	50
	1330	67	53
	1345	67	50
	1400	68	50
	1415	67	45
	1500	68	49
	1515	69	47
	1545	68	48
	1600	68	48
	1615	68	48
	1630	69	49
	1645	68	50
	1700	68	51
	1715	67	53
	1730	66	55
	1745	65	52
	1800	65	59
	1815	65	59

TABLE II-14

SUMMARY OF MARCH 29 AND 30, 1979 SIEVE AND BULK DENSITY MEASUREMENT ON THE PREDRYER INLET OF THE AMMONIUM NITRATE PLANT UNION OIL COMPANY, BREA, CALIFORNIA

	Predryer Inlet Product Sample #1 Collected @ 1412 on 3/29/79			Predryer Inlet Product Sample #2 Collected @ 1035 on 3/30/79			Predryer Inlet Product Sample #3 Collected @ 1614 on 3/30/79		
	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass
Sieve No. 8	2.4	0.82	100.00	4.0	1.30	100.00	4.1	1.42	100.00
10	13.2	4.46	99.18	17.8	5.78	98.70	15.0	5.23	98.58
12	50.9	17.22	94.72	63.3	20.58	92.92	44.9	15.63	93.35
14	113.3	40.02	77.50	122.2	39.72	72.34	112.3	39.08	77.72
16	78.7	26.62	37.48	65.8	21.29	32.62	74.9	26.07	38.64
20	30.6	10.35	10.86	31.4	10.22	11.23	33.3	11.59	12.57
Bottom	1.5	0.51	0.51	3.1	1.01	1.01	2.8	0.98	0.98
Sum of mass on sieve	290.6			307.6			287.3		
Bulk Density gms per 250 ml	212.5			216.6			215.5		

TABLE II-15

SUMMARY OF MARCH 29 AND 30, 1979 SIEVE AND BULK DENSITY MEASUREMENT ON THE DRYER INLET OF THE AMMONIUM NITRATE PLANT UNION OIL COMPANY, BREA, CALIFORNIA

	Dryer Inlet Product Sample #1 Collected @ 1444 on 3/29/79			Dryer Inlet Product Sample #2 Collected @ 1054 on 3/30/79			Dryer Inlet Product Sample #3 Collected @ 1632 on 3/30/79		
	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass
Sieve No. 8	1.1	0.43	100.00	1.8	0.84	100.00	2.1	0.79	100.00
10	8.0	3.12	99.57	10.3	4.79	99.16	11.8	4.42	99.19
12	34.8	13.57	96.45	40.2	18.71	94.37	38.2	14.32	94.76
14	98.4	38.38	82.88	40.2	41.98	75.66	104.6	39.22	80.41
16	73.0	28.47	44.50	47.2	21.96	33.68	69.1	25.91	41.13
20	37.8	14.74	16.03	21.8	10.14	11.72	36.5	13.69	15.22
Bottom	3.3	1.29	1.29	3.4	1.58	1.58	4.4	1.65	1.66
Sum of mass on sieve	256.4			164.9			266.7		
Bulk Density gms per 250 ml	204.4			194.8			201.2		

TABLE II-16

SUMMARY OF MARCH 29 AND 30, 1979 SIEVE AND BULK DENSITY MEASUREMENT ON THE COOLER INLET OF THE AMMONIUM NITRATE PLANT UNION OIL COMPANY, BREA, CALIFORNIA

	Cooler Inlet Product Sample #1 Collected @ 1512 on 3/29/79			Cooler Inlet Product Sample #2 Collected @ 1115 on 3/30/79			Cooler Inlet Product Sample #3 Collected @ 1648 on 3/30/79		
	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass
Sieve No. 8	1.6	0.53	100.00	1.7	0.78	100.00	2.5	0.94	100.00
10	8.2	2.67	99.47	10.4	4.38	99.22	11.6	4.35	99.06
12	41.0	13.34	96.80	34.5	18.14	94.44	40.0	15.00	94.71
14	113.1	36.82	83.46	87.3	40.10	76.30	97.5	36.57	79.71
16	87.2	28.38	46.64	44.2	20.31	36.20	66.8	25.05	43.14
20	50.4	16.41	18.26	27.2	12.49	15.09	40.0	15.00	18.09
Bottom	5.7	1.85	1.85	7.4	3.40	3.40	8.20	3.09	3.09
Sum of mass on sieve	307.2			212.7			266.6		
Bulk Density gms per 250 ml	200.5			188.3			194.6		

TABLE II-17

SUMMARY OF MARCH 29 AND 30, 1979 SIEVE AND BULK DENSITY MEASUREMENT ON THE COOLER OUTLET OF THE AMMONIUM NITRATE PLANT UNION OIL COMPANY, BREA, CALIFORNIA

	Cooler Outlet Product Sample #1 Collected @ 1532 on 3/29/79			Cooler Outlet Product Sample #2 Collected @ 1634 on 3/30/79			Cooler Outlet Product Sample #3 Collected @ 1704 on 3/30/79		
	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass	Mass gm	% of Total Mass	Cumul. % of Total Mass
Sieve No. 8	1.6	0.62	100.00	2.8	1.14	100.00	3.0	1.08	100.00
10	10.2	3.92	99.38	15.1	6.17	98.86	14.3	5.15	98.91
12	42.1	16.17	95.46	51.2	20.93	92.69	48.2	17.36	93.76
14	102.2	39.26	79.29	101.0	41.26	71.76	102.0	36.74	76.40
16	66.9	25.71	40.03	45.9	18.77	30.50	69.7	25.11	39.66
20	33.8	12.98	14.32	23.9	9.76	11.73	34.7	12.50	14.55
Bottom	3.5	1.34	1.34	4.8	1.97	1.97	5.7	2.05	2.05
Sum of mass on sieve	260.3			244.7			277.6		
Bulk Density gms per 250 ml	189.9			185.8			192.5		

SECTION III

PROCESS DESCRIPTION AND OPERATION

SECTION III

PROCESS DESCRIPTION AND OPERATION

Process Equipment

The ammonium nitrate (AN) solution leaves the neutralizer at a concentration of 83 percent AN. The solution is concentrated to 95 percent in a vacuum evaporator and pumped to a holding tank at the top of the prill tower. From the holding tank, the AN melt flows by gravity to the sprayheads.

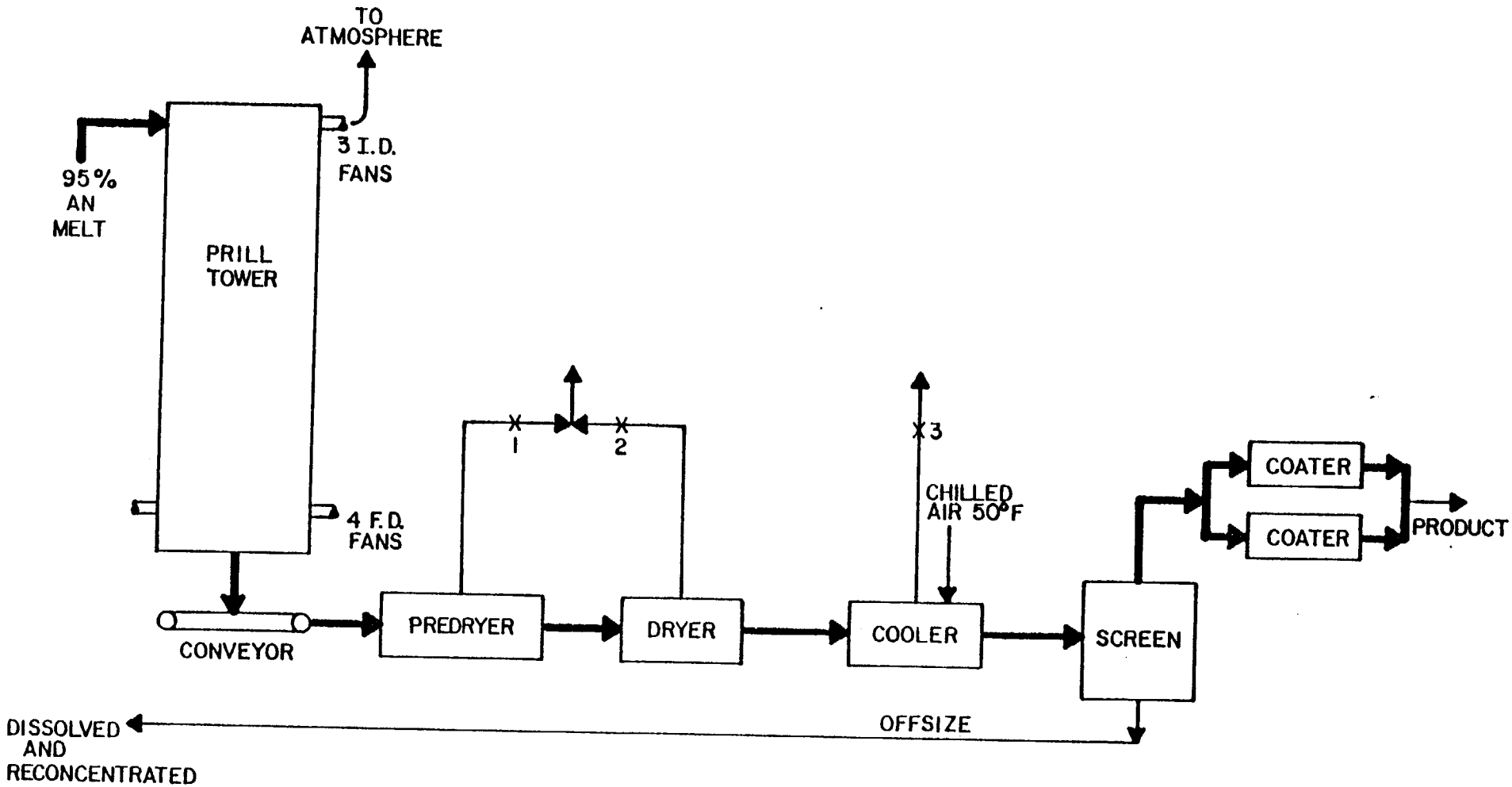
The week before testing, the sprayheads were replaced by a set of larger sized sprayheads. The new sprayheads have twice the diameter of the old sprayheads and, therefore, four times the surface area. These new sprayheads have an estimated production rate of four times that of the old sprayheads, or 32 ton/day per new sprayhead. Production rate is controlled by the number of sprayheads in operation.

The low density prills exit from the bottom of the tower on a conveyor belt and are transferred to the rotary drum predryer. The product leaving the predryer enters the rotary drum dryer and from there passes through the rotary drum cooler. Prills leaving the cooler are screened and transported to a coating drum.

The air stream passing through the cooler is treated with a Sly Scrubber before being released to the atmosphere. The exhaust from the dryer and the predryer are combined and treated by a second Sly Scrubber before being vented to the atmosphere. The exhaust from the top of the prill tower is not treated at this facility.

Figure III-1 depicts the solids formation section of this ammonium nitrate plant. Two coaters are present and each applies a different type of coating; however, only one coater is used at a given time. One coating is for industrial grade product, the other coating is for fertilizer grade product. There is no difference in the low density prills used for the two products, only the coating used on the prills is different.

AMMONIUM NITRATE PROCESS FLOW DIAGRAM
UNION OIL COMPANY OF CALIFORNIA, BREA, CALIFORNIA



SAMPLING POINTS
1. PREDRYER
2. DRYER
3. COOLER

FIGURE III-1

ENGINEERING-SCIENCE, INC.

PROCESS OPERATION

GCA monitored and recorded process equipment parameters while stack sampling was in progress. Sampling was conducted on the uncontrolled exhaust from the predryer, dryer and cooler. Process parameters were carefully monitored and recorded to ensure that sampling was conducted while the ammonium nitrate process was operating at steady state and at a production rate representative of normal operation.

The stack sampling consisted of three mass emissions runs and three particle size runs on the uncontrolled outlet air stream for each of the three rotary drums: i.e., the predryer, the dryer, and the cooler. During testing, 17 parameters were monitored and recorded to insure that testing occurred only while the process was in normal operation. Appendix H contains a copy of the raw data taken during the test period. None of the values recorded at this facility are considered confidential by the plant.

Most of the readings recorded were taken as indicators of process stability during testing. Table III-1 shows how the recorded parameters varied during the three sets of mass emissions runs. A summary of the actual data appears in Table H-1 of Appendix H. The draft setting out of the predryer/dryer and the draft values were constant during testing, both set at 100.

Most of the readings remained relatively constant during testing. The greatest variation was experienced by the draft setting into the predryer, and the draft setting into the dryer. These values reflect the static pressure in the entrance duct to each drum. Variation in these values may reflect variation in air flow rate through the drums. This fact is important to the evaluation of the emission data and therefore deserves attention.

The damper on each drum inlet is seldom changed and airflow should be relatively constant. Fluctuations in the readings for the draft setting into predryer and draft setting into dryer, such as those encountered during the testing, are generally attributed by the plant to malfunctions of the transmitter. A buildup of AN in the pressure tap of these devices can result in readings which are much lower than the actual value. This type of problem can be expected to occur when the plant is experiencing problems of high moisture content in the prills. This condition was experienced throughout

TABLE III-1

AVERAGE VALUES AND RANGES FOR
PROCESS EQUIPMENT OPERATING PARAMETERS
UNION OIL COMPANY, BREA, CALIFORNIA

Parameter	3/29/79 14:09-14:40 18:00-19:30		3/30/79 9:45-14:30		3/30/79 16:40-18:30	
	Mean[a]	Range	Mean	Range	Mean	Range
Air temperature into Predryer	100	98-100	100	100-100	100	100-100
Air temperature out of Predryer	97	97-97	105	97-109	95	94-97
Air temperature into Dryer	105	102-107	98	97-100	97	97-97
Air temperature out of Dryer	98	93-101	102	99-105	99	99-99
Air temperature into Cooler	106	104-108	97	95-97	97	95-97
Air temperature out of Cooler	102	99-103	101	99-103	95	95-95
Temperature of AN to Head Tank	101	100-101	99	98-100	100	108-102
AN Head Tank level	103	98-107	96	93-103	104	98-112
Draft setting into Predryer	113	40-138	83	59-99	117	109-119
Draft setting into Dryer	86	22-111	95	67-111	129	111-133
Percent moisture product from Prill Tower	110	99-125	93	70-118	107	b
Product temperature into Predryer	98	97-100	106	95-110	87	85-89
Product temperature into Dryer	92	90-93	105	102-107	100	99-101
Product temperature into Cooler	102	96-106	101	97-102	96	95-97
Product temperature out of Cooler	100	100-101	100	99-100	99	99-99

a) Ranges and averages are expressed as percentages of the overall time-weighed average values of the three test periods.

b) Only one value taken.

the week of testing as a result of the heavy rains. The transmitter for the draft setting into the predryer had to be repaired Friday morning, March 30. The readings after it was repaired were more stable and after a couple of hours of operation, readings read consistently from 0.5 to 0.6. It therefore appears likely that the fluctuations in readings were caused by instrument error rather than variations in the airflow rates through the dryer and predryer.

Two readings of lesser importance which experienced some variation are Percent Moisture of the product from the cooler, and the Product Temperature into the predryer. It is not known if emission data are significantly affected by fluctuations of this magnitude in these two parameters.

The nine particle size runs were performed between mass emission runs on Thursday and Friday, and between 0945 and 1430 on Saturday. The process was operating normally during these tests, although the production rate on Saturday was somewhat lower than normal. The change in airflow through the predryer on Saturday occurred when no tests were being run on that device. A summary of process data taken over the entire 3 days of Thursday, Friday and Saturday apears in Table H-2 of Appendix H.

Production rates during all three mass emissions runs were in normal range. New sprayheads were installed during the week of March 19, 1979. At the time testing was performed, the throughput of AN melt for these sprayheads had not been determined. The new nozzles had twice the diameter of the old ones and hence four times the surface area. The throughput for the new heads were therefore estimated to be approximately four times that of the old sprayheads, or 32 ton/day per new sprayhead. Plant calculations made subsequent to testing have shown sprayhead throughput to be about 28.6 tons/day. Production rate, based on this value, for Thursday March 29, when seven heads were in operation was approximately 200 tons/day. On Friday March 30, eight heads were in operation during the first test (0945 to 1430), yielding a production rate of approximately 229 tons/day. During the third run, between 1640 and 1830 on March 30, production rate was reduced from eight sprayheads (229 tons/day) to seven sprayheads (200 tons/day). This change occurred at 1730; the mean production rate during this run is 213 tons/day. Production was somewhat lower on Saturday March 31, during the particle size tests. Only six heads were in operation,

corresponding to a production rate of 172 tons/day. A letter confirming these production rates and signed by a representative of the Union Oil Chemical Company appears in Appendix H. Table III-2 below summarizes these rates.

TABLE III-2

AMMONIUM NITRATE PRODUCTION RATE DURING TESTING

Test No.	Date	Time	Sprayheads in Operation	Production Rate (tons/day)
1	3/29/79	1409-1440 1800-1930	7	200
2	3/30/79	0945-1430	8	229
3	3/30/79	1640-1730 1730-1830	8 7	229 200 Mean = 213

SECTION IV

LOCATION OF SAMPLING POINTS

SECTION IV

LOCATION OF SAMPLING POINTS

The outlet ducts of the predryer, dryer and cooler did not have sampling ports located in accordance with EPA Method 1 as specified in the Federal Register, Vol. 42, No. 160. Therefore, additional sampling ports were installed. The location of the ports was determined by locating the port 80% of the total length of straight pipe from the nearest upstream disturbance. Two 4" ports were installed, orientated at a 90° angle to one another. These port locations are presented in Figures IV-1 and IV-2.

As a natural occurrence in the ammonium nitrate plant, a layer of product accumulates in the lower portion of the duct and on the inside walls of the duct. After calculating the sampling point locations in accordance with EPA Method 1, the points located within one inch of the duct wall were not sampled in order to prevent plugging of the sampling probe and pitot tube. The specific procedures used at each sampling site to eliminate the potential plugging problems are discussed in the following subsections.

PREDRYER

The predryer duct was a 158-inch long horizontal duct, 24.25" in diameter. The nearest upstream disturbance was 5.2 pipe diameters. The downstream disturbance was 1.3 pipe diameters. Therefore, in accordance with EPA Method 1, a particulate traverse of 20 points was conducted. The horizontal port was designated "A" and the vertical port was designated "B". Points A-1, A-10, B-11, and B-20 were sampled at a distance of 1 inch from the stack wall. Particle sizing was conducted at point 6 on traverse B (see Figure IV-3).

DRYER

The dryer duct was a 75-inch long horizontal duct, 23.5" in diameter. The nearest upstream disturbance was 2.5 pipe diameters. The downstream disturbance was 0.7 pipe diameters. Therefore, in accordance with EPA Method 1, a particulate traverse of 32 points was required. The horizontal port was designated "A" and the vertical port was designated "B". Particle sizing for the dryer was conducted at point 6 on traverse A (see Figure IV-3).

As a result of accumulated product inside the duct, several points could not be sampled. During the first run, points A-15, A-16, B-1, B-2, B-3, B-4, B-14, B-15, and B-16 were not sampled. The sampling time at points A-14, B-5, and B-13 was increased in proportion to the number of points not sampled. During the second and third runs, points 14, 15, and 16 on both A and B traverses were dropped, resulting in a 26 point traverse. In addition, points B-1 through B-4 were not sampled; instead, five times the normal amount of sampling was conducted at point B-5.

COOLER

The cooler duct was a 176-inch long horizontal duct, 25.25" in diameter. The nearest upstream disturbance was 5.6 pipe diameters. The downstream disturbance was 1.4 pipe diameters. Therefore, in accordance with EPA Method 1, a particulate traverse of 20 points was conducted. The horizontal port was designated "A" and the vertical port was designated "B". Particle sizing was conducted at point 8 on traverse A (see Figure IV-3). Points A-1, A-10, B-11, and B-20 were not sampled. Instead, the adjacent points (A-2, A-9, B-12, and B-19) were sampled for twice the normal time.

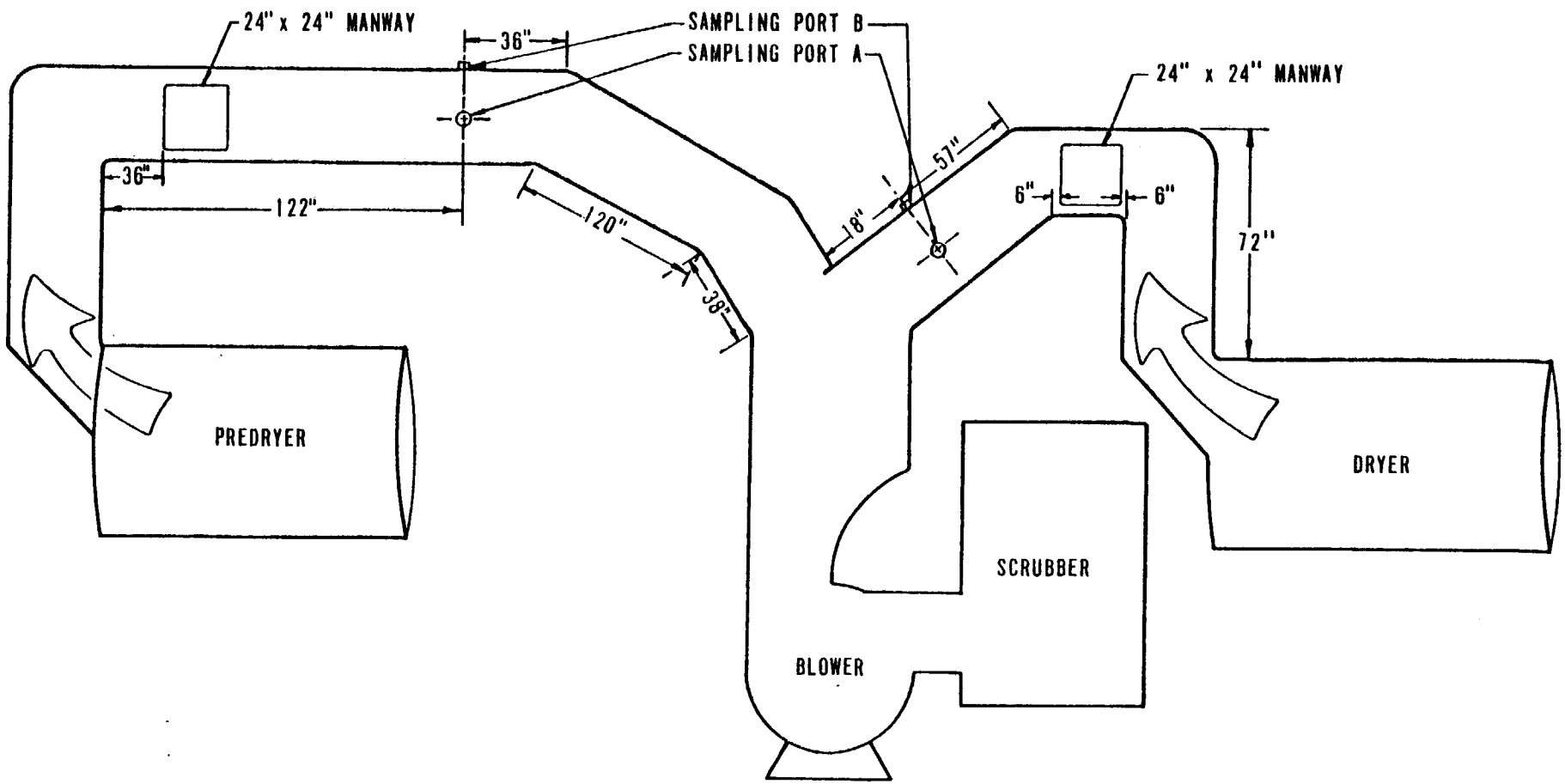
RELATIVE HUMIDITY AND AMBIENT TEMPERATURE

Relative humidity and ambient temperature were recorded at 15-minute intervals throughout the test. These readings were collected by sampling the air at the inlet to the refrigeration unit at the cooler. The ambient air entering the predryer and dryer was assumed to be the same as that entering the cooler refrigeration unit. For the location of the position of data collection, see Figure IV-4.

PRODUCT SAMPLING LOCATION

Composite samples of product were taken at conveyor belts of the predryer-in, dryer-in, cooler-in, and cooler-out. For the different sampling locations see Figure IV-4.

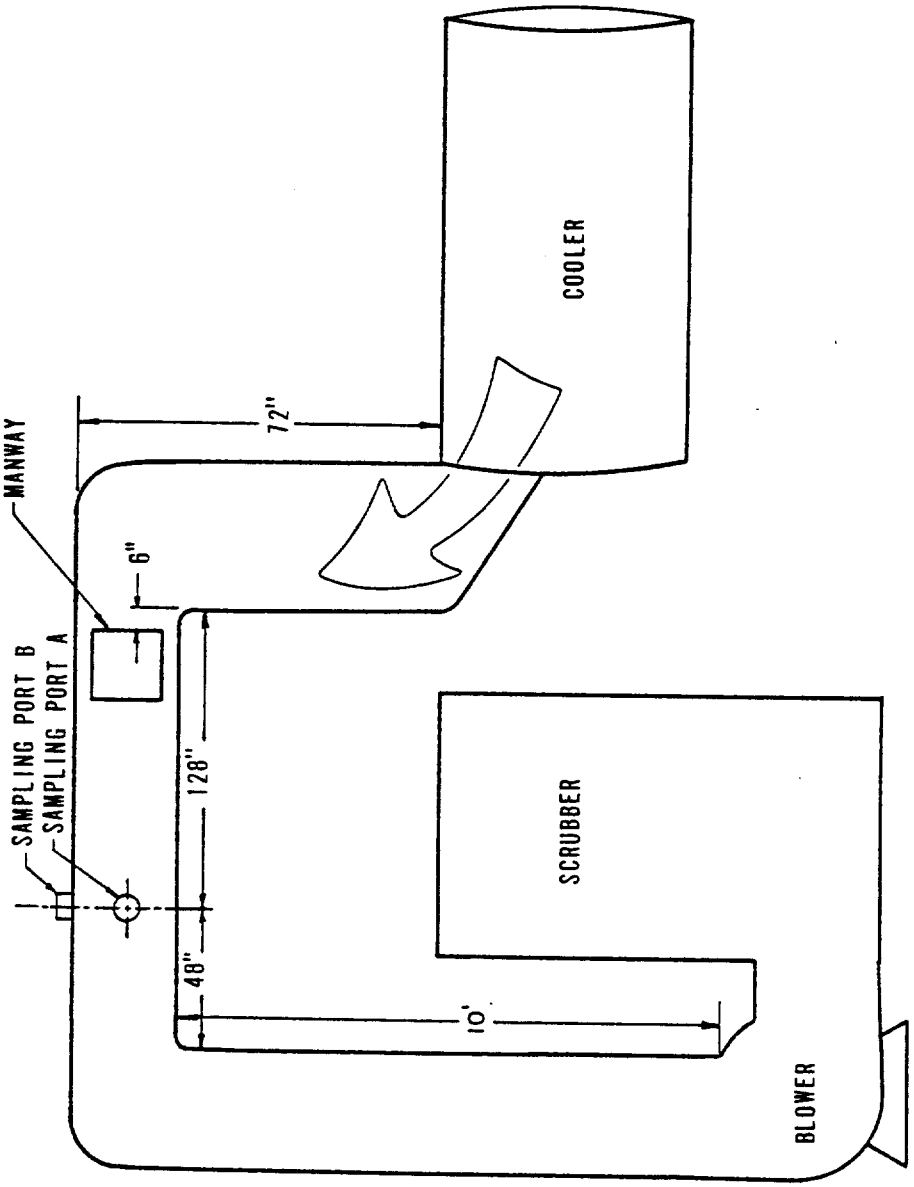
SAMPLING POINT LOCATION
AMMONIUM NITRATE PLANT
UNION OIL, BREA, CALIFORNIA
PREDRYER & DRYER



NOT TO SCALE

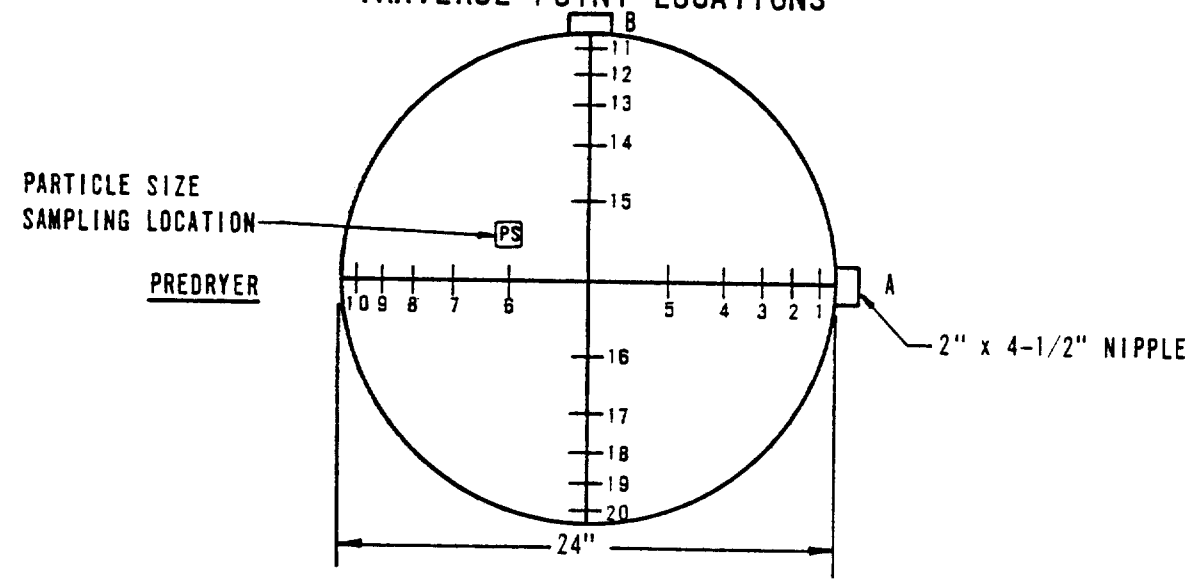
FIGURE IV-1

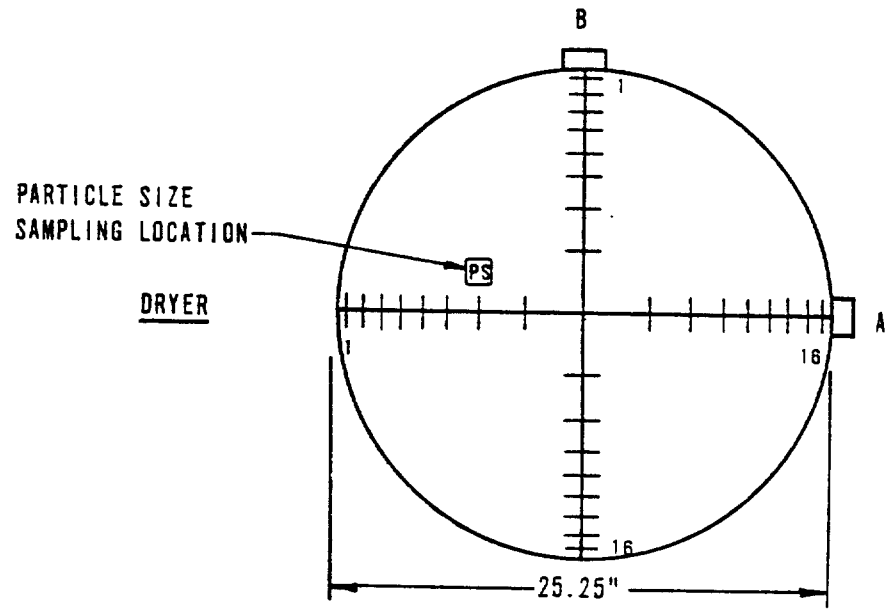
SAMPLING POINT LOCATION
AMMONIUM NITRATE PLANT
UNION OIL, BREA, CALIFORNIA
COOLER

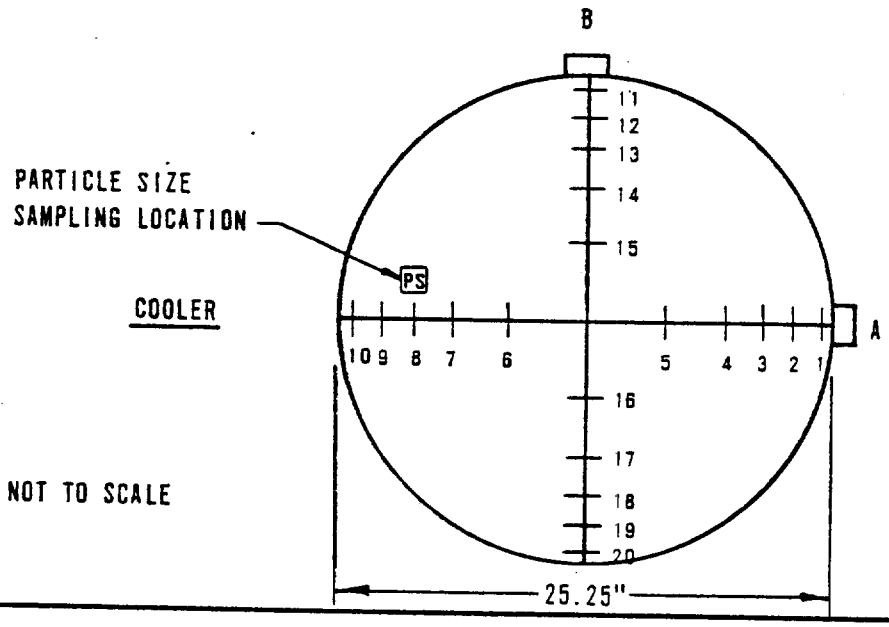


NOT TO SCALE

AMMONIUM NITRATE PLANT CROSS-SECTIONAL TRAVERSE POINT LOCATIONS

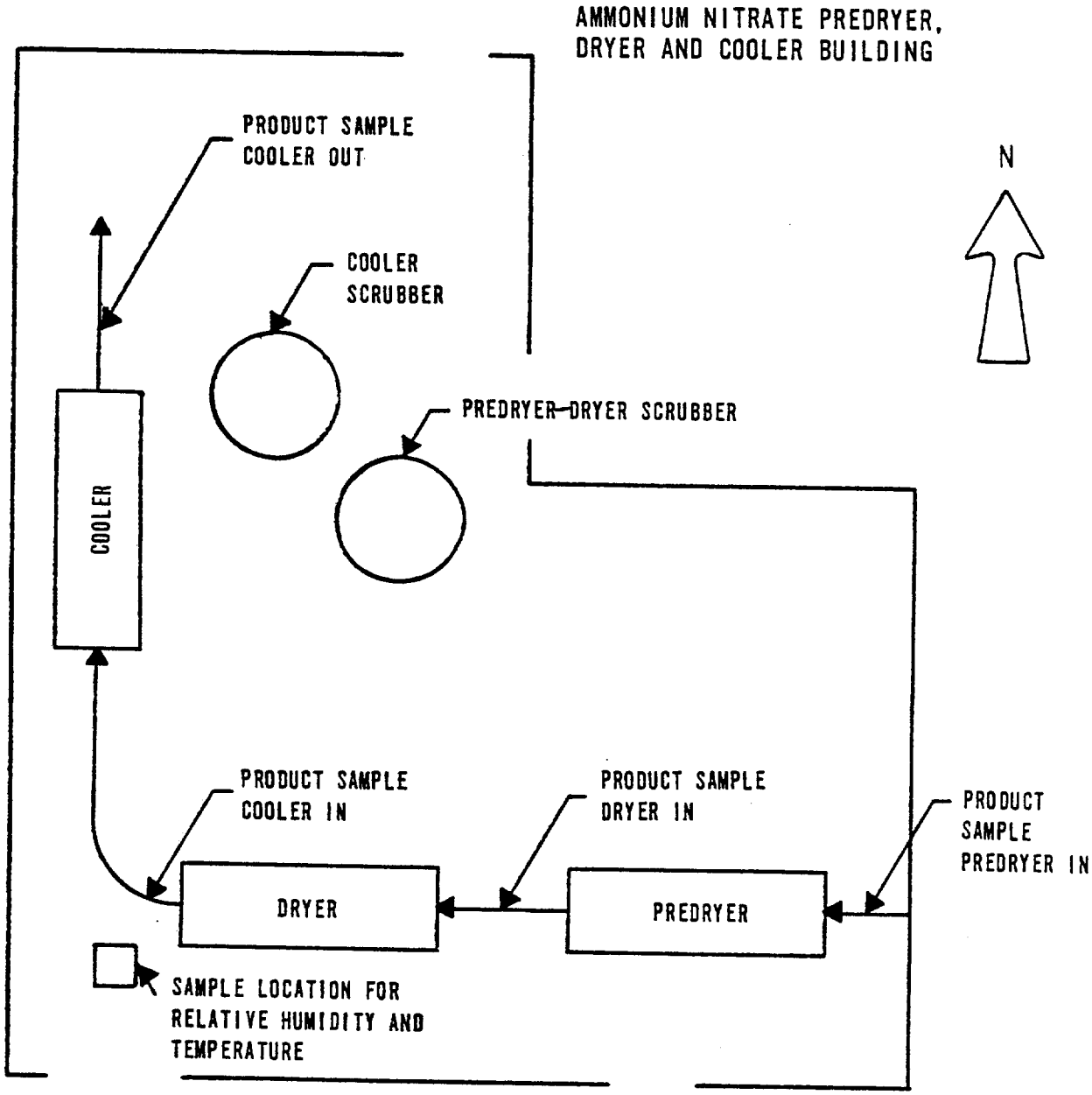






NOT TO SCALE

PRODUCT SAMPLE, RELATIVE HUMIDITY AND TEMPERATURE SAMPLING POINT LOCATION UNION OIL, BREA, CALIFORNIA



NOT TO SCALE

SECTION V

SAMPLING AND ANALYTICAL PROCEDURES

SECTION V

SAMPLING AND ANALYTICAL PROCEDURES

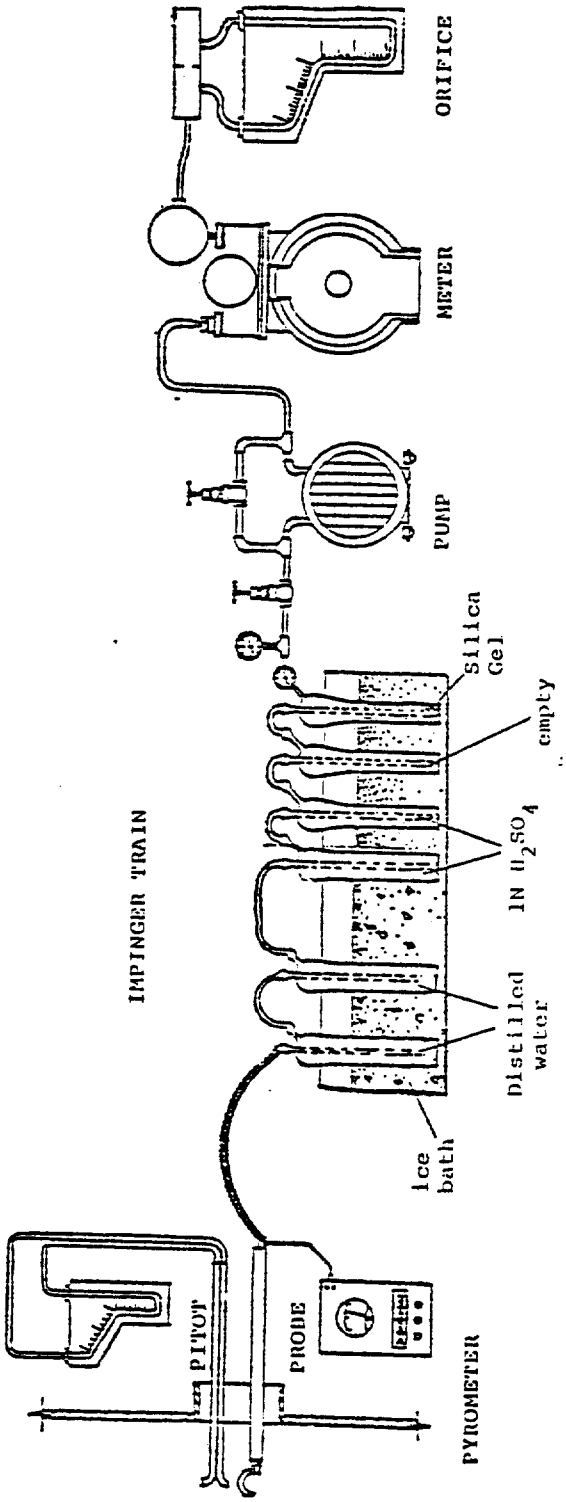
SAMPLING METHODS

Modified Method 5 sampling was conducted concurrently at the outlet ducts of the predryer, dryer and cooler. Traverse points were sampled three minutes per point. A total of 20 traverse points were sampled for the predryer and cooler. At the dryer, 32 traverse points were sampled during the first run, and 26 traverse points were sampled during the second and third runs.

Borosilicate heated glass probes were used for all sampling. Probe liner temperatures were maintained at approximately 10°F above the stack temperature. Between the probe and sample box, an unheated 5/8" OD Teflon® tube was used. The sample box contained six impingers. The second and fourth were Greenburg-Smith impingers, the remainder were 1/2" straight tube impingers with the open end within 1/2" of the bottom of the impinger jar. The first two impingers contained 200 ml deionized-distilled water. The third and fourth contained 200 mls 1N sulfuric acid (1N H_2SO_4). The fifth impinger was dry and the sixth contained 200 gms silica gel. All impingers were contained in an insulated container and kept under ice during sampling. Figure V-1 illustrates the sampling train configuration used.

All sampling was performed isokinetically. Sampling and meter box conditions were recorded every three minutes. During port changes all three sampling trains completed sampling at Port A before starting concurrent sampling at Port B.

Occasionally, plugging of the probe and pitot tube occurred. To dissolve the particulate plugging the probe, it was rinsed with deionized-distilled water after which sampling continued. The rinse water was allowed to flow through the probe and Teflon® tube into the first impinger where it was collected. On the vertical traverse, sampling points were limited by the amount of dust accumulated at the bottom of the duct. The traverse points near the duct walls were not sampled because of product accumulation. In order to prevent nozzle plugging or atypical results, traverse points within one inch of the duct walls were not sampled. To compensate for the unsampled point, the point prior was sampled twice. In some cases more than one point had to be omitted; then the procedure discussed in Section IV was applied.



AMMONIUM NITRATE SAMPLING TRAIN

Several intermediate and final gas meter readings were not recorded on the field data sheets for the dryer sampling. In order to calculate the total volume sampled, the readings were estimated by using the orifice meter equation, the orifice meter calibration, and the recorded orifice meter pressure drop.

SAMPLE CLEAN-UP

At the conclusion of each sample run, the Method 5 sample box, Teflon® tube, and probe for each team were delivered to a mobile field laboratory set-up at the Union Oil plant. During transport from the sampling site to the laboratory, rubber plugs were inserted into all open probes, Teflon® tubes and sample collector openings to prevent loss of sample and contamination.

Two borosilicate glass bottles with Teflon®-lined caps were labeled to identify the sample run, location, date and time. One container was identified as "Container #1" and contained the contents of the first two impingers, along with deionized water washings from the first two impingers, connecting glassware, Teflon® tube, and probe. The second glass container was identified as "Container #2" and contained the contents and rinses of the third, fourth and fifth impingers. All of these rinses were performed using 1N H_2SO_4. The impinger and associated glassware were rinsed three times with the corresponding liquid wash. The impinger tube assembly was not removed from the impinger jar during the clean-up procedures.

The Teflon® tube was washed with three separate deionized-distilled water rinses. A flask was attached to one end of the tube and it was filled with approximately 75 ml of deionized-distilled water. The tube was then washed three times by rinsing the rinse water from one end of the tube to the other. The rinse was then emptied into Container #1 and the procedure repeated two additional times.

The probe was washed with the nozzle attached. Seventy-five ml of rinse water were placed into the same flask used for the teflon tube washings. The rinsing for the probe was performed in the same manner as the teflon tube washings above. In addition to the rinsings, the probe was brushed and rinsed an additional three times to remove all particulates. These additional washups were collected and emptied into Container #1.

The liquid levels in Container #1 and Container #2 were marked and the caps sealed after the clean-up procedure was completed. The containers were then transported to the ES laboratory in Arcadia for analysis.

LABORATORY PROCEDURES FOR AMMONIUM NITRATE

Each AN sample was transported to the lab where they were logged in the lab notebook and measured volumetrically to determine the initial sample volume.

There were two types of sample solutions; deionized-distilled water and one normal sulfuric acid (1N H_2SO_4). The water solutions (referred to as Container #1) contained the in-line glass fiber filter. The sample jar was placed in an ultra sonic bath to dislodge any trapped particulates. The samples were then each filtered through a glass fiber filter and Buchner funnel. These filters were individually placed in plastic petri dishes and dried in a dessicator. Each glass fiber filter was numbered and weighed prior to its use. Once these filters were dry, they were weighed again and the insoluble particulate was determined.

The ammonia analysis was colorimetric, utilizing the Nessler's Reagent. The colorimetric absorbance reading was made on a Bausch and Lomb Spec-20 set at a wavelength of 405 nm. The nitrate analysis was conducted using a specific ion exchange electrode and Orion Model 901 digital readout. The sample solution was mixed with a Teflon® coated magnetic stirrer to ensure uniformity of the solution when the ion exchange probe was used.

All of the results were placed in a hard-bound laboratory notebook. The time, date, barometric pressure and room temperature were recorded at the time of analysis. These notes are reproduced in Appendix D.

PARTICLE SIZE SAMPLING AND ANALYTICAL METHODS

Particle size determinations were done using a six-stage Andersen Mark III high-temperature inertial cascade impactor. Stack gas samples were drawn isokinetically and the particulate was aerodynamically fractionated by size and captured on Andersen glass fiber collection disks. A single jet inertial preimpactor was used on all of the nine tests to minimize large particle bounce and reentrainment in the stages.

Samples were drawn with a standard Method 5 meter box and impinger train. The impactor was mounted on a five foot long threaded steel probe. A preliminary traverse of the duct was conducted, and a point of average velocity determined by the squared mean of the the square roots of the recorded P readings. A single point corresponding to this average velocity was used for sampling. Three tests each were run on the ammonium nitrate predryer at traverse point 6 on the horizontal port, on the AN-dryer at point 7 on the horizontal port, and on the AN-cooler at point 8 on the horizontal port.

All collection substrates were preweighed at the ES, McLean, Virginia laboratory using a Cahn Model 21 electrobalance. Circular aluminum foil disks were cut for each filter and weighed with the filter. Filters were dessicated until two successive weights were obtained with no more than a 0.10 mg difference. The minimum time between successive weighings was 12 hours.

After sampling, the impactor was disassembled and the collection filters folded into the tared aluminum foil liners and stored in individual petri dishes. Particulate adhering to the crossbars, O-rings, and stage plates were brushed onto the appropriate filter. The nozzle, pre-impactor and inlet cone were brushed into tared glass petri dishes. The normal practice of using a solvent wash could not be used for this material due to the hygroscopic nature of the particulate.

Following the completion of the sampling program the samples were returned to the ES, McLean, Virginia laboratory for analysis. Filters were dessicated and weighed using a $\pm$ 0.05 mg dessication criterion. The petri dishes containing the preimpactor catch were weighed to a $\pm$ 0.5 mg criterion. Particle size stage cutpoints were calculated using a modification of EPA program EPA 600/7-78-072 on an IBM 3033 computer. Additional information is located in Appendix B.

BULK DENSITY AND SIEVE ANALYSIS METHODS

Bulk Density

Bulk Density of the ammonium nitrate product was performed on samples taken at the predryer inlet, dryer inlet, cooler inlet, and cooler outlet according to the method listed in Appendix I of this report. Briefly, a 500 ml sample was taken at each of the previously mentioned sites. Each of

these samples was divided into two parts containing 250 ml of product. One half was set aside for sieve analysis (discussed later). The other half was poured through a funnel into a specially prepared, tared 250 ml graduated cylinder. When completely filled, the cylinder was leveled with a straight edge and weighed again. The results were then calculated and recorded. (See Section II and Appendix E.)

Sieve Analysis

Sieve analysis of the ammonium nitrate product was performed according to methods listed in Appendix I on the first half of the samples collected and described above. A 200 gm sample was poured into a nest of sieves, containing No. 8, 10, 12, 14, 20, 30, 40, and 50 mesh screens and shaken for one minute. The nest was then placed on a mechanical shaker and run for five minutes. The material on each screen and bottom pan was then weighed. The results were then calculated and recorded. (See Section II and Appendix E.)

RELATIVE HUMIDITY AND AMBIENT TEMPERATURE

Data were collected for relative humidity and ambient temperature during the course of testing in the ammonium nitrate plant. The data were collected inside the building that contains the predryer, dryer and cooler equipment. The actual location for sampling was within the building and near a larger door (approximately 15 feet wide) in the northwest corner of the building. Two kinds of instruments were used for data collection. For all the reported data a Bendix aspirated wet-dry bulb psychrometer was used. This instrument contains a small fan which passes the ambient air over the wet and dry bulb thermometer. About once per hour the above instrument was compared to the data read from a Bacharach Model 12-7011 mercury sling psychrometer. The data collected are tabulated in Section II and Appendix E.

APPENDIX A

PARTICULATE TEST RESULTS WITH EXAMPLE CALCULATIONS

Part I - Particulate Test Results
Part II - Particulate Calculations Terminology and Nomenclature
Part III - Example Calculations

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - PREDRYER

RUN No. 1

BAROMETRIC PRESSURE (In. Hg)	29.96
AVG. ORIFICE PRESSURE DROP (In. H_2O)	2.74
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	51.035
AVG. METER TEMP. (°F)	95
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	48.93
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	56.24
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.16
TOTAL AREA OF STACK (Ft^2)	3.142
AREA OF BLOCKAGE (Ft^2)	0
NET AREA OF STACK (Ft^2)	3.142
AREA OF NOZZLE (Ft^2)	3.168×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	52.81
AVERAGE STACK GAS TEMPERATURE (°F)	131
ABSOLUTE STACK GAS PRESSURE (In. Hg)	29.82
STACK GAS FLOW RATE (ACFM)(Q_a)	9956
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	8661
NET TIME OF TEST (Min.)	60
STACK DIAMETER (In.)	24
SAMPLING NOZZLE DIAMETER (In.)	0.241
% ISOKINETIC	93.4
PARTICULATE MASS AMMONIA (mg)	111.4
PARTICULATE MASS AMMONIUM NITRATE (mg)	10993
PART. CONC. AMMONIA (gr/SCF)	0.0351
PART. CONC. AMMONIUM NITRATE (gr/SCF)	3.47
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	0.0306
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	3.02
EMISSION RATE AMMONIA (lb/hr)	2.61
EMISSION RATE AMMONIUM NITRATE (lb/hr)	258

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - PREDRYER

RUN No. 2

BAROMETRIC PRESSURE (In. Hg)	30.43
AVG. ORIFICE PRESSURE DROP (In. H_2O)	2.32
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	47.032
AVG. METER TEMP. (°F)	101
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	45.28
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	52.17
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.60
TOTAL AREA OF STACK (Ft^2)	3.142
AREA OF BLOCKAGE (Ft^2)	0
NET AREA OF STACK (Ft^2)	3.142
AREA OF NOZZLE (Ft^2)	3.168×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	50.06
AVERAGE STACK GAS TEMPERATURE (°F)	142
ABSOLUTE STACK GAS PRESSURE (In. Hg)	30.29
STACK GAS FLOW RATE (ACFM)(Q_a)	9431
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	8188
NET TIME OF TEST (Min.)	60
STACK DIAMETER (In.)	24
SAMPLING NOZZLE DIAMETER (In.)	0.241
% ISOKINETIC	91.5
PARTICULATE MASS AMMONIA (mg)	675.7
PARTICULATE MASS AMMONIUM NITRATE (mg)	5877
PART. CONC. AMMONIA (gr/SCF)	0.230
PART. CONC. AMMONIUM NITRATE (gr/SCF)	2.00
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	0.200
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	1.74
EMISSION RATE AMMONIA (lb/hr)	16.1
EMISSION RATE AMMONIUM NITRATE (lb/hr)	140

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - PREDRYER

RUN No. 3

BAROMETRIC PRESSURE (In. Hg)	30.35
AVG. ORIFICE PRESSURE DROP (In. H_2O)	1.17
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	35.083
AVG. METER TEMP. (°F)	98
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	33.77
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	37.97
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.44
TOTAL AREA OF STACK (Ft^2)	3.142
AREA OF BLOCKAGE (Ft^2)	0
NET AREA OF STACK (Ft^2)	3.142
AREA OF NOZZLE (Ft^2)	3.168×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	34.03
AVERAGE STACK GAS TEMPERATURE (°F)	126
ABSOLUTE STACK GAS PRESSURE (In. Hg)	30.21
STACK GAS FLOW RATE (ACFM)(Q_a)	6411
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	5703
NET TIME OF TEST (Min.)	60
STACK DIAMETER (In.)	24
SAMPLING NOZZLE DIAMETER (In.)	0.241
% ISOKINETIC	98.0
PARTICULATE MASS AMMONIA (mg)	2412
PARTICULATE MASS AMMONIUM NITRATE (mg)	5915
PART. CONC. AMMONIA (gr/SCF)	1.10
PART. CONC. AMMONIUM NITRATE (gr/SCF)	2.70
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	0.980
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	2.40
EMISSION RATE AMMONIA (lb/hr)	53.8
EMISSION RATE AMMONIUM NITRATE (lb/hr)	132

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - DRYER

RUN No. 1

BAROMETRIC PRESSURE (In. Hg)	29.96
AVG. ORIFICE PRESSURE DROP (In. H_2O)	1.46
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	61.251
AVG. METER TEMP. (°F)	92
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	58.89
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	69.73
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.07
TOTAL AREA OF STACK (Ft^2)	3.012
AREA OF BLOCKAGE (Ft^2)	0.123
NET AREA OF STACK (Ft^2)	2.889
AREA OF NOZZLE (Ft^2)	3.012×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	40.22
AVERAGE STACK GAS TEMPERATURE (°F)	148
ABSOLUTE STACK GAS PRESSURE (In. Hg)	29.75
STACK GAS FLOW RATE (ACFM)(Q_a)	6974
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	5888
NET TIME OF TEST (Min.)	96
STACK DIAMETER (In.)	23.5
SAMPLING NOZZLE DIAMETER (In.)	0.235
% ISOKINETIC	100.0
PARTICULATE MASS AMMONIA (mg)	154.3
PARTICULATE MASS AMMONIUM NITRATE (mg)	16018
PART. CONC. AMMONIA (gr/SCF)	0.0404
PART. CONC. AMMONIUM NITRATE (gr/SCF)	4.20
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	0.0341
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	3.54
EMISSION RATE AMMONIA (lb/hr)	2.04
EMISSION RATE AMMONIUM NITRATE (lb/hr)	212

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - DRYER

RUN No. 2

BAROMETRIC PRESSURE (In. Hg)	30.43
AVG. ORIFICE PRESSURE DROP (In. H_2O)	1.15
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	42.570
AVG. METER TEMP. (°F)	105
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	40.58
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	48.40
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.51
TOTAL AREA OF STACK (Ft^2)	3.012
AREA OF BLOCKAGE (Ft^2)	0.123
NET AREA OF STACK (Ft^2)	2.889
AREA OF NOZZLE (Ft^2)	3.012×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	34.09
AVERAGE STACK GAS TEMPERATURE (°F)	162
ABSOLUTE STACK GAS PRESSURE (In. Hg)	30.22
STACK GAS FLOW RATE (ACFM)(Q_a)	5913
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	4957
NET TIME OF TEST (Min.)	78
STACK DIAMETER (In.)	23.5
SAMPLING NOZZLE DIAMETER (In.)	0.235
% ISOKINETIC	100.8
PARTICULATE MASS AMMONIA (mg)	8466
PARTICULATE MASS AMMONIUM NITRATE (mg)	22004
PART. CONC. AMMONIA (gr/SCF)	3.22
PART. CONC. AMMONIUM NITRATE (gr/SCF)	8.37
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	2.70
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	7.01
EMISSION RATE AMMONIA (lb/hr)	137
EMISSION RATE AMMONIUM NITRATE (lb/hr)	356

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - DRYER

RUN No. 3

BAROMETRIC PRESSURE (In. Hg)	30.35
AVG. ORIFICE PRESSURE DROP (In. H_2O)	3.12
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	74.587
AVG. METER TEMP. (°F)	107
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	71.03
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	83.50
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.58
TOTAL AREA OF STACK (Ft^2)	3.012
AREA OF BLOCKAGE (Ft^2)	0.123
NET AREA OF STACK (Ft^2)	2.889
AREA OF NOZZLE (Ft^2)	3.012×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	61.45
AVERAGE STACK GAS TEMPERATURE (°F)	151
ABSOLUTE STACK GAS PRESSURE (In. Hg)	30.14
STACK GAS FLOW RATE (ACFM)(Q_a)	10650
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	9060
NET TIME OF TEST (Min.)	78
STACK DIAMETER (In.)	23.5
SAMPLING NOZZLE DIAMETER (In.)	0.235
% ISOKINETIC	96.5
PARTICULATE MASS AMMONIA (mg)	1454
PARTICULATE MASS AMMONIUM NITRATE (mg)	3044
PART. CONC. AMMONIA (gr/SCF)	0.316
PART. CONC. AMMONIUM NITRATE (gr/SCF)	0.661
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	0.269
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	0.563
EMISSION RATE AMMONIA (lb/hr)	24.5
EMISSION RATE AMMONIUM NITRATE (lb/hr)	51.4

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - COOLER

RUN No. 1

BAROMETRIC PRESSURE (In. Hg)	29.96
AVG. ORIFICE PRESSURE DROP (In. H_2O)	1.94
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	45.03
AVG. METER TEMP. (°F)	84
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	43.98
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	49.96
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.10
TOTAL AREA OF STACK (Ft^2)	3.477
AREA OF BLOCKAGE (Ft^2)	0.047
NET AREA OF STACK (Ft^2)	3.430
AREA OF NOZZLE (Ft^2)	3.301×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	40.61
AVERAGE STACK GAS TEMPERATURE (°F)	122
ABSOLUTE STACK GAS PRESSURE (In. Hg)	29.70
STACK GAS FLOW RATE (ACFM)(Q_a)	8358
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	7359
NET TIME OF TEST (Min.)	60
STACK DIAMETER (In.)	25.25
SAMPLING NOZZLE DIAMETER (In.)	0.246
% ISOKINETIC	103.6
PARTICULATE MASS AMMONIA (mg)	124.6
PARTICULATE MASS AMMONIUM NITRATE (mg)	10876
PART. CONC. AMMONIA (gr/SCF)	0.0437
PART. CONC. AMMONIUM NITRATE (gr/SCF)	3.82
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	0.0385
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	3.36
EMISSION RATE AMMONIA (lb/hr)	2.76
EMISSION RATE AMMONIUM NITRATE (lb/hr)	241

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - COOLER

RUN No. 2

BAROMETRIC PRESSURE (In. Hg)	30.43
AVG. ORIFICE PRESSURE DROP (In. H_2O)	2.86
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	54.865
AVG. METER TEMP. (°F)	84
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	54.54
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	61.85
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.64
TOTAL AREA OF STACK (Ft^2)	3.477
AREA OF BLOCKAGE (Ft^2)	0.047
NET AREA OF STACK (Ft^2)	3.430
AREA OF NOZZLE (Ft^2)	3.301×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	51.01
AVERAGE STACK GAS TEMPERATURE (°F)	121
ABSOLUTE STACK GAS PRESSURE (In. Hg)	29.70
STACK GAS FLOW RATE (ACFM)(Q_a)	10507
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	9268
NET TIME OF TEST (Min.)	60
STACK DIAMETER (In.)	25.25
SAMPLING NOZZLE DIAMETER (In.)	0.246
% ISOKINETIC	102.0
PARTICULATE MASS AMMONIA (mg)	4653
PARTICULATE MASS AMMONIUM NITRATE (mg)	13971
PART. CONC. AMMONIA (gr/SCF)	1.32
PART. CONC. AMMONIUM NITRATE (gr/SCF)	3.95
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	1.16
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	3.49
EMISSION RATE AMMONIA (lb/hr)	105
EMISSION RATE AMMONIUM NITRATE (lb/hr)	314

PARTICULATE EMISSION DATA REPORT
UNION OIL COMPANY, BREA, CALIFORNIA

AMMONIA NITRATE - COOLER

RUN No. 3

BAROMETRIC PRESSURE (In. Hg)	30.35
AVG. ORIFICE PRESSURE DROP (In. H_2O)	2.43
VOLUME OF DRY GAS SAMPLED, METER COND. (CF)(V_m)	51.486
AVG. METER TEMP. (°F)	92
VOLUME OF DRY GAS SAMPLED (SCF)(V_{mst})	50.26
% MOISTURE IN STACK GAS	2.24
% DRY GAS IN STACK GAS	97.76
VOLUME OF GAS SAMPLED, STACK CONDITIONS (ACF) (V_{ts})	56.4
AVERAGE PRESSURE OF THE ORIFICE (In. Hg)	30.53
TOTAL AREA OF STACK (Ft^2)	3.477
AREA OF BLOCKAGE (Ft^2)	0.047
NET AREA OF STACK (Ft^2)	3.430
AREA OF NOZZLE (Ft^2)	3.301×10^{-4}
MOLECULAR WEIGHT OF DRY GAS	28.8
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	47.25
AVERAGE STACK GAS TEMPERATURE (°F)	115
ABSOLUTE STACK GAS PRESSURE (In. Hg)	29.70
STACK GAS FLOW RATE (ACFM)(Q_a)	9724
STACK GAS FLOW RATE (DSCFM)(Q_{ds})	8666
NET TIME OF TEST (Min.)	60
STACK DIAMETER (In.)	25.25
SAMPLING NOZZLE DIAMETER (In.)	0.246
% ISOKINETIC	100.4
PARTICULATE MASS AMMONIA (mg)	4526
PARTICULATE MASS AMMONIUM NITRATE (mg)	4778
PART. CONC. AMMONIA (gr/SCF)	1.39
PART. CONC. AMMONIUM NITRATE (gr/SCF)	1.47
PART. CONC. AMMONIA @ STACK COND. (gr/ACF)	1.24
PART. CONC. AMMONIUM NITRATE @ STACK COND. (gr/ACF)	1.31
EMISSION RATE AMMONIA (lb/hr)	103
EMISSION RATE AMMONIUM NITRATE (lb/hr)	109

PARTICULATE CALCULATION TERMINOLOGY AND NOMENCLATURE

Sampling Time, 24-Hour Clock

D_n	Sampling Nozzle Diameter, in.
T_t	Net Time of Test, min.
P_b	Barometric Pressure in. Hg, Absolute
P_m	Average Orifice Pressure Drop, in.
V_m	Volume of Dry Gas Sampled at Meter Conditions, DCF
T_m	Average Gas Meter Temperature, °F
$V_{m_{std}}$	Volume of Dry Gas Sampled at Standard Conditions[a)]
V_w	Total H_2O Collected in Impingers and Silica Gel, ml
V_{wst}	Volume of Water Vapor Collected at Standard Conditions[b)], SCF
%M	Percent Moisture in Stack Gas, by Volume
M_d	Mole Fraction of Dry Gas
MW_d	Molecular Weight of Stack Gas, Dry Basis
MW	Molecular Weight of Stack Gas, Wet Basis
C_p	Pitot Tube Coefficient
T_s	Average Stack Temperature, °F
N_p	Net Sampling Points
P_o	Average Orifice Pressure
P_{std}	Pressure at Standard Conditions, 29.92 in. Hg
P_{st}	Static Pressure of Stack Gas, in. H_2O
P_s	Stack Gas Presure, in. Hg Absolute
V_s	Stack Gas Velocity at Stack Conditions, FPS
A_s	Stack Area, in.^{2}
Q_{ds}	Dry Stack Gas Volumetric Flow Rate at Standard Conditions[c)], DSCFM
Q_a	Stack Gas Volumetric Flow Rate at Stack Conditions, ACFM
%I	Percent Isokinetic
%O	Percent Opacity
V_{sstd}	Stack Gas Velocity at Standard Conditions, SFPS
M_f	Mass of Constituent Analyzed, mg
C_{aw}	Mass Emission in lbs/hr
C_{at}	Grains/ACF
C_{an}	Grains/SCF
Q_s	Stack Gas Flow Rate, Standard Conditions, SCFM
T_{std}	Temperature at Standard Conditions, 528°R
V_{ts}	Total Volume Collected at Stack Conditions

a) Dry standard cubic feet at 68°F, 29.92 in. Hg
b) Standard conditions at 68°F, 29.92 in. Hg
c) Dry standard cubic feet per minute at 68°F, 29.92 in. Hg

EXAMPLE CALCULATIONS

PRE-DRYER - RUN NO. 1

1. CONSTANTS

a.	Stack Diameter (D_s)	24"
b.	Sampling Nozzle Diameter (D_n)	0.241"
c.	Pitot Tube Coefficient (C_p)	0.846

2. OPERATIONAL DATA

a.	Volume of Dry Gas Sampled, Meter Conditions (V_m)	51.035 SCF
b.	Net Time of Test (T_t)	60 min.
c.	Barometric Pressure (P_b)	29.96" Hg
d.	Molecular Weight of Gas (M_w)	28.8
e.	Average Gas Meter Temperature (T_m)	95.2°F
f.	Average Orifice Pressure Drop (P_m)	2.736 in. H_2O
g.	Average Stack Gas Temperature (T_s)	131.4°F
h.	Static Pressure of Stack Gas (P_{st})	-1.9 in. H_2O

3. DERIVED DATA

a. Average Pressure at the Orifice

$$P_o = P_b + \frac{P_m}{13.6} = 29.96 + \frac{2.736}{13.6} =$$ 30.161 in. Hg

b. Absolute Stack Gas Pressure

$$P_s = P_b + \frac{P_{st}}{13.6} = 29.96 + \frac{-1.9}{13.6} =$$ 29.820 in. Hg

c. Average square root of the product of the velocity head (ΔP_s) and the Absolute Stack Temperature (T_s)

$$\Sigma_1^n \frac{\sqrt{\Delta P'_s \times (T_s + 460)}}{n} =$$ 21.397

---

* Sample calculation results may vary slightly from computer calculated data because of intermediate round-off variations

d. Area of Stack

$$A_s = \frac{\pi D_s^2}{4 \times 144} = \frac{(\pi)\ (24)^2}{576} \qquad 3.142\ ft^2$$

e. Area of Nozzle

$$A_n = \frac{\pi D_n^2}{4 \times 144} = \frac{(\pi)\ (0.241)^2}{576} = \qquad 3.168 \times 10^{-4}\ ft^2$$

4. GAS ANALYSIS

a. Volume of Dry Gas Sampled, Standard Conditions

$$V_{m_{std}} = \frac{T_{std}}{P_{std}} \frac{(V_m)\ (P_o)}{(T_m+460)}$$

where T_{std} is the temperature at standard conditions (528°R) and P_{std} is the pressure at standard conditions (29.92 in. Hg).

$$V_{mstd} = \frac{(17.647)\ (51.035)\ (30.161)}{(95.2 + 460)} = \qquad 48.926\ SCF$$

b. Percent Moisture in Stack Gas

Note: A separate moisture run was conducted to determine moisture content.

A moisture content of 2.24 was assumed for all runs.

c. Percent Dry Gas in Stack Gas

$$\%\ V_m = 100 - \%\ M$$

$$\%\ V_m = 100 - 2.24 = \qquad 97.76\%$$

d. Mole Fraction Dry Gas

$$M_d = \frac{\%\ V_m}{100\%}$$

$$M_d = \frac{97.76\%}{100\%} = \qquad 0.9776$$

5. GAS FLOW ANALYSIS

a. Average Stack Velocity

$$V_s = (K_p)(C_p) \frac{\sqrt{(\Delta P_s)\ (T_s + 460)}(avg)}{\sqrt{P_s\ (MW)}}$$

$$V_s = \frac{(85.49)\ (0.846)\ (21.397)}{\sqrt{(29.82)(28.8)}} = \qquad 52.81$$

b. Stack Gas Flow Rate, Stack Conditions

$$Q_a = (60)(V_s)(A_s)$$

$$Q_a = (60)\ (52.81)\ (3.142) = \qquad 9956 \text{ ACFM}$$

c. Stack Gas Flow Rate, Standard Conditions

$$Q_{ds} = (Q_a)\ \left(\frac{T_{std}}{T_s}\right)\ \left(\frac{P_s}{P_{std}}\right)\ (M_d)$$

$$Q_{ds} = (9956)\ \left(\frac{528}{591.4}\right)\ \left(\frac{29.820}{29.92}\right)\ (0.9776) = \qquad 8661 \text{ DSCFM}$$

d. Total Gas Volume Collected, Stack Conditions

$$V_{ts} = \left(\frac{V_{mstd}}{M_d}\right)\ \left(\frac{T_s}{T_{std}}\right)\left(\frac{P_{std}}{P_s}\right)$$

$$V_{ts} = \left(\frac{48.926}{0.9776}\right)\ \left(\frac{591.4}{528}\right)\ \left(\frac{29.92}{29.820}\right) = \qquad 56.244$$

6. CONCENTRATION OF PARTICULATES IN SAMPLE

a. Standard Conditions

NH_3

$$C_{an} = \left(0.01543\right)\ \left(\frac{M_f}{V_{mst}}\right) = \left(0.01543\right)\ \left(\frac{111.4}{48.926}\right) = \qquad 0.03513 \text{ gr/scf}$$

NH_4NO_3

$$C_{an} = (0.01543)\left(\frac{10993}{48.926}\right) = 3.467 \text{ gr/scf}$$

b. Actual Conditions

NH_3

$$C_{at} = (0.01543)\left(\frac{M_f}{V_{ts}}\right) = (0.01543)\left(\frac{111.4}{56.244}\right) = 0.03056 \text{ gr/acf}$$

NH_4NO_3

$$C_{at} = (0.01543)\left(\frac{10993}{56.244}\right) = 3.016 \text{ gr/acf}$$

7. PERCENT ISOKINETIC

$$I = \frac{(T_s)(V_{mstd})(P_{std})(100)}{(T_{std})(V_s)(\theta)(A_n)(P_s)(60)(M_d)}$$

$$= \frac{(0.09450)(T_s)(V_{mstd}}{(P_s)(V_s)(A_n)(\theta)(M_d)}$$

$$= \frac{(0.09450)(591.4)(48.926)}{(29.820)(52.81)(3.168 \times 10^{-4})(60)(0.9776)} = 93.44\%$$

8. EMISSION RATE

a. Total for Run

NH_3

$$C_{aw} = (1.323 \times 10^{-4})\left(\frac{M_f}{V_{mstd}}\right)(Q_{ds})$$

$$= (1.323 \times 10^{-4})\left(\frac{111.4}{48.926}\right)(8661) = 2.609 \text{ lbs/hr}$$

NH_4NO_3

$$C_{aw} = (1.323 \times 10^{-4})\left(\frac{10993}{48.926}\right)(8661) = 257.5 \text{ lbs/hr}$$

9. EXCESS AMMONIA

$$\frac{\text{Moles of } NH_3}{17.032 \text{ (atomic wt } NH_3)} = 80.05 \text{ gm ammonium nitrate/mole} = \text{gms ammonium nitrate}$$

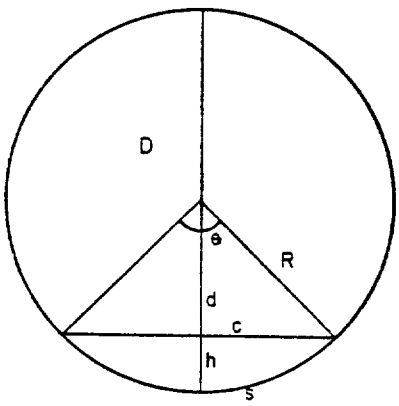
gms ammonium nitrate - total measured nitrate =

ammonium nitrate excess

$$\frac{\text{ammonium nitrate excess}}{80.05} \times 17.032 = \text{excess ammonia}$$

The above example is the method used to calculate excess ammonia. In the pre-dryer the access ammonia was at a negative value and therefore not reported.

10. CALCULATING DUCT AREA OCCUPIED BY DUST FOR DRYER AND COOLER



Example Calculation (Dryer)

D = 23.5" Duct diameter

R = D/2 = 11.75"

h = 2" Depth of Dust on bottom of duct

Find K_{seg} where:

$$K_{seg} = 1/2\ (RS - cd)$$

Unknown: s, c, d, θ

$d = R-h = 11.75-2 = 9.75$

$d = R \text{ Cos } 1/2\ \theta$

$\theta = 2 \text{ Arc Cos } (d/R)$

$\theta = 2 \text{ Arc Cos } \frac{9.75}{11.75} = 2 \text{ Arc Cos } (.83) = 1.18 \text{ radians}$

$s = R \cdot \theta = 11.75 \times 1.18 = 13.87 \text{ inches}$

$c = 2 \cdot R \text{ Sin } \frac{\theta}{2} = 2\ (11.75) \text{ Sin } \frac{1.18}{2} = 13.07 \text{ inches}$

$K_{seg} = 1/2\ (Rs-cd) = 1/2\ [(11.75 \times 13.87) - (13.07 \times 9.75)]$

$= 1/2\ [162.97 - 127.43] = 1/2\ (35.54) = 17.77 \text{ in}^2$

$\text{Area of Duct} = \pi \frac{D^2}{4} = \pi \frac{(23.5)^2}{4} = 433.8 \text{ in}^2$

% of Duct Cross-section occupied by dust

$$1 - \frac{433.8 - 17.8}{433.8} \times 100 = 4.1\%$$

APPENDIX B

PARTICLE SIZE RESULTS

Part I - Discussion
Part II - Computer Printout
Part III - Field Data Sheets
Part IV - Laboratory Weight Sheets

APPENDIX B

PARTICLE SIZE RESULTS

A total of nine particle size determinations were conducted on the ammonium nitrate production areas at Union Oil Co., Brea, California. Triplicate tests were run on the AN pre-dryer, dryer and cooler.

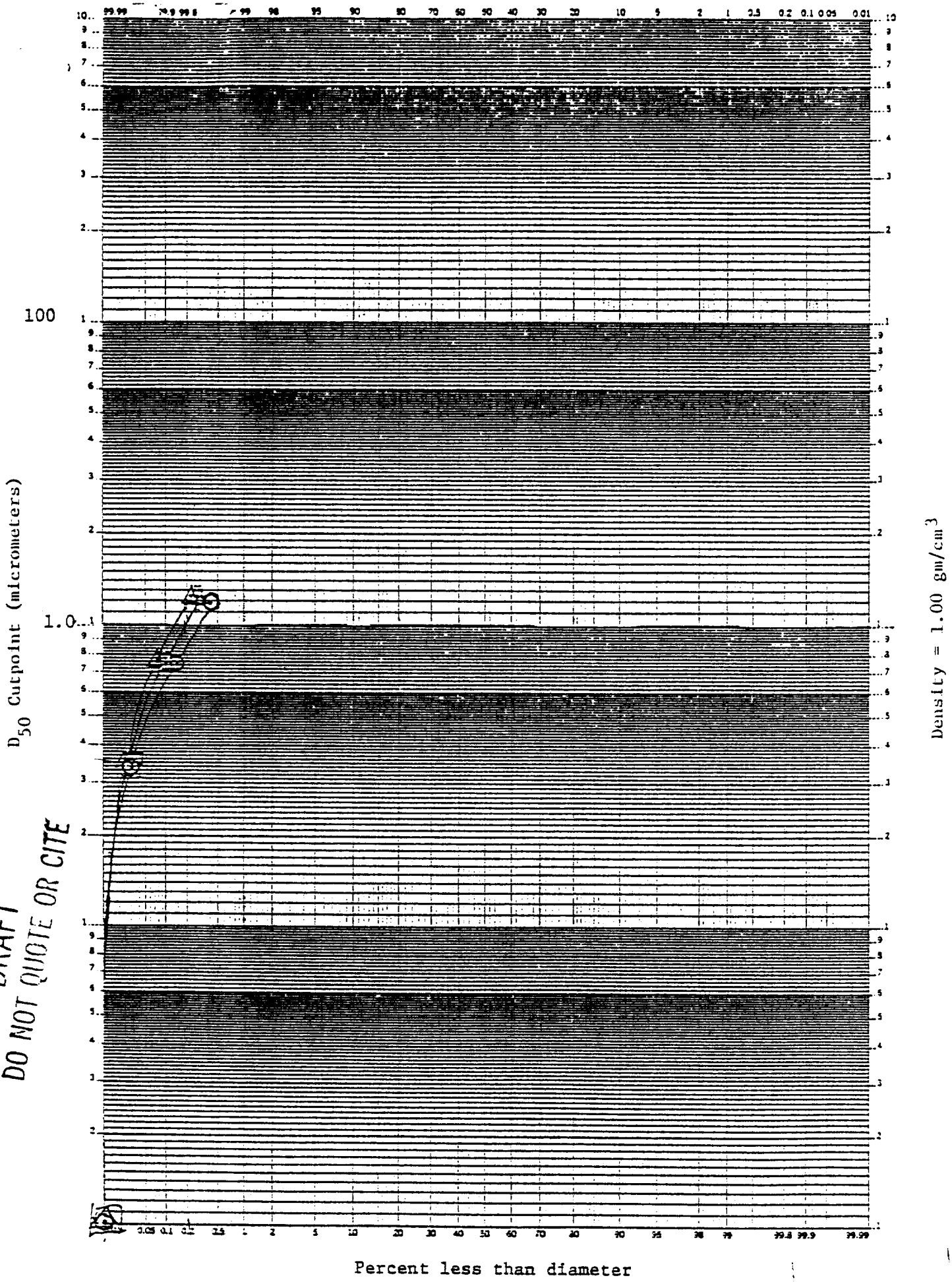
For each run, two computer printouts are presented in Appendix B; the first calculating aerodynamic diameters according to the Task Group on Lung Dynamics (TGLD) definition and a second calculating the physical or Stokes diameters. In the TGLD definition, an assumption of spherical particle shape is made, and the density of the particulate material is assigned a value of 1.00 gm/cm^3; D_{50} cutpoint determinations retain the calculation of Cunningham Slip Factors. In the second set, the physical density of 0.679 gm/cm^3 for ammonium nitrate is utilized, as supplied by Union Oil. The D_{50} calculations again use Cunningham Slip Factors. Constants entered into the calculations include stage hold size, square root of Stokes number, and partial pressure distribution, all obtained as representative values by the impactor manufacturer. The calculations employ determination of gas viscosity using the moisture determinations obtained during the ammonium nitrate/modified Method 5 tests, and an assumption that gas constituents are equal to ambient air. Following standard conventions, the particulate matter catch recovered from the pre-separator is included with the catch of the zero stage.

The results of the nine runs are presented in Figures B-1 through B-9 in three forms: 1) as percent distribution versus aerodynamic particle size; 2) as cumulative mass loading versus D_{50} cutpoint; and 3) as $\Delta M/\log D$ against geometric mean diameter. All data are presented using the TGLD definition of particle size.

In the first case, the plot describes the percent distribution of the particulate loading as a function of the calculated stage cutpoint, following the convention of a log-probability plot. For a given aerodynamic diameter on the ordinant, the percent of the mass loading less than the stated size is related on the absissa.

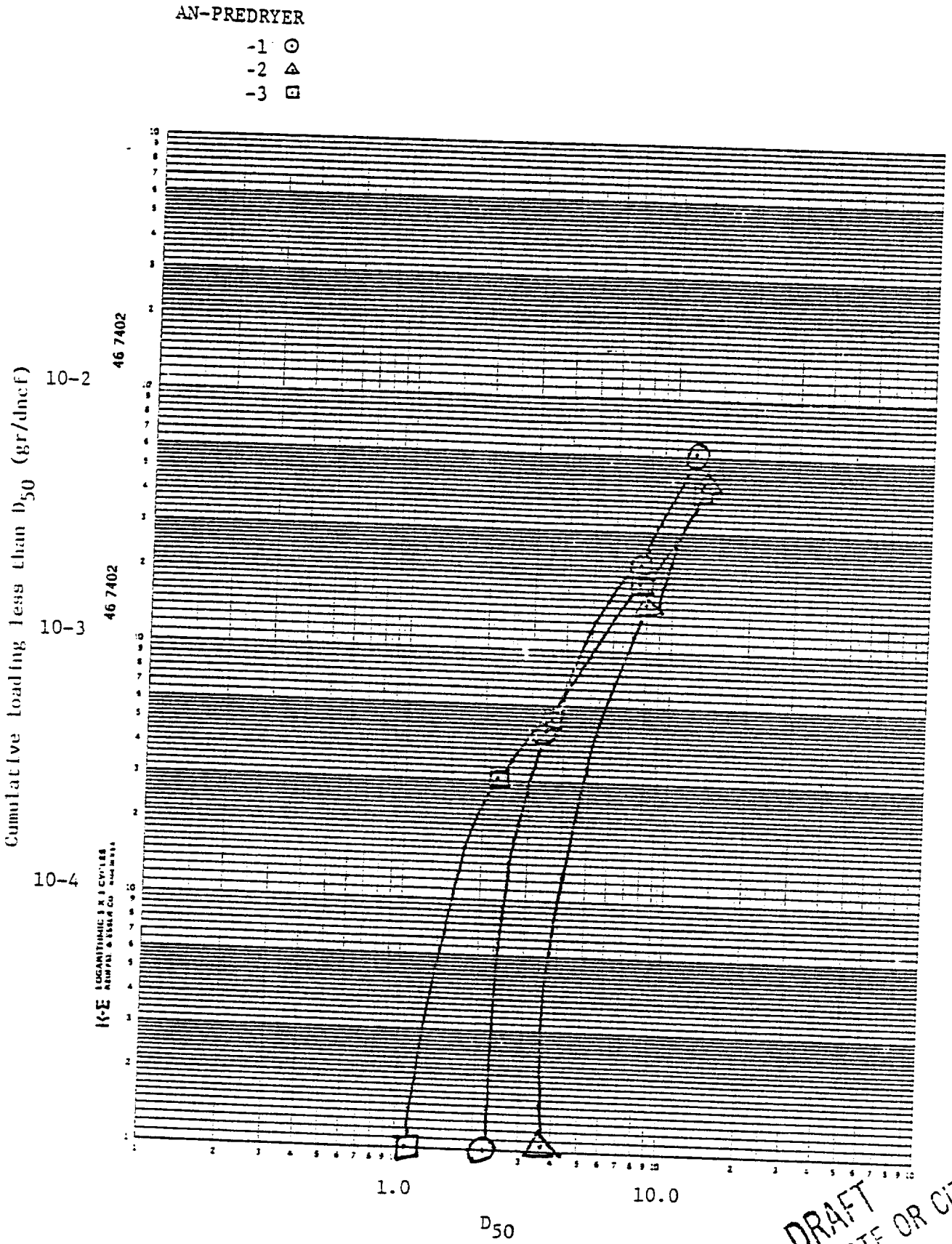
-1 ⊙
-2 △ PRE-DRYER
-3 ⊡

FIGURE B-1



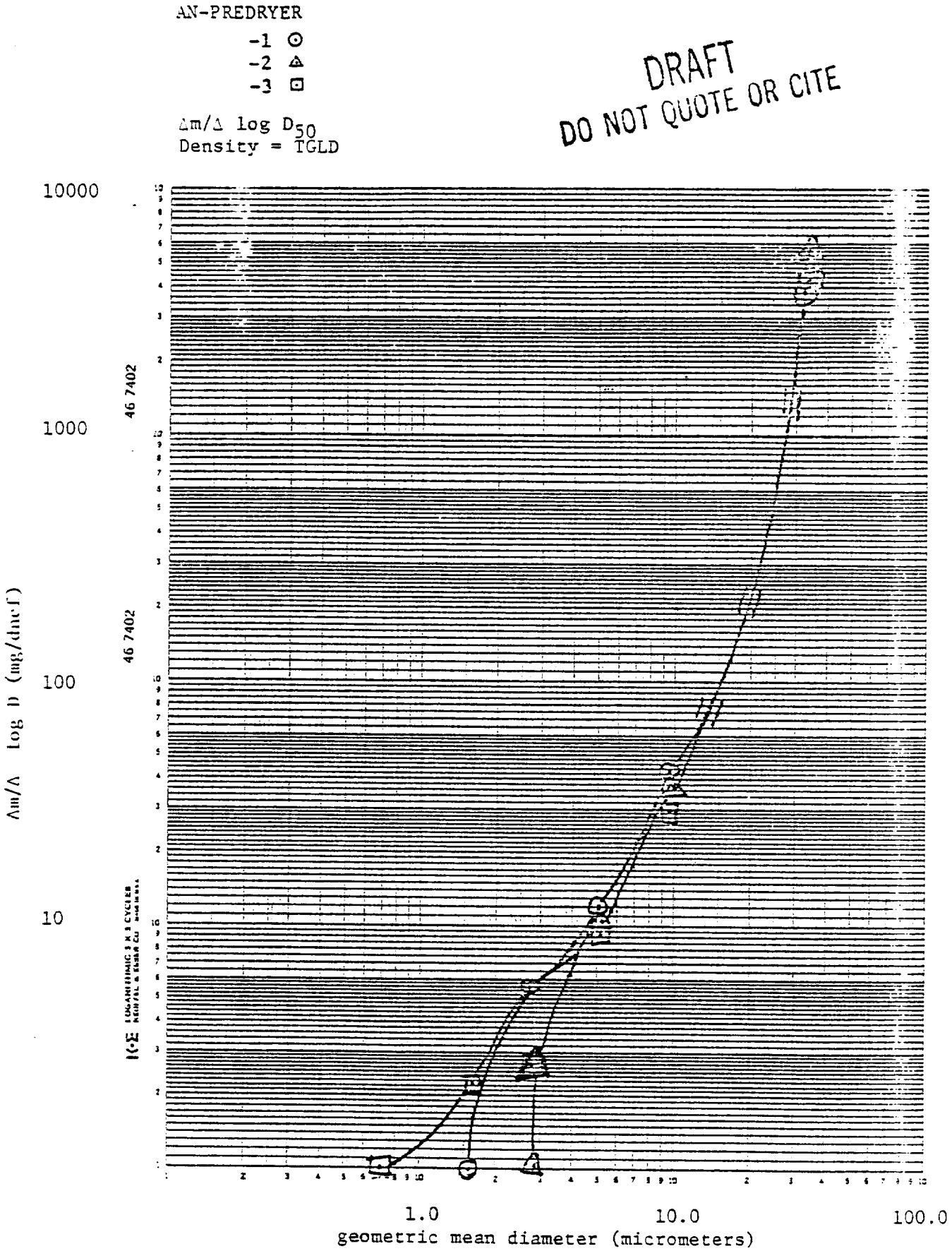
DRAFT
DO NOT QUOTE OR CITE

FIGURE B-2



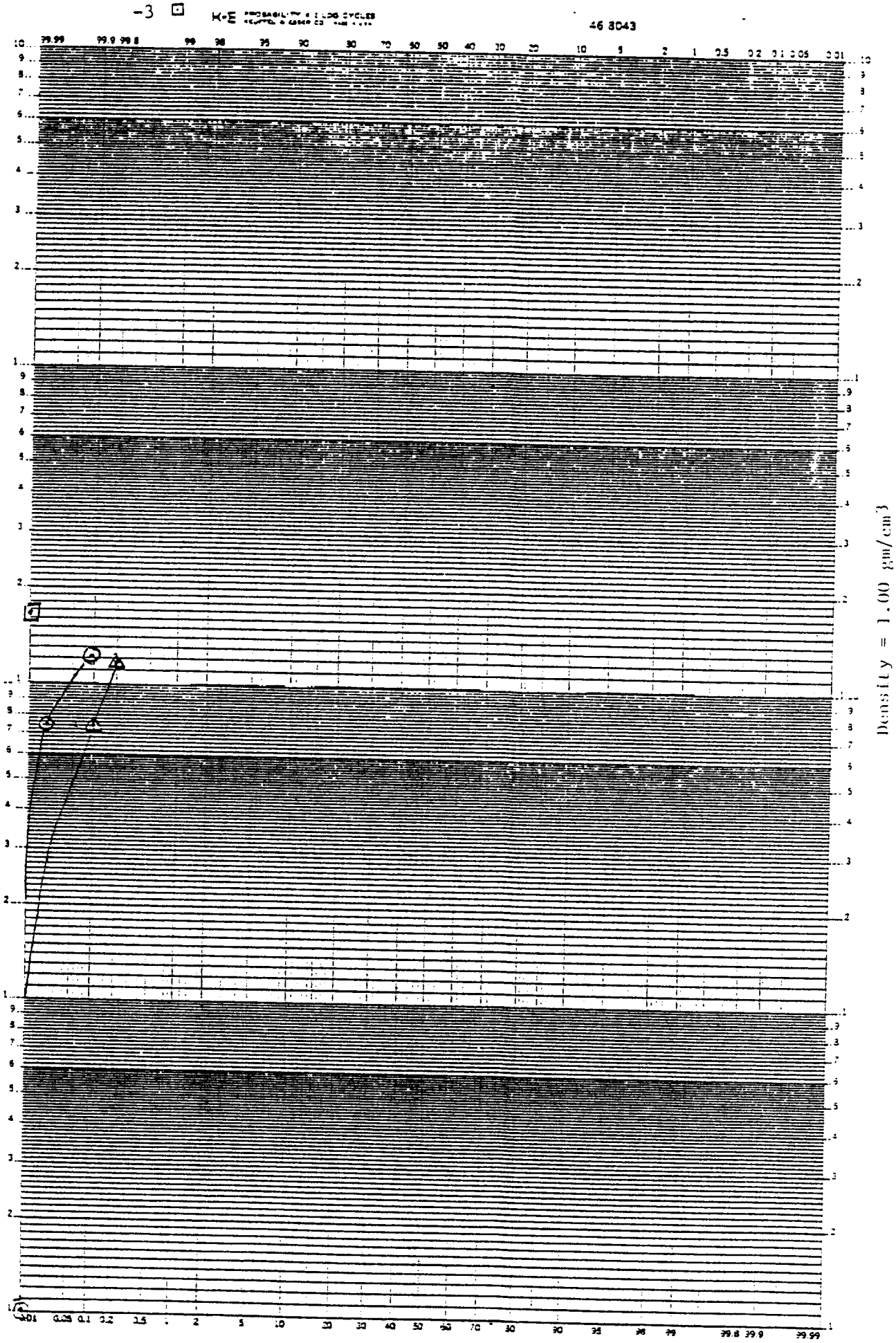
DRAFT
DO NOT QUOTE OR CITE

FIGURE B-3


AN-PREDRYER
-1
-2
-3
Δm/Δ log D50
Density = TGLD
DRAFT
DO NOT QUOTE OR CITE
10000
1000
100
10
Δm/Δ log D (mg/dscf)
46 7402
46 7402
1.0
10.0
100.0
geometric mean diameter (micrometers)

-1 ⊙
-2 △ DRYER
-3 ⊡

FIGURE B-4



DRAFT
DO NOT QUOTE OR CITE

FIGURE B-5

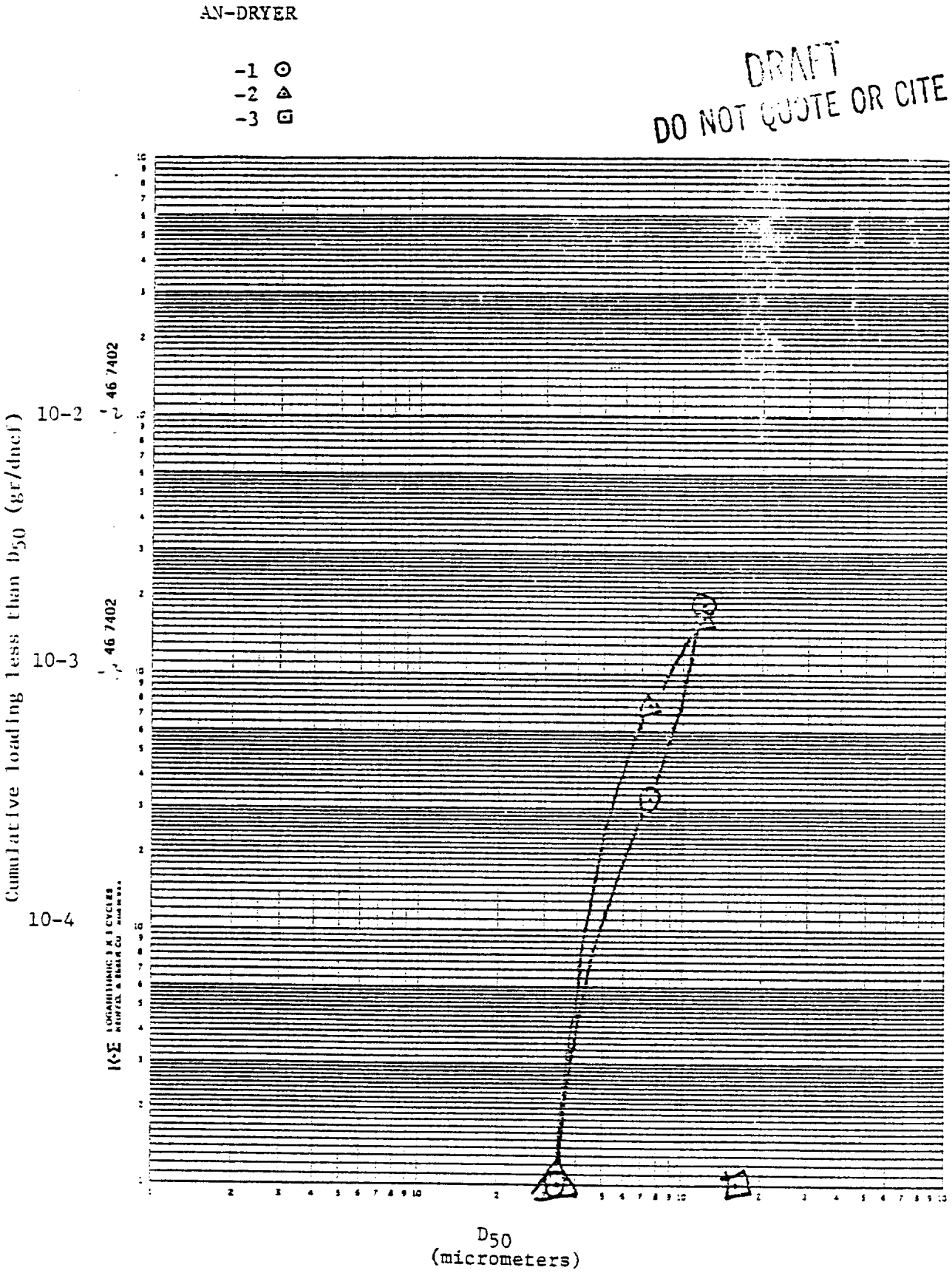
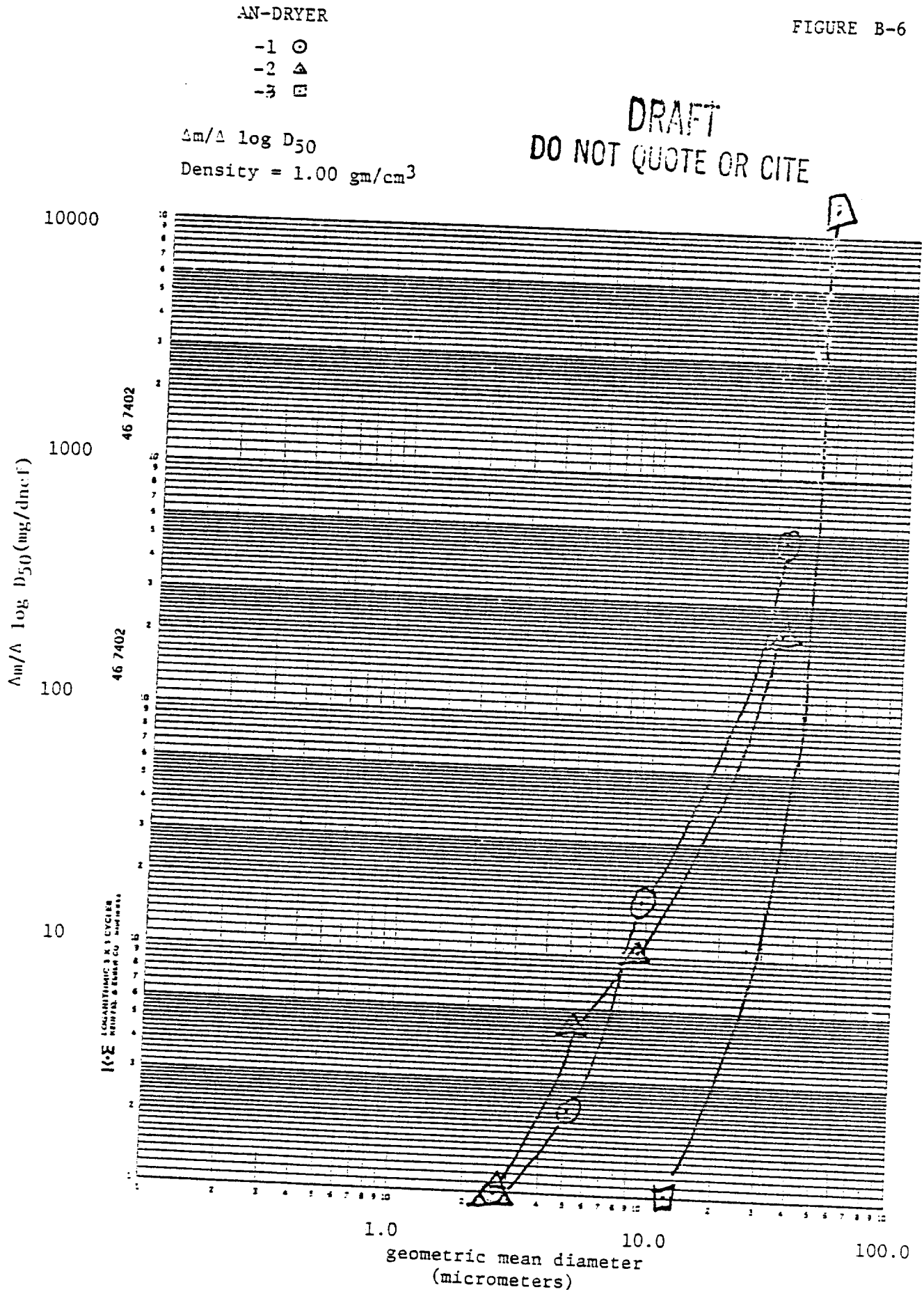

AN-DRYER
-1
-2
-3
DRAFT
DO NOT QUOTE OR CITE
Cumulative loading less than D50 (gr/dncf)
10-2
10-3
10-4
D50
(micrometers)

FIGURE B-6


AN-DRYER
-1
-2
-3
Δm/Δ log D50
Density = 1.00 gm/cm3
DRAFT
DO NOT QUOTE OR CITE
10000
1000
100
10
Δm/Δ log D50 (mg/dncf)
46 7402
46 7402
1.0
10.0
100.0
geometric mean diameter
(micrometers)

-1 ⊙
-2 △ AN-COOLER
-3 ⊡ K-E

FIGURE B-7

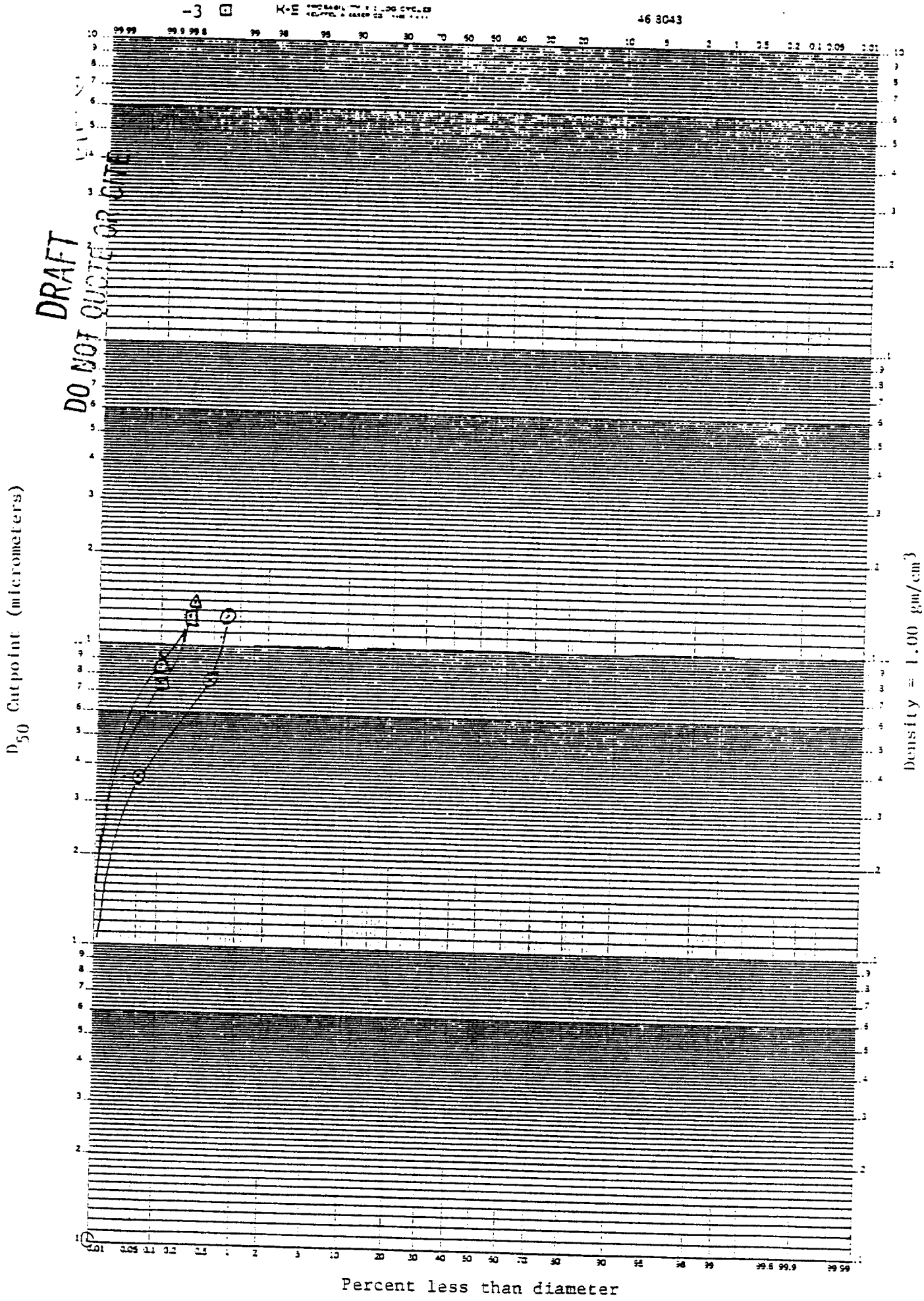


FIGURE B-8

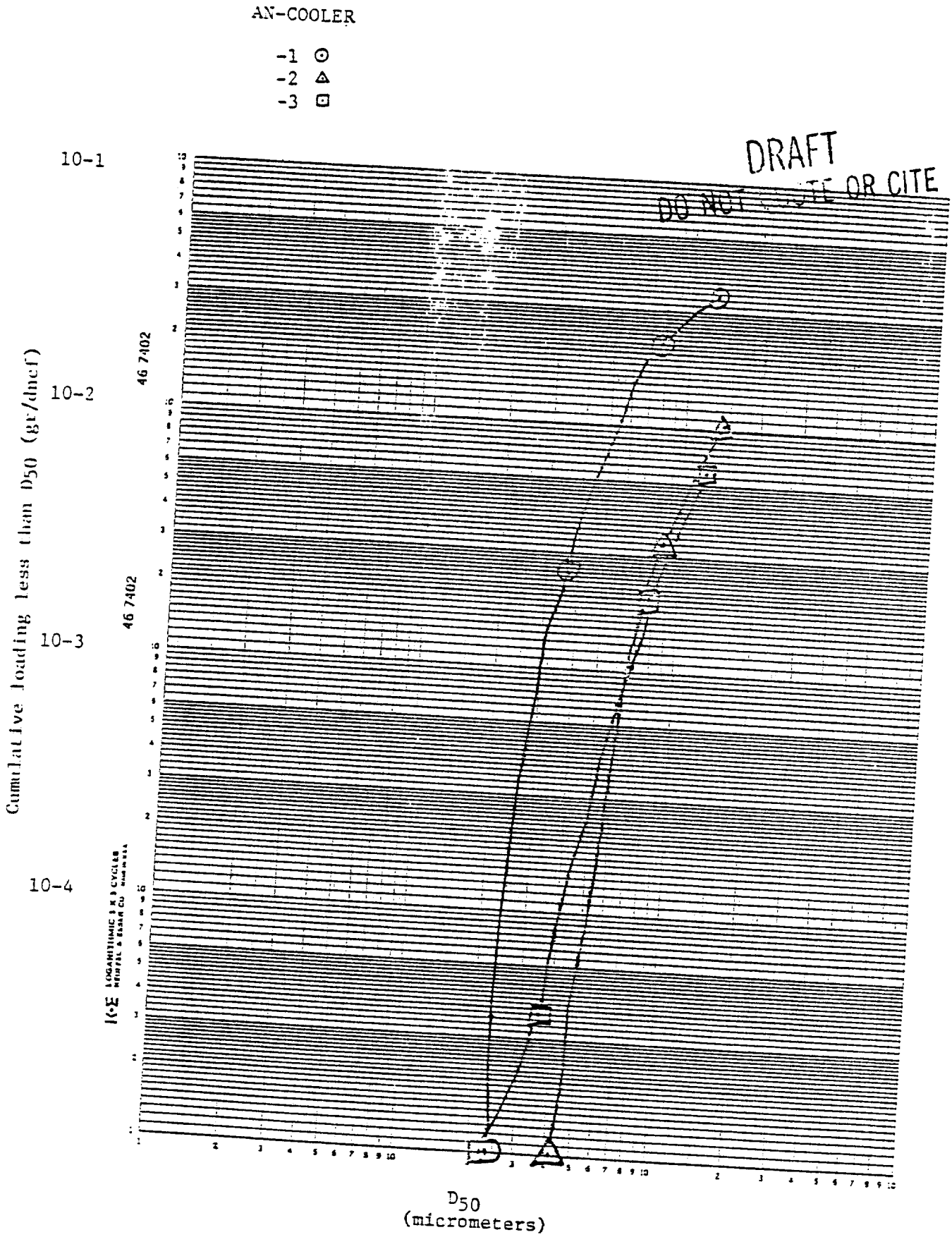
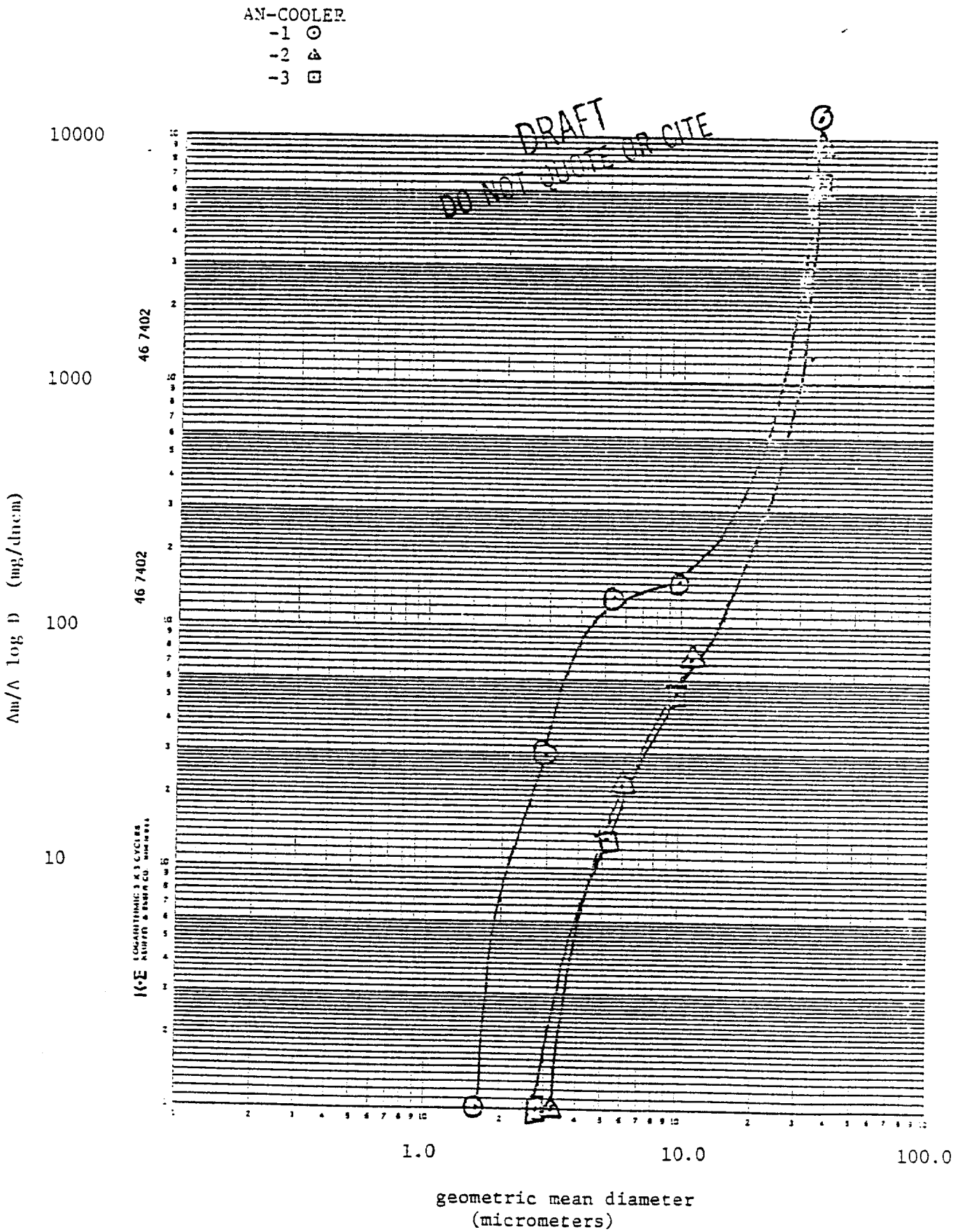

AN-COOLER
-1
-2
-3
DRAFT
DO NOT QUOTE OR CITE
10-1
10-2
10-3
10-4
Cumulative loading less than D50 (gr/dscf)
46 7402
46 7402
D50
(micrometers)

FIGURE B-9


AN-COOLER
-1
-2
-3
DRAFT
DO NOT QUOTE OR CITE
10000
1000
100
10
Am/A log D (mg/dncm)
1.0
10.0
100.0
geometric mean diameter
(micrometers)

The second curve is a function of the cumulative grain loading in GR/DNCF partitioned by what fraction of the total is due to particle sizes up to the stated D_{50} cutpoint. The function can be extended down to a zero particulate concentration at a "zero" micrometer diameter, and should level off at the upper end at the total particulate concentration, at a point roughly equal to the maximum diameter existing in the source. Care should be exercised, however, in assigning a full reliance on the calculated particulate loading values. The sample was taken as a single point estimation of the gas stream, and the sample volumes are much less than those specified by Method 5 of 40 CFR Part 60.

In the third figure, the general shape of the particle size distribution is presented as a plot of $\Delta M/\Delta \log D$ against geometric mean particle diameter, which is a function of the change in mass concentration (presented here as MG/DNCM) due to particles caught on a given stage. The graph can best be viewed as a frequency function with arbitrary units, relating which size ranges of particles contribute to the total mass loading of the source.

Briefly, $\Delta M/\Delta \log D$ is the ratio of the mass loading for each stage in milligrams per dry normal cubic meter over the difference in the common logs of the cutpoint diameter of a given stage and that of the previous stage. The geometric mean diameter is the average of the logs of the maximum and minimum particle sizes found on a stage, calculated as the square root of the minimum cutpoint particle size of a given stage times the minimum cutpoint size of the previous stage. For stage zero, the point of measurement for the largest size observed, the geometric mean is calculated using an arbitrary maximum particle size of 100 micrometers times the lower cutpoint size of the first stage.

Negative weight gains were observed on the collection substrates in all runs conducted on the ammonium nitrate predryer, dryer and cooler, predominantly in the bottom of the stage stack. In that the majority of the total particulate catch occurred in the precollector (about 99%), the weight losses will not significantly disrupt the integrity of the size distribution, but do point to technical problems associated with sampling this material. Nearly all the filters were visually free of impaction spots, even after samples of up to 16 cubic feet. In cases where slight particulate patterns were seen, the weight differentials were either positive, or within the limits of zero. Probably these weights are a combination of particulate loading and filter weight loss, and are therefore inaccurate. The three tests run on the urea cooler later in the test program at Union Oil showed much the same pattern

of a heavy precollector catch and light stage catches, but did not result in the same pattern of filter weight losses. The tentative conclusion, then, is that some component of either the gas or particulate in the ammonium nitrate process acts adversely on glass fiber substrates, and unconditioned filters should not be used in future size measurements of this type of source.

The low weights observed on the first stage suggest that the particle size distribution was significantly higher than the cutpoint of the preseparator. The cutpoint is the aerodynamic diameter at which a 50% collection efficiency is observed. If the size distribution contained particles near this diameter, up to 50% of them would not be collected in the preseparator, and would be entrained down into the stage stack to the first stage, which has a similar but not identical cutpoint. Relative to the preimpactor catch, very little of the material reached any of the stages, implying an almost complete collection efficiency of the preimpactor, which would occur with particles much larger than the cutpoint.

One anomaly observed in the ammonium nitrate tests was the appearance of a very small quantity of dark-colored particulate captured at the 2.2 micron cutpoint in the AN-predryer and at 0.48 and 0.56 micron cutpoint in the AN-dryer, contrasting with the light-colored ammonium nitrate. The quantity was such that the weight of this matter was lost in the filter weight loss, but would have been negligible even without the problem. The chemical structure of this compound is unknown.

Two sampling problems occurred during the tests conducted on the ammonium nitrate cooler. At the onset of AN-C-1 and AN-C-2, high vacuums were encountered. On AN-C-1, although the nozzle appeared free of particulate, the problem was diagnosed as a possible plug, and the sampling point was moved from A-9 to A-8 to be less close to the duct wall. The sample was then run normally, and a time weighted average of the sampling conditions was employed for the data reduction. At the onset of AN-C-2, high initial vacuums resulted in three aborted starts. The assumption is made that the nozzle again became plugged and particulate did not enter the body of the impactor, and these periods are voided from the calculations.

Data reported as grains per dry normal cubic feet (Gr/DNCF) is data that has been corrected to dry conditions, at standard temperature and pressure.

UNION OIL FCCA AN-PREDRYER PARTICLE SIZE RUN #1 3-29-79 1112-1127

IMPACTOR FLOWRATE = 0.551 ACFM

IMPACTOR PRESSURE DROP = 0.7 IN. OF HG

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM.

IMPACTOR TEMPERATURE = 139.0 F = 59.4 C

STACK TEMPERATURE = 139.0 F = 59.4 C

STACK PRESSURE =30.15 IN. OF HG

SAMPLING DURATION = 15.00 MIN

MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 77.38 O2 = 20.71 H2O = 0.92

CALC. MASS LOADING = 1.2940E+00 GR/ACF 1.4751E+00 GR/DNCF 2.9702E+03 MG/ACM 3.3765E+03 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	13.65	8.52	3.93	2.52	1.25	0.56	
MASS (MILLIGRAMS)	792.94	2.07	0.94	0.26	0.0	0.0	0.0
MG/DNCM/STAGE	3.36E+03	8.78E+00	3.99E+00	1.10E+00	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.41	0.15	0.03	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	1.22E+01	4.48E+00	9.70E-01	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	1.39E+01	5.09E+00	1.10E+00	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	5.33E-03	1.96E-03	4.24E-04	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	6.06E-03	2.22E-03	4.82E-04	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.69E+01	1.08E+01	5.78E+00	3.15E+00	1.78E+00	8.40E-01	
DM/DLOGD (MG/DNCM)	3.89E+03	4.26E+01	1.19E+01	5.71E+00	0.0	0.0	3.98E-01
DN/DLOGD (NO. PARTICLES/DNCM)	1.91E+08	8.49E+07	1.52E+08	4.55E+08	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

DEIGN OIL BEA AN-PEEDRYEE PARTICLE SIZE RUN #2 3-29-79 1632-1702

IMPACTOR FLOWRATE = 0.553 ACFM IMPACTOR TEMPERATURE = 129.0 F = 53.9 C SAMPLING DURATION = 30.00 MIN

IMPACTOR PRESSURE DROP = 0.0 IN. OF HG STACK TEMPERATURE = 129.0 F = 53.9 C

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM. STACK PRESSURE = 30.19 IN. OF HG MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 77.38 O2 = 20.71 H2O = 0.92

CALC. MASS LOADING = 1.0623E+00 GR/ACF 2.0779E+00 GR/DNCF 4.2609E+03 MG/ACM 4.7549E+03 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	14.50	9.05	4.18	2.68	1.34	0.61	
MASS (MILLIGRAMS)	1995.62 ******	3.11	1.47	0.01	0.0	0.0	0.0
MG/DNCM/STAGE	4.74E+03	7.35E+00	3.49E+00	2.38E-02	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.23	0.07	0.00	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	9.78E+00	3.15E+00	2.13E-02	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	1.09E+01	3.52E+00	2.38E-02	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	4.27E-03	1.38E-03	9.31E-06	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	4.77E-03	1.54E-03	1.04E-05	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.81E+01	1.15E+01	6.15E+00	3.35E+00	1.90E+00	9.02E-01	4.29E-01
DM/DLOGD (MG/DNCM)	5.66E+03	3.61E+01	1.04E+01	1.23E-01	0.0	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	2.54E+08	5.96E+07	1.11E+08	8.15E+06	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

UNION OIL BREA AN-PREDRYER PARTICLE SIZE RUN #3 3-29-79 1951-2021

IMPACTOR FLOWRATE = 0.008 ACFM

IMPACTOR PRESSURE DROP = 0.7 IN. OF HG

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM.

IMPACTOR TEMPERATURE = 129.1 F = 53.9 C

STACK TEMPERATURE = 129.1 F = 53.9 C

SAMPLING DURATION = 30.00 MIN

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 77.38 O2 = 20.71 H2O = 0.92

STACK PRESSURE = 30.23 IN. OF HG

MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

CALC. MASS LOADING = 1.4344E+00 GR/ACF 1.5988E+00 GR/DNCF 3.2823E+03 MG/ACM 3.6587E+03 MG/DNCM

IMPACTOR STAGE

	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	13.83	8.63	3.98	2.55	1.27	0.57	
MASS (MILLIGRAMS)	1689.66 ******	2.80	1.46	0.24	0.32	0.0	0.0
MG/DNCM/STAGE	3.65E+03	6.05E+00	3.15E+00	5.18E-01	6.91E-01	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.28	0.12	0.03	0.02	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	9.34E+00	3.91E+00	1.08E+00	6.20E-01	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	1.04E+01	4.36E+00	1.21E+00	6.91E-01	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	4.08E-03	1.71E-03	4.74E-04	2.71E-04	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	4.55E-03	1.91E-03	5.28E-04	3.02E-04	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.72E+01	1.09E+01	5.86E+00	3.19E+00	1.60E+00	0.55E-01	4.06E-01
DM/DLOGD (MG/DNCM)	4.25E+03	2.95E+01	9.39E+00	2.69E+00	2.29E+00	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	2.05E+08	5.62E+07	1.16E+08	2.05E+08	9.67E+08	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

UNION OIL BELA AN-COOLER PARTICLE SIZE RUN #1 3-30-79 1239-1305

IMPACTOR FLOWRATE = 0.557 ACFM IMPACTOR TEMPERATURE = 124.1 F = 51.2 C SAMPLING DURATION = 15.50 MIN

IMPACTOR PRESSURE DROP = 0.6 IN. OF HG STACK TEMPERATURE = 124.1 F = 51.2 C

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM. STACK PRESSURE =30.16 IN. OF HG MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 76.23 O2 = 20.40 H2O = 2.40

CALC. MASS LOADING = 4.2[illegible]E+00 GR/ACF 4.8048E+00 GR/DNCF 9.7773E+03 MG/ACM 1.0995E+04 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	14.35	8.56	4.14	2.66	1.33	0.60	
MASS (MILLIGRAMS)	237302 ******	6.72	9.75	1.24	0.0	0.0	0.0
MG/DNCM/STAGE	1.09E+04	3.09E+01	4.48E+01	5.70E+00	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.74	0.46	0.05	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	7.24E+01	4.49E+01	5.07E+00	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	8.14E+01	5.05E+01	5.70E+00	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	3.17E-02	1.96E-02	2.22E-03	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	3.56E-02	2.21E-02	2.49E-03	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.79E+01	1.13E+01	6.09E+00	3.31E+00	1.88E+00	8.93E-01	4.25E-01
DM/DLOGD (MG/DNCM)	1.29E+04	1.51E+02	1.34E+02	2.96E+01	0.0	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	5.91E+08	2.57E+08	1.47E+09	2.02E+09	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

WATER OFF BETA AN-COOLER PARTICLE SIZE RUN #2 3-30-79 1528-1556

IMPACTOR FLOWRATE = 0.451 ACFM IMPACTOR TEMPERATURE = 117.0 F = 47.2 C SAMPLING DURATION = 15.00 MIN

IMPACTOR PRESSURE DROP = 0.1 IN. OF HG STACK TEMPERATURE = 117.0 F = 47.2 C

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM. STACK PRESSURE = 30.11 IN. OF HG MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 76.48 O2 = 20.47 H2O = 2.04

CALC. MASS LOADING = 3.1444E+00 GR/ACF 3.4874E+00 GR/DNCF 7.1954E+03 MG/ACM 7.9805E+03 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	15.91	9.94	4.60	2.95	1.48	0.68	
MASS (MILLIGRAMS)	1372.90 ******	2.63	1.33	0.0	0.0	0.0	0.0
MG/DNCM/STAGE	7.56E+03	1.52E+01	7.71E+00	0.0	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.29	0.10	0.0	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	2.07E+01	6.95E+00	0.0	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	2.30E+01	7.71E+00	0.0	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	9.04E-03	3.04E-03	0.0	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	1.00E-02	3.37E-03	0.0	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.99E+01	1.26E+01	6.76E+00	3.68E+00	2.09E+00	1.00E+00	4.80E-01
DM/DLOGD (MG/DNCM)	9.97E+03	7.45E+01	2.30E+01	0.0	0.0	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	3.90E+08	9.31E+07	1.85E+08	0.0	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

UNION OIL BREA AN-COOLER PARTICLE SIZE RUN #2 3-30-79 1842-1857

IMPACTOR FLOWRATE = 0.568 ACFM IMPACTOR TEMPERATURE = 115.3 F = 46.3 C SAMPLING DURATION = 15.00 MIN

IMPACTOR PRESSURE DROP = 0.7 IN. OF HG STACK TEMPERATURE = 115.3 F = 46.3 C

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM. STACK PRESSURE =30.11 IN. OF HG MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 76.48 O2 = 20.47 H2O = 2.04

CALC. MASS LOADING = 2.2276E+00 GR/ACF 2.4635E+00 GR/DNCF 5.0980E+03 MG/ACM 5.6374E+03 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	13.91	8.68	4.01	2.97	1.28	0.58	
MASS (MILLIGRAMS)	****** 1269.11	2.45	1.02	0.02	0.0	0.0	0.0
MG/DNCM/STAGE	5.02E+03	1.09E+01	4.52E+00	8.86E-02	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.27	0.08	0.00	0.0	0.0	0.0	
CUM. (MG/ACF) SMALLER THAN D50	1.40E+01	4.17E+00	8.01E-02	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	1.55E+01	4.61E+00	8.86E-02	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	6.11E-03	1.82E-03	3.50E-05	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	6.76E-03	2.01E-03	3.87E-05	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.73E+01	1.10E+01	5.90E+00	3.21E+00	1.82E+00	9.63E-01	4.10E-01
DM/DLOGD (MG/DNCM)	6.56E+03	5.30E+01	1.35E+01	4.60E-01	0.0	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	3.14E+08	9.93E+07	1.63E+08	3.45E+07	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

UNION OIL AREA AN-OXYGEN PARTICLE SIZE RUN #1 3-31-79 1007-1022

IMPACTOR FLOWRATE = 0.031 ACFM IMPACTOR TEMPERATURE = 160.0 F = 71.1 C SAMPLING DURATION = 15.00 MIN

IMPACTOR PRESSURE DROP = 0.7 IN. OF HG STACK TEMPERATURE = 160.0 F = 71.1 C

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM. STACK PRESSURE =30.18 IN. OF HG MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 75.41 O2 = 20.18 H2O = 3.45

CALC. MASS LOADING = 1.7315E+00 GR/ACF 2.0881E+00 GR/DNCF 3.9624E+03 MG/ACM 4.7783E+03 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	13.71	8.57	3.95	2.53	1.26	0.56	
MASS (MILLIGRAMS)	1061.38 ******	0.78	0.17	0.0	0.0	0.0	0.0
MG/DNCM/STAGE	4.77E+03	3.51E+00	7.65E-01	0.0	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.09	0.02	0.0	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	3.54E+00	6.34E-01	0.0	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	4.27E+00	7.65E-01	0.0	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	1.55E-03	2.77E-04	0.0	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	1.87E-03	3.34E-04	0.0	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.71E+01	1.08E+01	5.82E+00	3.16E+00	1.79E+00	8.45E-01	3.99E-01
DM/DLOGD (MG/DNCM)	5.54E+03	1.71E+01	2.28E+00	0.0	0.0	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	2.70E+08	3.33E+07	2.87E+07	0.0	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

UNION OIL DEA AN-DRYER PARTICLE SIZE RUN #2 3-31-79 1203-1233

IMPACTOR FLOWRATE = 0.642 ACFM IMPACTOR TEMPERATURE = 139.9 F = 59.9 C SAMPLING DURATION = 30.00 MIN

IMPACTOR PRESSURE DROP = 0.7 IN. OF HG STACK TEMPERATURE = 139.9 F = 59.9 C

ASSUMED PARTICLE DENSITY = 0.77 GM/CU.CM. STACK PRESSURE =20.18 IN. OF HG MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 75.41 O2 = 20.18 H2O = 3.45

CALC. MASS LOADING = 7.5306E-01 GR/ACF 8.7517E-01 GR/DNCF 1.7164E+03 MG/ACM 2.0027E+03 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	13.57	8.47	3.91	2.50	1.25	0.56	
MASS (MILLIGRAMS)	919.15	0.97	0.81	0.0	0.0	0.0	0.0
MG/DNCM/STAGE	2.00E+03	2.11E+00	1.76E+00	0.0	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	0.19	0.09	0.0	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	3.32E+00	1.51E+00	0.0	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	3.87E+00	1.76E+00	0.0	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	1.45E-03	6.60E-04	0.0	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	1.69E-03	7.70E-04	0.0	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	3.68E+01	1.07E+01	5.75E+00	3.13E+00	1.77E+00	8.35E-01	3.96E-01
DM/DLOGD (MG/DNCM)	2.30E+03	1.03E+01	5.24E+00	0.0	0.0	0.0	0.0
DN/DLOGD (NO. PARTICLES/DNCM)	1.14E+08	2.08E+07	6.85E+07	0.0	0.0	0.0	0.0

NORMAL (ENGINEERING STANDARD) CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ALL CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

UNION OIL PREA AN-DRYER PARTICLE SIZE RUN #3 3-31-79 1406-1430

IMPACTOR FLOWRATE = 0.341 ACFM

IMPACTOR TEMPERATURE = 134.6 F = 57.0 C

SAMPLING DURATION = 24.00 MIN

IMPACTOR PRESSURE DROP = 0.[illegible] IN. OF HG

STACK TEMPERATURE = 134.6 F = 57.0 C

ASSUMED PARTICLE DENSITY = 3.77 GM/CU.CM.

STACK PRESSURE =30.18 IN. OF HG

MAX. PARTICLE DIAMETER = 100.0 MICROMETERS

GAS COMPOSITION (PERCENT) CO2 = 0.00 CO = 0.00 N2 = 75.41 O2 = 20.18 H2O = 3.45

CALC. MASS LOADING = 4.4278E+00 GR/ACF 5.1206E+00 GR/DNCF 1.0132E+04 MG/ACM 1.1718E+04 MG/DNCM

IMPACTOR STAGE	S0	S1	S2	S3	S4	S5	FILTER
STAGE INDEX NUMBER	1	2	3	4	5	6	7
D50 (MICROMETERS)	18.44	11.52	5.33	3.43	1.73	0.80	
MASS (MILLIGRAMS)	2348.10	0.0	0.0	0.0	0.0	0.0	0.0
MG/DNCM/STAGE	******	0.0	0.0	0.0	0.0	0.0	0.0
CUM. PERCENT OF MASS SMALLER THAN D50	1.17E+04	0.0	0.0	0.0	0.0	0.0	
CUM. (MG/ACM) SMALLER THAN D50	0.0	0.0	0.0	0.0	0.0	0.0	
CUM. (MG/DNCM) SMALLER THAN D50	0.0	0.0	0.0	0.0	0.0	0.0	
CUM. (GR/ACF) SMALLER THAN D50	0.0	0.0	0.0	0.0	0.0	0.0	
CUM. (GR/DNCF) SMALLER THAN D50	0.0	0.0	0.0	0.0	0.0	0.0	
GEO. MEAN DIA. (MICROMETERS)	0.0	0.0	0.0	0.0	0.0	0.0	
DM/DLOGD (MG/DNCM)	4.29E+01	1.46E+01	7.84E+00	4.28E+00	2.43E+00	1.18E+00	5.65E-01
DN/DLOGD (NO. PARTICLES/DNCM)	1.60E+04	0.0	0.0	0.0	0.0	0.0	0.0
	5.01E+08	0.0	0.0	0.0	0.0	0.0	0.0

NORMAL TEMPERATURE STANDARD CONDITIONS ARE 20 DEG C AND 760MM HG.

AERODYNAMIC DIAMETERS ARE CALCULATED HERE ACCORDING TO THE TASK GROUP ON LUNG DYNAMICS.

IMPACTOR ANALYSIS WEIGHTS

ANALYSIS Filter Wts SOLVENT —— ANALYSIS STARTED May 1, 1979 FINISHED May 4/1967

PROJECT NUMBER 3026.10 PROJECT NAME Union Oil Brea, Ca PROJECT MANAGER Becker ITEM WEIGHED Filter

WEIGHT

DATE			5/1	5/3	5/4						
R.H.(%)			22	34	40						
TEMP(°F)			74	75	74						
Std.Wt. 500mg			150.41	zero ck 150.41	150.42						
ANALYST			cc	cc	cc						
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt.(mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Feed 3											
57C	350	50 heavy	65.38	65.49	65.49				65.49	63.83	1.66
82B	(200.		43.79	43.83					43.81	42.82	0.99
56C	100 heavy)		66.34	66.40	66.42				66.41	65.03	1.38
81B	50		52.79	52.85	52.87				52.86	50.25	2.61
55C			68.80	68.84					68.82	65.08	3.74
80B			43.22	43.24					43.23	41.77	1.46
19B			144.55	144.67	144.68				144.67	~~55.64~~ 143.45	1.22

FINAL WEIGHT

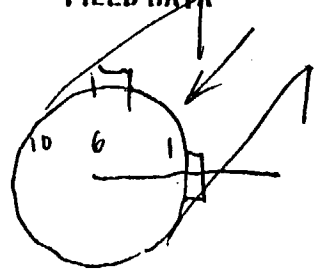
DATE											
R.H.(%)											
TEMP(°F)											
Std.Wt.											
ANALYST											
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	rd wt	4th wt.	5th wt.	6th wt.	FINAL wt.(mg)	TARE wt. (mg)	DIFFERENCE (mg)

DTL 1

IN 1027

FIELD DATA

PLANT Union Oil - Brea Ca
DATE 3-29-79
SAMPLING LOCATION PREDRYER AN
SAMPLE TYPE ANDERSEN 6 STAGE
RUN NUMBER AN-PRE-1
OPERATOR LAMBERT
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 30.29
STATIC PRESSURE, (P_s) -1.9
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$ 1.58 @ 0.5" H_2O
C FACTOR 1.1
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.5

PKE

0	39C
1	63B
2	38C
3	64B
4	37C
5	62B
6	13B

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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
6	0	1112	742.928	0.84	1.06	1.06	138	70	70	4		
	3	1115	744.60		1.06	1.06	139	76	70	4		
	6	1118	746.28		1.06	1.06	139	82	70	4		
	9	1121	747.92		1.06	1.06	140	89	71	4		
	12	1124	749.60		1.06	1.06	139	95	72	4		
	15	1127	751.283				96 STOP	TEST	75			
							Impaction	Spots	on			
	ΔP off prelim.						Stg 3/4	black	in color			

COMMENTS:

PLANT Brea

RUN # AN-PREDRYER #1
DATE 3-29-79 TIME ~~1130~~ 1100
LOCATION #6

BP AMB ~~29.81~~ 30.29
T AMB ~65
Ps -1.9 "H2O

PRE = PI 1

0	39C
1	63B
2	38C
3	64B
4	~~[illegible]~~ 37C
5	62B
6	13B
F	

PRELIM:

T_s = 113.9 + 460 = TSR = 573.9

EST T_m = 75 + 460 = TMR = 535

$\bar{X}\sqrt{\Delta P}^2$ = .807 ~~cfm~~ .8395 discard #1 → POINT # 6 = 0.86 ΔP

% M = 2

ΔH@ at 0.5 "H_2O = 1.98

C = 1.1

$$Q_M = 0.5\left(\frac{T_{mR}}{T_{sR}}\right)\left(\frac{P_s}{P_m}\right)(1 - F_{H_2O})$$

$$= 0.5\left(\frac{535}{574}\right)\left(\frac{\quad}{\quad}\right)(0.98)$$

Q_M = .4567

$Q_M \cong$ 0.80 " ΔH

CHECK:

$$Q_s = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_s}\right)\left(\frac{1}{1-F_H}\right)$$

$$= \left(\frac{574}{535}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{0.98}\right)$$

Q_s = 0.5 ✓

NOMOGRAPH = 0.84 ΔP to 0.80 ΔH

D NOZ = 0.186

REF ΔP = ~~2.0~~ 1.50

Obs T_s = 140

Obs ΔP = .84

Set ΔH = 1.06

MIN = ~15

pt #1 not included in flow determination: poor port sealing. Avg determined from pts 2→10, = 0.84 = $\sqrt{\Delta P}^2_{\bar{X}}$

Change in temp to 140: mod bad thermocouple on

$\bar{p}$: Q_m = .5575 Q_s =

0	
1	
2	
3	
4	
5	
6	
7	
8	
F	

AN: MW 80, D = 48.0 lb/cuft
Fert UREA: MW: 60.06, D = 47.4 lb/cuft
Feed Urea MW: 60.06, D: 48.5 lb/cuft

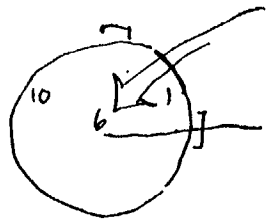
FIELD DATA

PRE - PI-2

0	42C
1	66B
2	41C
3	67B
4	40C
5	65B
6	14B

PLANT Union Oil/Brea Ca
DATE 3-29-79
SAMPLING LOCATION AN-PD Predryer
SAMPLE TYPE Andersen
RUN NUMBER AN-PD-A2
OPERATOR Lamber
AMBIENT TEMPERATURE ~70
BAROMETRIC PRESSURE 30.33
STATIC PRESSURE, (P_s) ~1.9
FILTER NUMBER (s)

warmup @ 1611



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$ 1.98 @ 0.5" H_2O
C FACTOR 1.11
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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
6	0	1632	775.446	0.68 *	0.87	0.87	118 **	74	74	3		
	3	1635	776.98		0.87	0.87	123	77	74	3		
	8	1640	779.47		0.87	0.87	129	86	75	3		
	11	1643	780.96		0.87	0.87	130	91	76	3		
	14	1646	782.47		0.87	0.87	131	94	76	3		
	17	1649	784.00		0.87	0.87	131	97	78	3		
	20	1652	785.51		0.87	0.87	132	101	80	3		
	23	1655	787.03		0.87	0.87	132	103	80	3		
	26	1658	788.55		0.87	0.87	132	105	82	3		
	29	1701	790.08		0.87	0.87	132	107	83	3		
	30	1702	790.589			STOP	TEST					

* Inconsistent point to warmup

** Temp was stable here throughout warmup

COMMENTS:

PLANT Union Oil Brea Ca

RUN # AN-PD-2
DATE 3-29-79 TIME 1630
LOCATION #6 Preheater

BP AMB
T AMB
Ps

PRE

0	42C
1	66B
2	41C
3	67B
4	40C
5	65B
6	14B
F	

PRELIM:

T_S = 120
+460
TSR = 580

EST T_M = 87
+460
TMR = 547

$\bar{X}$ ΔP = .68 → POINT # ____ = ____ ΔP
% M =
ΔH@ at ____ " H_2O = ____
C =

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_s}{P_m}\right)(1 - F_{H_2O})$$

$$= 0.5\left(\frac{547}{580}\right)\left(\frac{\quad}{\quad}\right)(0.98)$$

Q_M = ____
$Q_M \cong$ ____ " ΔH

CHECK:

$$Q_S = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_s}\right)\left(\frac{1}{1 - F_H}\right)$$

$$= \left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{0.}\right)$$

Q_S =

NOMOGRAPH = .68 ΔP to .80 ΔH
D NOZ = .186
REF ΔP = 1.45

Obs TS = 122
Obs ΔP = .68
Set ΔH = ____

MIN = 30

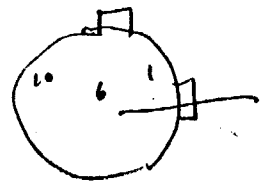
0	
1	
2	
3	
4	
5	
6	
7	
8	
F	

INC-PI-3

FIELD DATA

INTO WARM 1921
OUT 1937
IN 1939

PLANT Union Oil / Brea Ca
DATE 3-29-79
SAMPLING LOCATION AN-PD PREDRYER
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-PD-3
OPERATOR Lambert
AMBIENT TEMPERATURE ~55
BAROMETRIC PRESSURE 30.37
STATIC PRESSURE, (P_s) -1.9
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 5' Steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$ 1.98 @ 0.5" H_2O
C FACTOR 1.11
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.45

0 — 44C
1 — 69B
2 — 45C
3 — 70B
4 — 43C
5 — 68B
6 — 15B

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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 F STAGE OUTLET	IMPINGER TEMPERATURE, °F
6	0	1951	819.628	0.85*	1.02	1.02	129	76	77	4	125→112 ②	
	3	1954	821.29		1.02	1.02	130	80	77	4	120	
	6	1957	822.96		1.02	1.02	129	85	77	4	124	
	9	2000	824.62		1.02	1.02	129	90	77	4	127	
	12	2003	826.29		1.02	1.02	129	93	78	4	128	
	15	2006	827.96		1.02	1.02	129	96	78	4	128	
	18	2009	829.63		1.02	1.02	129	100	80	4	128	
	21	2012	831.29		1.02	1.02	129	102	81	4	129	
	24	2015	832.96		1.02	1.02	129	105	82	4	129	
	27	2018	834.65		1.02	1.02	130	106	83	4	129	
	30	2021	836.323				128	106	84	4	129	STOP TEST

② Drops from stg 6 to 125→112 in 10 seconds. slow climb to 120 @ 3"
* measured immediately prior to run

COMMENTS:

PLANT Union Oil / Brea CA

RUN # AN-PD-3
DATE 3-29-79 TIME 1950
LOCATION Predryer AN #6

BP AMB 30.37
T AMB ~60
Ps ~1.9

PRE

0	44C
1	69B
2	45C
3	70B
4	43C
5	68B
6	15B
F	

PRELIM:

T_s = . + 460 = TSR

EST T_M = + 460 = TMR

$\bar{X}$ ΔP = _____ → Point # _____ = _____ ΔP

% M =

ΔH@ at ____ " H_2O = ____

C = 1.1

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_s}{P_m}\right)(1 - F_{H_2O})$$

$$= 0.5\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)(0.\quad)$$

Q_M = _____

$Q_M \cong$ _____ " ΔH

CHECK:

$$Q_s = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_s}\right)\left(\frac{1}{1 - F_{H_2O}}\right)$$

$$= \left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{0.}\right)$$

Qs =

NOMOGRAPH = _____ ΔP to _____ ΔH

D NOZ = 0.186

REF ΔP = 1.45

Obs TS = 130

Obs ΔP = 0.85

Set ΔH = 1.02

MIN = 30

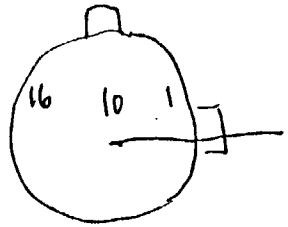
0
1
2
3
4
5
6
7
8
F

IN 0944

PRE PI 7

FIELD DATA

PLANT Union Oil / Brea Ca
DATE 3-31-79
SAMPLING LOCATION AN DRYER
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-D-1
OPERATOR LAMBERT
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE ~~29.65~~ 30.39
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR 1.10
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.6

0 — 3C
1 — 28B
2 — 2C
3 — 27B
4 — 1C
5 — 26B
6 — 1B

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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~~ Fout	IMPINGER TEMPERATURE, °F
Horz 10	0	1007	946.379 (.379)	0.85	0.96	0.96	160	68	65	3	151	
	3	1010	947.79	0.95*	0.96	0.96	160	71	65	3	154	
	6	1013	949.39	0.99	0.96	0.96	160	76	66	3.5	157	
	9	1016	950.98	1.1	0.96	0.96	160	81	67	3.5	159	
	12	1019	952.18	1.1	0.96	0.96	160	85	68	3.5	159	
	15	1022	954.175	1.15	0.96	0.96	160	88	69	3.5	160	stop test
*	ΔP stabl'd at slowly climbing		0.85 ~1 min: test started. Then started Ping? Pitot tube cleared immed. before insertion.									

COMMENTS:

PLANT Union Oil / Brea Ca

RUN # AN-D-1

DATE 3-31-79 TIME 1000

LOCATION DRYER

BP AMB ~~29.65~~ 30.39

T AMB 60

Ps ?

PRE Pi 7

0 — 3C
1 — 28B
2 — 2C
3 — 27B
4 — 1C
5 — 26B
6 — 1B
F

PRELIM:

T_s = 160
+460
TSR = 620

EST T_M = 75
+460
TMR = 535

$\bar{X}$ ΔP = 1.03 → POINT # 10 = 1.0 ΔP

% M = 2

ΔH@ at 1.98 " H_2O = ____

C = 1.1

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_s}{P_m}\right)(1 - F_{H_2O})$$

$$= 0.5\left(\_\_\_\right)\left(\_\_\_\right)\left(0.\quad\right)$$

Q_M = ____

$Q_M \cong$ ____ " ΔH

CHECK:

$$Q_s = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_s}\right)\left(\frac{1}{1 - F_{H_2}}\right)$$

$$= \left(\_\_\_\right)\left(\_\_\_\right)\left(\frac{\_\_\_}{0.}\right)$$

Qs =

NOMOGRAPH = ____ ΔP to ____ ΔH

D NOZ = 0.186

REF ΔP = 1.6

Obs TS = ____

Obs ΔP = ____

Set ΔH = ____

MIN = ____

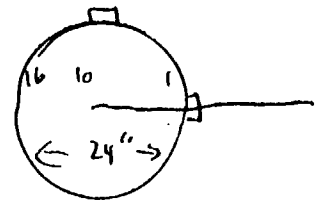
0
1
2
3
4
5
6
7
8
F

IN 1141

.ire P18

FIELD DATA

PLANT Union Oil / Brea Ca
DATE 3-31-79
SAMPLING LOCATION AN DRYER
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-D-2
OPERATOR LAMBERT
AMBIENT TEMPERATURE ~70
BAROMETRIC PRESSURE ~~[illegible]~~ 30.39
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2.0
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.6

0 — 6C
1 — 31B
2 — 5C
3 — 30B
4 — 4C
5 — 29B
6 — 2B

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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 F out	IMPINGER TEMPERATURE, °F
Horz 10	0	1203	954.230	0.93	1.06	1.06	148	76	76	3.5	132	
	3	1206	955.84	0.96	1.06	1.06	146	80	76	3.5	139	
	6	1209	957.50	0.96	1.06	1.06	145	85	77	3.5	140	
	9	1212	959.16	0.98	1.06	1.06	142	89	77	3.5	140	
	12	1215	960.83	0.98	1.06	1.06	140	93	78	3.5	138	
	15	1218	962.48	0.98	1.06	1.06	139	96	80	3.5	136	
	18	1221	964.15	0.98	1.06	1.06	137	102	81	3.5	135	
	21	1224	965.81	0.98	1.06	1.06	136	103	82	3.5	133	
	24	1227	967.48	0.99	1.06	1.06	136	106	84	3.5	132	
	27	1230	969.15	0.98	1.06	1.06	135	108	85	3.5	131	
	30	1233	970.817	0.99	1.06	1.06	135	110	86	3.5	131	slip test

5C small wh
29B " bl

COMMENTS:

PLANT Union Oil / Brea Ca

RUN # AN-D-2

DATE 3-31-79 TIME 1200

LOCATION AN DRYER Pt 10

BP_{AMB} _____

T_{AMB} _____

P_S _____

PRE	Pi 8
0	6C
1	31B
2	5C
3	30B
4	4C
5	29B
6	2B
F	

PRELIM:

T_S = . + 460 = TSR = _____

EST T_M = + 460 = TMR = _____

$\bar{X}$ ΔP = _____ → Point # _____ = _____ ΔP

% M =

ΔH@ at _____ " H_2O = _____

C =

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_S}{P_m}\right)(1 - F_{H_2O})$$

$$= 0.5\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)(0.\quad)$$

Q_M = _____

$Q_M \cong$ _____ " ΔH

CHECK:

$$Q_S = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_S}\right)\left(\frac{1}{1 - F_{H_2}}\right)$$

$$= \left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{0.}\right)$$

Q_S =

NOMOGRAPH = _____ ΔP to _____ ΔH

D NOZ = _____

REF ΔP = _____

Obs TS = _____

Obs ΔP = _____

Set ΔH = _____

MIN = _____

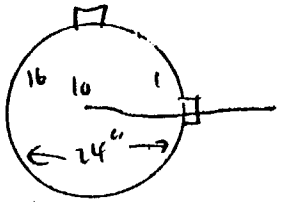
0
1
2
3
4
5
6
7
8
F

PRE P19

FIELD DATA

PLANT Union Oil / Brea Cg
DATE 3-31-79
SAMPLING LOCATION AN DRYER
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-D-3
OPERATOR Lambert
AMBIENT TEMPERATURE 75°
BAROMETRIC PRESSURE 30.39
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)

IN: 1337



PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. ~~0.186~~ 0.125
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR 1.18
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 6.5

0 — 9C
1 — 34B
2 — 8C
3 — 33B
4 — 7C
5 — 32B
6 — 3B

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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 F out	IMPINGER TEMPERATURE, °F
Run 10	0	1406	970.817	1.02 *	0.32	0.32	133	83	83	0.5	113	
	3	1409	971.71	0.91	0.32	0.32	134	85	83	0.5	120	
	6	1412	972.61	0.91	0.32	0.32	134	87	83	0.5	122	
	9	1415	973.51	0.92	0.32	0.32	135	90	84	0.5	125	
	12	1418	974.41	0.92	0.32	0.32	135	93	84	0.5	126	
	15	1421	975.33	0.92	0.32	0.32	135	96	85	0.5	127	
	18	1424	976.23	0.91	0.32	0.32	135	98	86	0.5	127	
	21	1427	977.14	0.92	0.32	0.32	135	100	87	0.5	127	
	24	1430	978.057	0.93	0.32	0.32	135	102	88	0.5	128	STOP TEST
8C	wh cloth											
32B	black dirt											
			0.186 NOZZLE →	ΔH = 1.4.	Change	to 1/8":	Flow is now	on low	end.			
			Δp was stable here	>2min.	Plug?							

COMMENTS:

PLANT Union Oil Brea Co

RUN # AN-D-3
DATE 3-31-79 TIME 1400
LOCATION AN DRYER

BP AMB _____
T AMB _____
Ps _____

PRE	Pig
0	9C
1	34B
2	8C
3	33B
4	7C
5	32B
6	3B
F	

PRELIM:

T_S = . + 460 = TSR = _____

EST T_M = + 460 = TMR = _____

$\bar{X}$ ΔP = _____ → POINT # _____ = _____ ΔP
% M =
ΔH@ at ____ " H_2O = ____
C =

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_S}{P_m}\right)(1 - F_{H_2O})$$
$$= 0.5\left(\_\_\_\right)\left(\_\_\_\right)\left(0.\quad\right)$$

Q_M = _____
$Q_M \cong$ _____ " ΔH

CHECK:
$$Q_S = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_S}\right)\left(\frac{1}{1 - F_{H_2}}\right)$$
$$= \left(\_\_\_\right)\left(\_\_\_\right)\left(\_\_\_\right)$$
Q_S =

NOMOGRAPH = _____ ΔP to _____ ΔH
D NOZ = _____
REF ΔP = _____

Obs TS = _____
Obs ΔP = _____
Set ΔH = _____

MIN = _____

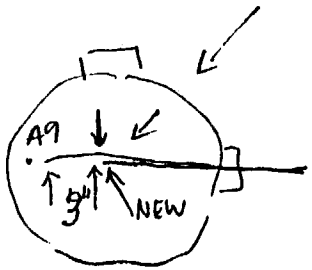
0
1
2
3
4
5
6
7
8
F

IKE-PI4

IN 1218

FIELD DATA

PLANT Union Oil - Brea Ca
DATE 3-30-79
SAMPLING LOCATION AN ~~DRYER~~ COOLER
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-C-1
OPERATOR LAmbert
AMBIENT TEMPERATURE ~60
BAROMETRIC PRESSURE 30.42
STATIC PRESSURE, (P_s) 29.70 (CALW)
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR 1.2
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.30

0 — 21C
1 — 45B
2 — 20C
3 — 46B
4 — 19C
5 — 44B
6 — 7B
F

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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 F Stage Outlet	IMPINGER TEMPERATURE, °F
A-9	0	1239	863.392	0.60	0.78	0.78	124	84	84		123	
		1239.5	863.495	HIGH	VAC/	TEST	STOPPED					
			(Δ= 0.103)									
	0.5	1244	863.519	STOP:	PLUG	/HIGH VAC.				(18)	NOZZLE WAS PLUGGED	
			(Δ= 0.024)									
*A8?	0.5	1250	863.610		0.78	0.78	125	82	83	2	118	
	4.5	1254	865.48		0.78	0.78	124	87	83	2	118	
	7.5	1257	866.90		0.78	0.78	124	92	83	2	121	
	10.5	1300	868.32		0.78	0.78	124	95	84	2	123	
	13.5	1303	869.74		0.78	0.78	124	99	84	2	123	
	15.5	1305	870.686				124	101	85	2	123	
				STOP	TEST							
			.103									
			.024									
			TOT .127 in	0.5 min								
	IN FIRST ABORTED STARTS, FLOW			AVG ≅	0.2 cfm							
	A9 BELIEVED TO BE TOO CLOSE TOO			OUTSIDE	WALL.	POINT	MOVED	3"	towards	port	(~A8)	

COMMENTS:

PLANT Union Oil / Brea Ca

RUN # AN-C-1
DATE 3-30-79 TIME _____
LOCATION ~~Dryer~~ Cooler AN

BP AMB _____
T AMB _____
Ps _____

PRE	Pi4
0	21C
1	45B
2	20C
3	46B
4	19C
5	44B
6	7B
F	

PRELIM:

T_S = ~120
+460
TSR = 586

EST T_M = 105
+460
TMR = 565

$\bar{X}$ ΔP = .37 (AL 3-29) → Point # A9 = _____ ΔP
% M = 2
ΔH@ at ____ " H_2O = ____
C = 1.2

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_s}{P_m}\right)(1 - F_{H_2O})$$
$$= 0.5\left(\frac{565}{586}\right)\left(\frac{\quad}{\quad}\right)(0.98)$$

Q_M = .4724
$Q_M \cong$ 1 " ΔH

CHECK:
$$Q_S = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_s}\right)\left(\frac{1}{1 - F_{H_2}}\right)$$
$$= \left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{0.}\right)$$
Qs =

NOMOGRAPH = 0.60 ΔP to _____ ΔH
D NOZ = 0.186
REF ΔP = 1.3

Obs TS = 124
Obs ΔP = 0.60
Set ΔH = 0.78

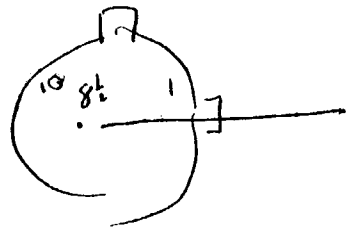
MIN = 15

0
1
2
3
4
5
6
7
8
F

IN 1503

FIELD DATA

PLANT Union Oil / Brea Ca
DATE 3-30-79
SAMPLING LOCATION AN Cooler
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-C-2
OPERATOR Lambert
AMBIENT TEMPERATURE ~60
BAROMETRIC PRESSURE 30.37
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$ 1.98@ .5" H_2O
C FACTOR 1.70
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.3

PRE Pi5
0 24C
1 48B
2 23C
3 49B
4 22C
5 47B
6 8B
F

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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 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
A 8.5	0	1528	895.316	0.43	0.63	0.63	118	77	77		F stage out	
											STOP p̄ 5	sec/plug
		1532	895.365	p̄ 20	sec	stop/plug						
		1537	895.454	p̄ 10	sec	stop/plug						
	[0]	1541:30	895.502		0.63	0.63	117	76	76	1.5		
	3	1544:30	896.88		0.63	0.63	117	78	76	1.5		
	6	1547:30	898.05		0.63	0.63	117	82	76	1.5	112	
	9	1550:30	899.31		0.63	0.63	117	85	77	1.5	114	
	12	1553:30	900.59		0.63	0.63	117	90	78	1.5	115	
	15	1556:30	901.869				117	93	80	1.5	116	STOP TEST

1 Δ .049
2 Δ .079
3 Δ .048

COMMENTS:

PLANT Union Oil / Brea Ca

RUN # AN-C-2

DATE _____ TIME _____

LOCATION AN Cooler # ~8

BP_{AMB} _____

T_{AMB} _____

P_S _____

PRE
0
1
2
3
4
5
6
F

24C
48B
23C
49B
22C
47B
8B

PRELIM:

T_S = . + 460

TSR = _____

EST T_M = + 460

TMR = _____

$\bar{X}$ ΔP = _____ → Point # _____ = _____ ΔP

% M =

ΔH@ at ____ " H_2O = _____

C =

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_S}{P_m}\right)\left(1 - F_{H_2O}\right)$$

$$= 0.5\left(\_\_\_\_\right)\left(\_\_\_\_\right)\left(0.\quad\right)$$

Q_M = _____

$Q_M \cong$ _____ " ΔH

CHECK:

$$Q_S = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_m}{P_S}\right)\left(\frac{1}{1 - F_{H_2}}\right)$$

$$= \left(\_\_\_\_\right)\left(\_\_\_\_\right)\left(\frac{\_\_\_\_}{0.}\right)$$

Q_S =

NOMOGRAPH = _____ ΔP to _____ ΔH

D NOZ = _____

REF ΔP = _____

Obs T_S = _____

Obs ΔP = _____

Set ΔH = _____

MIN = _____

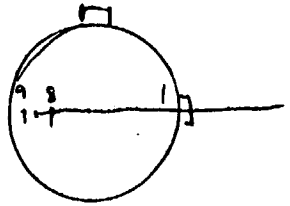
0
1
2
3
4
5
6
7
8
F

IN #824

PRE PI-6

FIELD DATA

PLANT Union Oil / Brea Cg
DATE 3-30 79
SAMPLING LOCATION AN COOLER
SAMPLE TYPE ANDERSEN
RUN NUMBER AN-C-3
OPERATOR Lambert
AMBIENT TEMPERATURE ~60
BAROMETRIC PRESSURE 30.37
STATIC PRESSURE, (P_s) -3.5
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 5' steel
NOZZLE I.D. 0.186
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER —
METER BOX NUMBER —
METER $\Delta H_@$ 1.98 @ 0.5 "H_2O
C FACTOR 1.15
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 1.30

0 — 27C
1 — 51B
2 — 26C
3 — 52B
4 — 25C
5 — 50B
6 — 9B
F

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	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 F out	IMPINGER TEMPERATURE, °F
A 8½	0	1842	938.029	*0.74	0.97	0.97	116	79	79	2	101	
	3	1845	939.64	0.75	0.97	0.97	116	83	80	2	108	
	6	1848	—	0.75	0.97	0.97	115	88	80	2	112	
	9	1851	942.89	0.75	0.97	0.97	115	93	80	2	113	
	12	1854	944.51	0.75	0.97	0.97	115	95	80	2	114	
	15	1857	946.128	0.75	0.97	0.97	115	96	80	2	114	

* Flow is set for this value above

Blank Filter

COMMENTS:

PLANT Union Oil / Brea Ca

RUN # AN-C-3
DATE 3-30-79 TIME ~1800
LOCATION AN-Cooler 8½

BP AMB 30.37
T AMB ~60
Ps ~3.5

PRE	
0	27C
1	51B
2	~~26C~~ 26C
3	52B
4	25C
5	50B
6	9B
F	

PRELIM:

T_S = . + 460 = TSR = _____

EST T_M = + 460 = TMR = _____

$\bar{X}$ ΔP = _____ → Point # _____ = _____ ΔP

% M = 2

ΔH@ at ____ " H_2O = _____

C = 1.15

$$Q_M = 0.5\left(\frac{T_{MR}}{T_{SR}}\right)\left(\frac{P_S}{P_M}\right)(1 - F_{H_2O})$$

$$= 0.5\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)(0.\quad)$$

Q_M = _____

$Q_M \cong$ _____ " ΔH

CHECK:

$$Q_S = \left(\frac{T_{SR}}{T_{MR}}\right)\left(\frac{P_M}{P_S}\right)\left(\frac{1}{1 - F_{H_2}}\right)$$

$$= \left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{\quad}{0.}\right)$$

Q_S =

NOMOGRAPH = _____ ΔP to _____ ΔH

D NOZ = 0.186

REF ΔP = 1.40

Obs T_S = _____

Obs ΔP = _____

Set ΔH = _____

MIN = _____

0
1
2
3
4
5
6
7
8
F

Anderson Impactor Weights for 3026

Original Dessication Date 2/25/79

1st Wgt 2/26/79 1200
2nd Wgt 2/27/79 1000

1st Set of Filter

Counter weights used are in cup labelled "Weights for Tin Cup Taring heavy sling on tare

Filter #	B/Tare	Weight 1	Weight 2
1 TS	350/50	133.98	134.01
2		130.45	130.47
3		129.69	129.59 ok
4		124.52	124.53
5		146.46	146.41
6		146.22	146.21
7		139.62	139.60
8		139.85	139.90
9	ok	132.47	132.36
10		142.38	142.36
11		142.86	142.96
12		143.29	143.25
13		146.00	146.05
14		145.72	145.71
15		150.17	150.17
16		142.64	142.61
17		141.13	141.10
18		138.04	138.01
19		143.43	143.47
20		144.77	144.74
21		142.69	142.63
22		144.72	144.76
23		149.36	149.31
24		148.94	149.91
25		150.65	150.67

Anderson Impactor Filter for 3026

See Page 24

Filter #	B/Tare	Weight 1	Weight 2
26B	350/50	49.77 ~~33.52~~	49.80
27		53.70	53.51
28		48.00	47.97
29		45.21	45.22
30		54.58	54.57
31		51.57	51.66
32		43.66	43.63
33		42.79	42.75
34		54.70	54.65
35		52.18	52.09
36		51.17	51.18
37		52.66	52.68
38		47.05	47.00
39		49.67	49.70
40		45.78	45.70
41		47.09	47.07
42		46.74	46.72
43		40.78	40.81
44		38.10	38.13
45		34.60	34.57
46		31.53	31.48
47		33.52	33.53
1C	OK	69.03	69.03
2		65.14	65.14
3		60.94	60.97
4		65.62	65.61
5		53.82	53.82
6		63.76	63.74
7		60.88	60.89
8		57.95	57.96
9		63.75	63.77
10		63.73	63.71

Anderson Impactor Filters for 3026

See Page 24

Filter #	B/Tare	Weight 1	Weight 2	Weight 3 (3/5/79)
11C		57.90	57.93	
12		58.51	58.50	
13		63.27	63.24	
14		59.87	59.83	
15		51.89	51.26	
16		54.52	—	54.56
17		57.86	57.883	
18		49.94	49.90	
19		55.66	55.63	
20		62.37	62.41	

Con't from pg 29		3/1/79	3/1/79	3/3/79
83 B	50/350	~~48.40~~	46.40	46.42
84 B		47.77	45.82	45.80
85 B		44.77	43.01	43.01
86 B		41.13 ~~44.13~~	39.13	39.20
87 B		49.84 ~~44.13~~ ok	48.84	48.89
88 B		37.12	35.16	35.16
89 B		36.27	34.29	34.32
90 B		41.22	39.22	39.28
91 B		45.55	43.61	43.61
92 B		38.56	36.60	36.60
93 B		39.79	37.81	37.79
94 B		38.48	36.53	36.55
95 B		48.52	46.59	46.61
96 B		38.57	36.50	36.50
97 B		40.49	38.49	38.51
98 B		36.44	34.49	34.43
99 B		32.81	30.92	30.87
100 B		32.92	30.96	30.94

FAT 50 = TARE / 200 + 100 + thin 50 = 350 zero

Anderson Impactor Filters for 3026

1st wt 2/28/79 1130 42C-49C

3/1/79 21C-41C

Filter #	B/Tare	Weight 1	Weight 2		Weight 3 (3/5/79)	wt 4 (3/6/79)
21C	350/50	54.03	52.06		52.08	
22C		66.50	64.46	64.45		
23C		55.59	53.56		53.57	
24C		52.60	50.59		50.64	
25C		58.69	56.63		56.67	
26C		60.73	58.67		58.77	58.66
27C		54.83	52.87		52.81	
28C		57.89	55.83	55.83		
29C		58.56	56.56		56.61	
30C		48.16	47.08		47.05	
31C		57.70	55.93		55.95	
32C		62.73	60.67		60.74	60.66
33C		54.41	52.40		52.40	
34C		58.98	56.88		56.97	56.82
35C		62.18	60.23		60.19	
36C		51.53	49.50		49.54	
37C		62.39	60.28	60.36		
38C		59.71	57.68	57.72		
39C		69.60	67.47	67.48		
40C		57.31	55.28	55.26		
41C		64.94	62.89	62.87		
42C		59.75			59.85	59.77
43C		68.28			68.28	
44C		59.00			59.04	
45C		55.40			55.43	
46C		51.44			51.45	
47C		58.94			59.00	58.95
48C		59.26			59.33	59.26
49C		65.58			65.62	

Anderson Impactor Filter for 3026
1st wt 2/28/79

Filter #	B/Tare	Weight 1	Weight 2 (3/5/79)	Wt 3 3/6/79
50C	350/50	58.84	58.92	58.86
51C		59.14	59.15	
52C		56.85	56.81	
53C		63.67	63.62	
54C		65.27	65.31	
55C		65.11	65.05	
56C		65.03	65.04	
57C		63.80	63.86	
58C		63.35	63.41	63.36
59C		63.63	63.66	
60C		49.56	49.61	
61C		56.96	57.03	56.97
62C		56.72	56.79	56.75
63C		61.55	61.57	
64C		44.96	44.98	
65C		60.98	60.99	
66C		53.81	53.84	
67C		51.15	51.17	
68C		61.17	61.23	61.16
69C		56.40	56.44	
70C		59.13	59.20	59.18
71C		52.35	52.42	52.33
72C		52.29	52.35	52.29
73C		60.62	60.69	60.65
74C		58.20	58.24	
75C		53.25	53.27	

Anderson Impactor Filters for 3026

Date		3-1-79	3-2-79	Fat 50 - Tare / 200 + heavy 100 + thin 50 3-5-79	3-6-79	3-8
Filter #	B/Tare	wt 1	wt 2	wt 3	wt 4	wt 5
48B	32/50	36.73	36.76			
49B		~~47.38~~	45.34	45.33		
50B		33.33	31.21	31.19		
51B		48.23	46.20	46.17		
52B		41.80	39.82	39.77		
53B		36.42	34.36	34.24	34.19	
54B		40.84	38.83	38.88		
55B		40.83	38.83	38.75		
56B		43.00	41.19	40.90	40.79	40.84
57B		43.86	41.77	41.75		
58B		35.73	33.64	33.62		
59B		28.13	26.02	26.01		
60B		34.13	32.07	32.10		
61B		29.18	27.11	27.07		
62B		44.02	41.87	41.93		
63B		39.50	37.50	37.39	37.41	
64B		45.81	43.68	43.66		
65B		43.47	41.45	41.37		
66B		36.86	34.86	34.82		
67B		42.71	40.73	40.63	40.59	
68B		39.54	37.48	37.42		
69B		44.73	44.69			
70B		32.46	32.54			
71B		34.54	34.56			
72B		28.46	28.48			
73B		48.73	48.77			
74B		37.63	37.62			
75B		28.82	28.90			
76B		39.20	39.13			
77B		41.23	41.25			
78B		44.06	44.04			
79B		31.05	31.00			
80B		41.82	41.72			
81B		50.25	50.25			
82B		42.85	42.81			

Con't page 26

JOB/JOBS: 3026 Union Oil
Temp: R.H.: Std. Weight:
Date: Sign:
Comments:

~~Petri Filter~~ Dishes No.	~~Filter~~ Size	Weight 1	Weight 2	Weight 3	Weight 4
PI-1		25.4400	25.4391	25.4395 x	
2		25.9227	25.9215	25.9220 x	
3		26.6124	26.6112	26.6112 x	
4		24.6620	24.6613	24.6617 x	
5		29.3407	29.3400	29.3401 x	
6		28.5263	28.5265 x		
7		28.1426	28.1414	28.1418 x	
8		30.9176	30.9168	30.9165 x	
9		29.6543	27.6535	27.6540 x	
10		27.6253	27.6258 x		
11		29.7878	29.7876 x		
12		30.5473	30.5470 x		
13		30.3298	30.3288	30.3288 x	
14		29.0697	29.0698 x		
15		31.2013	31.2008 x		
16		30.1431	30.1427 x		
17		28.7656	28.7646	28.7650 x	
18		27.8521	27.8513	27.8512 x	
19		29.4037	29.4029	29.4029 x	
20		28.7392	28.7379	28.7380 x	
21		32.2128	32.2114	32.2124	32.2120 x
22		25.6245	25.6234	25.6238 x	
23		27.4659	27.4658 x		
24		27.9958	27.9956 x	~~27.9~~	
25		29.4400	29.4385	29.4396	29.4400 x
			Mar 12	Mar 14	Mar 15
				RH - 32%	RH - 14%
				T 72°F	T - 70°F
				30.00005 std	30.00009 std

ANALYSIS Filter Wt SOLVENT — ANALYSIS STARTED April 27 FINISHED

PROJECT NUMBER 3026.10 PROJECT NAME Union Oil, Brea, Ca PROJECT MANAGER Becvar ITEM WEIGHED Filter

WEIGHT

DATE			4/27	5/1	5/3							
R.H. (%)			42	23	32							
TEMP (°F)			74	74	75							
Std. Wt.			zero ck.	150.40	zero ck							
ANALYST			CC	FW	CC							
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Cooler 2											
30 C	350	50	51.70	51.74					51.72	47.06	4.66
55 B	(200,	(heavy)	43.83	43.81					43.82	38.79	5.03
29 C	100 heavy)		60.04	60.02					60.03	56.58	3.45
54 B	50		39.18	39.16					39.17	38.85 ~~65.29~~	0.32
28 C			56.05	56.00					56.02	55.83	0.19
53 B			34.42	34.35	34.37				34.36	34.21	0.15
10 B			142.57	142.50	142.52				142.51	142.37	0.14

FINAL WEIGHT

DATE			4/27	4/27 5/1	5/3	5/4 9A	5/4 4P					
R.H. (%)			42	22	32	40	38					
TEMP (°F)			74	74	75	74	76					
Std. Wt. (500)			zero ck	zero ck	150.42	150.42	zero ck					
ANALYST			CC	CC	CC	CC	CC					
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Cooler 3											
33 C	350	50	56.26	56.26					56.26	52.40	3.86
58 B	(200,	(heavy)	37.66	37.60	37.70	37.62	37.67		37.65	33.63	4.04
32 C	100 heavy)		64.90	64.86					64.88	60.70	4.18
57 B	50		42.15	42.11					42.13	41.76	0.37
31 C			56.02	56.02					56.02	55.94	0.08
56 B			40.76	40.78					40.77	40.81	-0.04
11 B			143.08	143.08					143.08	142.91	0.17

IMPINGER ANALYSIS WEIGHTS

ANALYSIS Filter Wts SOLVENT — ANALYSIS STARTED April 26, 1979 FINISHED April 30, 1979

PROJECT NUMBER 3026.10 PROJECT NAME Union Oil, Brea, Ca PROJECT MANAGER Becvar ITEM WEIGHED Filter

WEIGHT

DATE			4/26	4/27								
R.H. (%)			42	42								
TEMP (°F)			76	74								
Std. Wt. (500mg)			150.43	150.41								
ANALYST			cc	cc								
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
AN Cooler 3											
27C	350	50 heavy	59.23	59.22					59.22	52.81	6.41
51B	200.		48.64	48.62					48.63	46.18	2.45
26C	100 heavy		59.72	59.75					59.73	58.71	1.02
52B	50		39.80	39.82					39.81	39.79	0.02
25C			56.59	56.59					56.59	56.67	-0.08
50B			30.94	30.99					30.97	31.20	-0.23
9B			132.05	132.01					132.03	132.40	-0.37

FINAL WEIGHT

DATE			4/26	4/27	4/30							
R.H. (%)			42	42	25							
TEMP (°F)			76	74	74							
Std. Wt.			~~zero~~ ck	zero ck	zero ck							
ANALYST			cc	cc	cc							
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Ured Cooler 1											
63C	350	50 heavy	67.06	67.09					67.07	61.56	5.51
88B	200.		41.72	41.70					41.71	35.16	6.55
62C	100 heavy		64.03	64.03					64.03	56.77	7.26
87B	50		50.24	50.13	50.18				50.16	48.87	1.29
61C			57.07	57.00	57.01				57.01	57.00	0.01
86B			39.09	39.10					39.10	39.16	-0.06
21B			142.70	142.71					142.70	142.66	0.04

00388

IMPACTOR ANALYSIS WEIGHTS

ANALYSIS NOZZLE PRE-IMPACTOR/ CONE CATCH SOLVENT _____ ANALYSIS STARTED 4-26-79 FINISHED 5-3-79

PROJECT NUMBER 3026.10 PROJECT NAME Union Oil/Brea, Calif. PROJECT MANAGER Becraft ITEM WEIGHED Petrie Dish

FINAL WEIGHT

DATE			4/30/79	5/1	5/3							
R.H.(%)			25%	23	33							
TEMP(°F)			73°	74	72							
Std.Wt.			30.00g	30.00g	30.00g							
ANALYST			FW	FW	FW							FW
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt.(mg)	TARE wt. (mg)	DIFFERENCE (mg)
PI-1			26225.4	26225.3					26225.4	25439.3	786.1
PI-2			27891.5	27891.7					27891.6	25921.8	1969.8
PI-3			28291.6	28291.6					28291.6	26611.2	1680.4
PI-4			27024.8	27024.7					27024.8	24661.5	2363.3
PI-5			30710.4	30709.4	30709.5				30709.4	29340.0	1369.4
PI-6			29789.2	29789.0					29789.1	28526.4	1262.7
PI-7			29199.4	29199.4					29199.4	28141.6	1057.8
PI-8			31833.0	31833.0					31833.0	30916.6	916.4
PI-9			30002.0	30001.8					30001.9	27653.8	2348.1
PI-10											

FINAL WEIGHT

DATE			4/30/79	5/1	5/3							
R.H.(%)			25%	23	33							
TEMP(°F)			73°	74	72							
Std.Wt.			30.00g	30.00g	30.00g							
ANALYST			FW	FW	FW							FW
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt	4th wt.	5th wt.	6th wt	FINAL wt.(mg)	TARE wt. (mg)	DIFFERENCE (mg)
PI-11			29790.6	29790.1					29790.4	29787.7	2.7
PI-12			30547.5	30546.9	30547.3				30547.1	30547.2	(0.0)
PI-13			30330.1	30329.3	30329.8				30329.6	30328.8	0.8
PI-14			30389.3	30388.6	30388.9				30388.8	29068.0	1320.8
PI-15			32318.7	32318.2					32318.4	31201.0	1117.4
PI-16			31192.4	31191.6	31192.0				31191.8	30142.9	1048.9
PI-17			28766.1	28765.4	28765.9				28765.6	28764.8	0.8

IMPORTANT WEIGHTS

ANALYSIS Filter Wts SOLVENT — ANALYSIS STARTED April 26, 1979 FINISHED May 1, 1979

PROJECT NUMBER 3026.10 PROJECT NAME Union Oil, Brea, Ca PROJECT MANAGER Becvar ITEM WEIGHED Filter

WEIGHT

DATE			4/26	4/27							
R.H. (%)			42	42							
TEMP (°F)			76	74							
Std. Wt.			150.43	150.43							
ANALYST			cc	cc							
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Fert IN 1											
54C	350	50 (heavy)	66.38	66.40					66.39	65.29	1.10
79B	200.		31.67	31.62					31.64	31.03	0.61
53C	100 heavy		64.67	64.70					64.68	63.65	1.03
78B	50		45.07	45.09					45.08	44.02	1.06
52C			60.58	60.58					60.58	56.83	3.75
77B			46.10	46.14					46.12	41.24	4.88
18B			146.63	146.58					146.60	138.03	8.57

FINAL WEIGHT

DATE			4/26	4/27	4/30	5/1					
R.H. (%)			42	42	25	22					
TEMP (°F)			76	74	74	74					
Std. Wt. (500 mg)			zero ck	zero ck	150.42	zero ck					
ANALYST			cc	cc	cc						
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Fert IN 2											
69C	350	50 (heavy)	56.78	56.76					56.77	56.42	0.35
94B	200.		36.52	36.53					36.53	36.54	-0.01
68C	100 heavy		61.40	61.44					61.42	61.20	0.22
93B	50		38.08	38.08					38.08	37.80	0.28
67C			52.40	52.45					52.42	51.16	1.26
92B			39.98	40.03					40.01	36.60	3.41
23B			150.62	150.68	150.59	150.55			150.57	149.34	1.23

IMPORTANT WEIGHTS

ANALYSIS Filter wt SOLVENT —

PROJECT NUMBER 3026.10 PROJECT NAME Union Oil, Brea, Ca PROJECT MANAGER Becvar

ANALYSIS STARTED April 26, 1979 FINISHED May 1, 1979

ITEM WEIGHED Filter

WEIGHT

DATE / R.H. (%) / TEMP (°F) / Std. Wt. 500 mg / ANALYST			4/26	4/27	4/30	5/1					
			42	42	25	22					
			76	74	73	74					
			150.43	zero ck	zero ck	150.41					
			cc	cc	cc	cc					
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Fert. IN 3											
75C	350	50 (heavy)	53.61	53.63					53.62	53.26	-0.36
100B	(200.		31.07	31.13	31.07	31.10			31.08	30.95	0.13
74C	100 heavy		58.40	58.43					58.42	58.22	0.20
99B	50)		31.13	31.15					31.14	30.89	0.25
73C			61.05	61.13	61.00	61.02			61.01	60.67	0.34
98B			37.54	37.63	37.57	37.53			37.55	34.40	3.09
25B			152.81	152.95	152.81	152.77			152.79	150.66	2.13

FINAL WEIGHT

DATE / R.H. (%) / TEMP (°F) / Std. Wt. 150 mg / ANALYST			4/26	4/27	4/30	5/1					
			42	42	25	22					
			76	74	73	74					
			zero ck	150.42 zero ck	150.44	zero ck					
			cc	cc	cc	cc					
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt. (mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Fert IN 4											
66C	350	50 (heavy)	54.21	54.23					54.22	53.82	+0.40
91B	(200.		43.90	43.94					43.92	43.61	0.31
65C	100 heavy		61.22	61.22					61.22	60.98	0.24
90B	50)		39.48	39.51					39.50	39.25	0.25
64BC			46.10	46.11					46.10	43.67	2.43
89B			36.46	36.54	36.44	36.44			36.44	34.30	2.14
22B			147.03	147.21	147.05	147.07			147.06	144.74	2.32

IMPACTOR ANALYSIS WEIGHTS

ANALYSIS Filter Wts SOLVENT ——— ANALYSIS STARTED April 27 FINISHED May 4, 1979

PROJECT NUMBER 3026.1 PROJECT NAME Union Oil, Brea, Ca PROJECT MANAGER Becvar ITEM WEIGHED Filter

WEIGHT

DATE			4/27	4/30	5/1						
R.H.(%)			42	25	22						
TEMP(°F)			74	73	74						
Std.Wt. 500mg			150.43	150.40	2nd ck						
ANALYST			CC	CC	CC						
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	3rd wt.	4th wt.	5th wt.	6th wt.	FINAL wt.(mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Feed-In 1											
36C	350	50	50.48	50.47					50.47	49.52	0.95
61B	(200.	(heavy)	27.65	27.65					27.65	27.09	0.56
35C	100heavy		61.89	61.85					61.87	60.21	1.66
60B	50)		37.97	37.92					37.94	32.08	5.86
34C			63.19	63.14					63.17	52.40	10.77
59B			27.97	27.94					27.96	26.01	1.95
12B			144.40	144.38	144.36				~~143.2~~ 144.34	143.27	1.07

FINAL WEIGHT AM PM

DATE			5/1	5/3/79	5/4/79	5/4/79					
R.H.(%)			22	32	40	38					
TEMP(°F)			74	75	74	76					
Std.Wt.			150.41	150.42	150.42	150.42					
ANALYST			CC	CC	CC	CC					
FIELD SAMPLE NUMBER	SUBSTITUTE wt.	COUNTER TARE	1st wt.	2nd wt.	rd wt	4th wt.	5th wt.	6th wt	FINAL wt.(mg)	TARE wt. (mg)	DIFFERENCE (mg)
Urea Feed IN-2	350	50									
	(200.	(heavy)									
	100 heavy										
60C	50)		51.00	51.06	51.06				51.06	49.58	1.48
85B			43.88	43.86					43.87	43.01	0.86
59C			64.75	64.82	64.84				64.83	63.64	1.19
84B			48.71	48.72					48.71	45.81	2.91
58C			67.72	67.78	67.78				67.78	63.38	4.40
83B			48.09	48.13					48.11	46.41	1.70

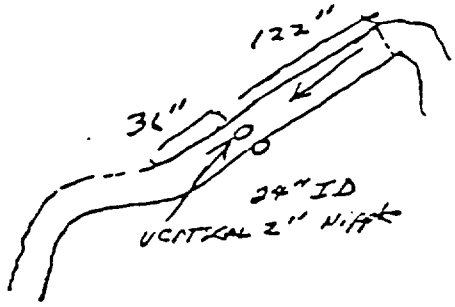
APPENDIX C

FIELD DATA SHEET

Part I - Predryer Test
Part II - Dryer Test
Part III - Cooler Test

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Union Oil Fertilizer Plant
DATE 3/27/79
SAMPLING LOCATION Ammonium Nitrate Predryer
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 26"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) 2"
STACK I.D., (DISTANCE A - DISTANCE B) 24"
NEAREST UPSTREAM DISTURBANCE 122"
NEAREST DOWNSTREAM DISTURBANCE 36"
CALCULATOR Cox



AN PREDRYER
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.	0.026	24"	0.624	2"	2.624 2 5/8"
2	0.082		1.968		3.968 4
3	0.146		3.504		5.504 5 1/2
4	0.226		5.424		7.424 7 1/2
5	0.342		8.208		10.208 10 1/4
6	0.658		15.792		17.792 17 7/8
7	0.774		18.576		20.576 20 5/8
8	0.854		20.496		22.496 22 1/2
9	0.918		22.032		24.032 24 1/8
10	0.974		23.376		25.376 25 3/8

EPA (Dur) 232
4/72

NOMOGRAPH DATA

PLANT Union Oil Co., Brea, Ca

DATE: 3/29/79

SAMPLING LOCATION A N - Predryer

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.93
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	104
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.56
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	29.82
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.995
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	140
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.811
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	1.1
C FACTOR		1.16
CALCULATED NOZZLE DIAMETER, in.		0.25
ACTUAL NOZZLE DIAMETER, in.		0.241
REFERENCE Δp, in. H_2O		0.54

EPA (Dur) 234
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT Union Oil Brea
DATE 3-29-79
LOCATION AN PREDRYER
STACK I.D. 24
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O -1.9" H_2O
OPERATORS LAmbert, COX

Static -1.9" H_2O

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	0.54	112
2	0.71	113
3	0.78	114
4	0.78	115
5	0.81	114
6	0.86	114
7	0.87	114
8	0.95	114
9	0.93	115
10	0.88	114
AVERAGE	0.811	114

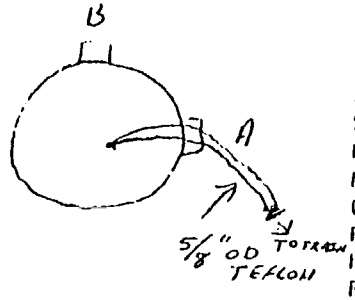
SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

NOTE: 45 min p̄ traverse, temp is ~140°F. CGR says 140 is correct.

FIELD D

PLANT Union Oil
DATE 3/30/79
SAMPLING LOCATION PREDRYER
SAMPLE TYPE EPA M4 (MOISTURE)
RUN NUMBER M-1
OPERATOR COX
AMBIENT TEMPERATURE 78
BAROMETRIC PRESSURE 30.37
STATIC PRESSURE, (P_s) -1.9" H_2O
FILTER NUMBER (s)



PROBE LENGTH AND TYPE N/A
NOZZLE I.D. N/A
ASSUMED MOISTURE, % N/A
SAMPLE BOX NUMBER N/A
METER BOX NUMBER ES-2
METER $\Delta H_@$ 1.85
C FACTOR N/A
PROBE HEATER SETTING N/A
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

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 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	1525	147.143	–	2.00	2.00	140	69	70	7	–	–
	5	1528	151.23		2.00	2.00	140	80	70	7		
	10	1533	155.37		2.00	2.00	140	86	70	7		
	15	1538	159.03		2.00	2.00	140	92	72	7		
	20	1543	163.73		2.00	2.00	140	97	74	7		
	25	1548	167.46		2.00	2.00	140	99	76	7		
	30	1553	170.806	END TEST								
			23.663			2.00		77.58				

COMMENTS:

EPA (Dm) 235
4/72

ANALYTICAL DATA

PLANT Hwin. U.S. Gen. Sta.

DATE 3/30/74

SAMPLING LOCATION

SAMPLE TYPE moisture run

RUN NUMBER 1

SAMPLE BOX NUMBER

CLEAN-UP MAN [illegible]

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

IMPINGERS

FINAL VOLUME 206 ml

INITIAL VOLUME 200 ml

NET VOLUME 6 ml

SILICA GEL

FINAL WEIGHT 599.4 g _____ g _____ g

INITIAL WEIGHT 593.9 g _____ g _____ g

NET WEIGHT 5.5 g _____ g _____ g

TOTAL MOISTURE 11.5 g

EPA (Dur) 231
4/72

Moisture

FIELD

PLANT: Union Oil
DATE: 3/29/79
SAMPLING LOCATION: Air Predryer
SAMPLE TYPE: EPA-5
RUN NUMBER: #1 P.D.
OPERATOR: COX
AMBIENT TEMPERATURE: 84
BAROMETRIC PRESSURE: 29.96
STATIC PRESSURE, (P_s): -1.9 "H_2O
FILTER NUMBER (s):

PROBE LENGTH AND TYPE: 4' [illegible] / 2' [illegible]
NOZZLE I.D.: 0.241 #35
ASSUMED MOISTURE, %: 2
SAMPLE BOX NUMBER: 1
METER BOX NUMBER: 3
METER $\Delta H_@$: 1.92
C FACTOR: 1.16
PROBE HEATER SETTING:
HEATER BOX SETTING:
REFERENCE Δp: 0.52

For traverse A Cp = 0.
FOR TRAVERSE B Cp = 0.846.

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

initial leak rate = 0.004 cfm @ 15" Hg
Final leak rate = 0.010 cfm @ 11" Hg

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 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 PROBE	IMPINGER TEMPERATURE, °F
A-10	0	1409	751.745	0.73	2.39	2.39	132	81	78	7	135	69
9	3	1412	753.07	0.79	2.45	2.45	131	93	78	7	137	62
8	6	1415	756.42	0.80	2.80	2.80	131	101	80	8	135	66
7	9	1418	758.98	0.78	2.78	2.78	130	108	82	8	133	72
6	12	1421	761.50	0.73	2.60	2.60	130	112	83	8	127	75
5	15	1424	763.97	0.63	2.25	2.25	130	114	85	8	129	73
4	18	1427	766.319	PLANT DOWN								
4B	18	1432	766.319	0.63	2.25	2.25	130	112	83	7	127	70
3B	21	1435	768.77	0.61	2.19	2.19	129	113	89	7	130	66
2B	24	1438	771.02	0.51	1.83	1.83	133	113	89	7	133	68
1B	27	1441	773.23	0.51	1.83	1.83	139	114	90	7	130	67
1B	30	1444	775.353	STOP TEST FOR POINT CHANGE AND PROBE CHANGE; LEAK RATE = 0.008 cfm @ 15" Hg								
B-20	30	1823	792.013	0.91	3.20	3.20	133	80	77	9	130	64
19	33	1826	794.76	0.95	3.37	3.37	132	91	77	9		57
18	36	1829	797.86	1.10	3.85	3.85	133	102	78	11		66
17	39	1832	800.97	0.96	3.35	3.35	131	110	80	10		69
16	42	1835	803.75	0.94	3.30	3.30	132	114	82	9		72
15	45	1838	806.62	0.89	3.15	3.15	131	115	83	9		72
14	48	1841	809.52	0.79	2.78	2.78	131	118	85	7		70
13	51	1844	812.14	0.79	2.78	2.78	130	117	86	7		72
12	54	1847	814.56	0.79	2.78	2.78	130	119	87	7		70
12	57	1850	816.58	0.79	2.78	2.78	130	120	88	7		70

COMMENTS: Traverse B - No Probe heat

EPA 12 60 1853 817.44 END TEST

ANALYTICAL DATA

PLANT UNION OIL CO/Brea, CA

DATE 3/29/79

SAMPLING LOCATION Ammonium Nitrate Pre-Dryer

SAMPLE TYPE Modified M-5

RUN NUMBER #1

SAMPLE BOX NUMBER Team #1

CLEAN-UP MAN Deriada / Willi

COMMENTS: Time in: 1920

4) some condensate in impinger #5

FRONT HALF

LABORATORY RESULT

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

FILTER NUMBER _____ _____ — CONTAINER _____ _____ g

_____ _____

_____ _____

FRONT HALF SUBTOTAL _____ g

BACK HALF

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

ETHER-CHLOROFORM EXTRACTION _____ g

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

BACK HALF SUBTOTAL _____ g

TOTAL WEIGHT _____ g

MOISTURE

IMPINGERS	H_2O		H_2SO_4
FINAL VOLUME	205	ml	190 ml
INITIAL VOLUME	200	ml	200 ml
NET VOLUME	5	ml	

Note: Total rinse volume for H_2O
for filter container
2 elbow, 1st & 2nd impinger

container # 1 300 ml

Container # 2 420 ml

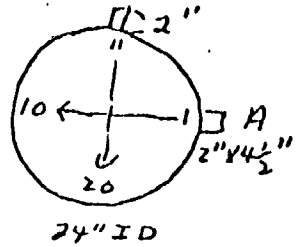
SILICA GEL			
FINAL WEIGHT	599.7 g	_____ g	_____ g
INITIAL WEIGHT	585.1 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

TOTAL MOISTURE _____

EPA (Dur) 231
4/72

K-1-PD

PLANT Union Oil
DATE 3/30/79
SAMPLING LOCATION AN PREDRYER
SAMPLE TYPE EPA 5 modified
RUN NUMBER H2 P.D
OPERATOR J L Cox
AMBIENT TEMPERATURE 28
BAROMETRIC PRESSURE 30.43
STATIC PRESSURE, (P_s) -1.9" H_2O
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 2' S.S
NOZZLE I.D. 0.241
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 1
METER BOX NUMBER 3
METER $\Delta H_@$ 1.90
C FACTOR 1.09
PROBE HEATER SETTING 30
HEATER BOX SETTING —
REFERENCE Δp 0.54

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

initial leak rate = 0.000 cfm @ 15" Hg
Final leak rate = ... cfm @ 15" Hg

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 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 PROBE	IMPINGER TEMPERATURE, °F
					PLUG IN PROBE							
A-10	0	1044	839.842	.79	2.50	2.50	146	98	82		138	64
9	3	1047	842.07	0.81	2.48	2.48	146	113	85	11	146	63
8	6	1050	844.23	0.76	2.40	2.40	146	117	88	10	149	67
7	9	1053	846.87	0.68	2.15	2.15	146	121	89	10	156	68
6	12	1056	849.20	0.63	2.00	2.00	146	122	90	9	155	69
5	15	1059	851.34	0.63	2.00	2.00	145	123	91	9	160	67
4	18	1102	853.71	0.63	2.00	2.00	143	122	93	9	161	66
3	21	1105	855.05	0.61	1.96	1.96	140	122	94	9	160	65
2	24	1108	858.22	0.72	2.29	2.29	140	123	96	9	165	67
1	27	1111	860.63	0.65	2.08	2.08	140	124	96	9	166	69
1	30	1114	862.899	STOP TEST TO CHANGE PARTS								
B-20	30	1338	870.686	0.53	1.83	1.83	144	84	83	9	157	76
19	33	1341	872.96	0.53	1.83	1.83	144	89	84	9	158	75
18	36	1344	875.06	0.55	1.90	1.90	144	96	85	9	155	73
17	39	1347	877.22	0.59	2.05	2.05	144	101	87	9	157	69
16	42	1350	879.63	0.62	2.18	2.18	143	107	88	9	158	68
15	45	1353	881.67	0.69	2.38	2.38	140	110	89	9	152	69
14	48	1356	883.70	0.86	2.98	2.98	138	113	89	14	147	68
13	51	1359	886.73	0.90	3.10	3.10	137	119	89	14	142	66
12	54	1402	889.24	0.90	3.10	3.10	139	121	89	14	144	68
11	57	1405	891.02	0.90	3.10	3.10	137	123	90	14	147	67
11	60	1408	894.661	END TEST								

COMMENTS OK TO BOOST PROBE HEAT ABOVE 10°F limit

NO Final leak Check; probe liner slipped loose from union during test.

EPA (Dul) 235
4 77

ANALYTICAL DATA

PLANT Union Oil Co/Brea, CA

DATE 3/30/79

SAMPLING LOCATION A.N - Pre Dryer

SAMPLE TYPE Modified M-5

RUN NUMBER #2

SAMPLE BOX NUMBER Team #1

CLEAN-UP MAN Deriada / Willi

COMMENTS:
1. filter container has H_2SO_4 in back half. This is rinse into container #2
1st rinse: some lost w/H_2O

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

IMPINGERS	H_2O		H_2SO_4
FINAL VOLUME	242	ml	178 ml
INITIAL VOLUME	200	ml	200 ml
NET VOLUME	42	ml	

SILICA GEL			
FINAL WEIGHT	598.61 g	_____ g	_____ g
INITIAL WEIGHT	583.1 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

TOTAL RINSE VOLUME
Container #1 = 375 ml
(without probe & line wash)
Container #2 : 367

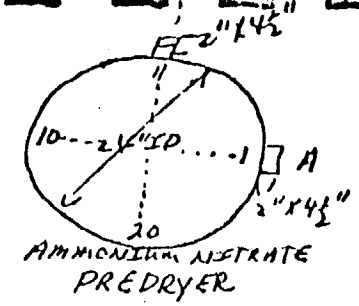
TOTAL MOISTURE _____ g

EPA (Dur) 231
4/72

2-PD

FIELD

PLANT: Union Oil
DATE: 3/30/79
SAMPLING LOCATION: AN PREDRYER
SAMPLE TYPE: EPA M-5
RUN NUMBER: #3 P.D.
OPERATOR: JL Cox
AMBIENT TEMPERATURE: 79
BAROMETRIC PRESSURE: 30.35
STATIC PRESSURE, (P_s): -1.9" H_2O
FILTER NUMBER (s):



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE: 30" pyrex
NOZZLE I.D.: 0.241
ASSUMED MOISTURE, %: 2
SAMPLE BOX NUMBER: 1
METER BOX NUMBER: 3
METER $\Delta H_@$: 1.90
C FACTOR: 1.09
PROBE HEATER SETTING: 70
HEATER BOX SETTING: –
REFERENCE Δp: 0.54

Cp = 0.846

initial leak rate = 0.002 cfm @ 15" Hg
Final leak rate = 0.004 cfm @ 7" Hg

READ AND RECORD ALL DATA EVERY 3 MINUTES

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 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
A-10	0	1642	902.535	0.60	2.09	2.09	193	86	85	6	126	79
09	3	1645	904.07	0.59	2.05	2.05	130	95	86	6	131	76
8	6	1648	907.31	0.49	1.73	1.73	130	103	88	6	132	73
7	9	1651	909.508	STOP TEST TO REPAIR GAS SUPPLY								
7	9	1658	907.31	0.43	1.52	1.52	128	97	88	6	136	70
6	12	1701	911.67	0.38	1.30	1.30	128	103	90	6	133	67
5	15	1704	913.33	0.35	1.22	1.22	128	108	90	6	131	66
4	18	1707	915.07	0.35	1.22	1.22	129	110	91	6	130	67
3	21	1710	917.07	0.33	1.18	1.18	128	110	91	6	130	69
2	24	1713	918.85	0.33	1.18	1.18	128	111	92	5	133	71
1	27	1716	920.66	0.33	1.18	1.18	127	112	93	5	134	71
1	30	1719	922.542	STOP TEST TO CHANGE PORTS								
B-20	30	1727	922.542	0.27	0.94	0.94	126	99	91	4	131	71
19	33	1730	924.31	0.27	0.94	0.94	127	100	92	5	130	70
18	36	1733	925.76	0.26	0.90	0.90	126	102	92	5	130	70
17	39	1736	927.31	0.23	0.77	0.77	126	104	92	4	133	73
16	42	1739	928.71	0.24	0.79	0.79	126	105	92	4	130	73
15	45	1742	930.12	0.26	0.90	0.90	125	106	92	4	131	74
14	48	1745	931.56	0.23	0.77	0.77	119	108	93	4	129	73
13	51	1748	933.06	0.26	0.90	0.90	119	109	93	4	130	74
12	54	1751	934.59	0.26	0.90	0.90	121	110	93	4	131	74
11	57	1754	936.56	0.26	0.90	0.90	121	111	94	4	131	73
11	60	1757	937.618	END TEST								

COMMENTS: OK

EPA (Dul) 235
4 72

ANALYTICAL DATA

PLANT Union Oil Co. / Brea CA

DATE 3/30/79

SAMPLING LOCATION AN - Pre-Dryer

SAMPLE TYPE Modified M-5

RUN NUMBER #3

SAMPLE BOX NUMBER Team #1

CLEAN-UP MAN Deviada / Willi

COMMENTS:
Time in: 1830

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 _____ _____ m

ETHER-CHLOROFORM EXTRACTION _____ m

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

BACK HALF SUBTOTAL _____ m

TOTAL WEIGHT _____ m

MOISTURE

IMPINGERS	H_2O		H_2SO_4
FINAL VOLUME	207	ml	196 ml
INITIAL VOLUME	200	ml	200 ml
NET VOLUME	7	ml	

SILICA GEL			
FINAL WEIGHT	_____ g	_____ g	_____ g
INITIAL WEIGHT	_____ g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

Total Rinse Volume

Container #1 : 447 ml (before probe & line wash)

Container #2 : 400 ml

TOTAL MOISTURE _____

EPA (Dur) 231
4/72

2-3-80

SAMPLING SUMMARY SHEET

Plant: Union Oil Location: Brea Calif.

Sampled source: Ammonium Nitrate Predryer Inlet

Run	Date	N_p	P_m	P_b	V_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
PD1	3/29/79	20	2.74	29.96	51.035	93.1	49.110	11.5	0.5428	2.2	.978
PD2	3/30/79	20	2.32	30.43	47.032	100.6	45.079	11.5	0.5428	2.2	.978
PD3	3/30/79	20	1.17	30.35	35.083	97.7	33.774	11.5	0.5428	2.2	.978

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}$ [c]	V_s	T_s	T_t	D_n	%I
PD1		29	-.14	29.82	0.846	21.4	3157.5	131	60	.241	93.3
PD2		29	-.14	30.29	0.846	20.4	2992.8	142	60	.241	91.2
PD3		29	-.14	30.21	0.846	13.9	2041.2	129	60	.241	97.8

$$V_{m_{std}} = \frac{17.64 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

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

$$V_{w_{gas}} = 0.0474 \times V_w$$

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

$$MW_d = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + (\%CO + \%N_2) \times \frac{28}{100}$$

$$MW = MW_d \times M_d + 18 (1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5128.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\% I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

% M % Moisture by Volume

M_d Mole Fraction of Dry Gas

$\% CO_2$ Volume % Dry

$\% O_2$ Volume % Dry

% CO Volume % Dry

$\% N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg. Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

% I Percent Isokinetic

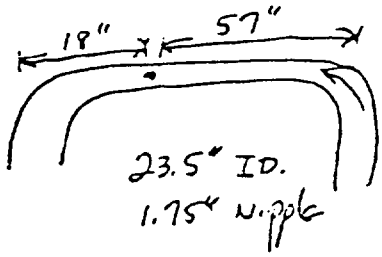
[a] Dry standard cubic feet at 70°F, 29.92 in. Hg.

[b] Standard conditions at 70°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute stack temperature from each sampling point.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Union Oil Fertilizer Plant
DATE 3/27/79
SAMPLING LOCATION Ammonium Nitrate Dryer
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 25.25"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) 1.75"
STACK I.D., (DISTANCE A - DISTANCE B) 23.5"
NEAREST UPSTREAM DISTURBANCE 57"
NEAREST DOWNSTREAM DISTURBANCE 18"
CALCULATOR Hockett



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 LOCA FROM OUTSIDE OF NIPP (SUM OF COLUMNS 4 &	
1	0.016	23.5"	0.376 ✓	1.75"	2.126	2 1/8"
2	0.049		1.151		2.901	2 7/8"
3	0.085		1.997		3.747	3 3/4"
4	0.125		2.937		4.687	4 5/8"
5	0.169		3.971		5.721	5 3/4"
6	0.220		5.17		6.920	6 7/8"
7	0.283		6.650		8.4	8 3/8"
8	0.375		8.812		10.562	10 1/2"
9	0.625		14.687		16.437	16 1/2"
10	0.717		16.849		18.599	18 5/8"
11	0.780		18.330		20.08	20"
12	0.831		19.528		21.278	21 1/4"
13	0.875		20.562		22.312	22 3/8
14	0.915		21.502		23.252	23 1/4"
15	0.951		22.348		24.098	24 1/8"
16	0.984		23.124 ✓		24.874	24 7/8

EPA (Dur) 232
4/72

NOMOGRAPH DATA

PLANT Unim Oil Co., Brea, Ca

DATE: 3/29/79

SAMPLING LOCATION AN - Dryer

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.93
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	2.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.56
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	29.74
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.99
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	161
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.93
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	1.4
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	0.250	
ACTUAL NOZZLE DIAMETER, in.	0.235	
REFERENCE Δp, in. H_2O	0.61	

EPA (Dur) 234
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT Union Oil Co. of California
DATE 3/29/79
LOCATION Dryer Outlet
STACK I.D. 23.5"
BAROMETRIC PRESSURE, in. Hg 29.96
STACK GAUGE PRESSURE, in. H_2O
OPERATORS M. Hackett / R. Dearborn

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	0.76	156
2	0.81	160
3	0.80	161
4	0.81	162
5	0.79	161
6	0.82	161
7	0.93	161
8	1.0	161
AVERAGE		

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	1.5	162
2	1.5	162
3	1.5	162
4	0.95	162
5	0.88	162
6	0.81	162
7	0.79	162
8	0.65	162
AVERAGE		

EPA (Dur) 233
4/72

PLANT Union Oil of California
DATE March 29, 1979
SAMPLING LOCATION Dryer
SAMPLE TYPE Modified EPA Method 5
RUN NUMBER 1: 1 D
OPERATOR Hackett
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.96
STATIC PRESSURE, (P_s) -2.9" H_2O
FILTER NUMBER (s)

PROBE LENGTH AND TYPE
NOZZLE I.D.
ASSUMED MOISTURE, %
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

initial leak check 0.00 cfm/15 sec.

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 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
14A	0	1409	93.463	.4	1.3	1.3	145	87		4	142	72
14A	3	1412	95.0	.45	1.5	1.5	144	90		4	146	78
14A	6	1415	97.002	.45	1.5	1.5	144	91		4	148	78
13A	9	1418	98.800	.4	1.3	1.3	143	92		4	146	77
12A	12	1421	100.550	.4	1.3	1.3	143	94		4	149	75
11A	15	1424	102.310	.38	1.25	1.25	143	95		4	149	73
10A	18	1427	104.071		Plant		Shut Down					
10A		1432	104.071	.3	1.0	1.0	143	95		4	150	69
9A	21	1435	105.71	.28	.95	.95	143	95		4	150	71
8A	24	1438	107.33	.23	.76	.76	145	95		4	147	71
7A	27	1441	108.81	.17	.575	.575	150	96		3	144	69
6A	30	1444	110.11	.17	.575	.575	152	97		3	142	69
5A	33	1447	111.34	.35	1.15	1.15	142	97		4	143	69
4A	36	1450	113.01	.4	1.3	1.3	140	98		4	144	70
3A	39	1453	114.81	.48	1.5	1.5	134	99		4.5	146	70
2A	42	1456	116.75	.47	1.45	1.45	124	100		4.5	146	69
1A	45	1459	118.85	.42	1.4	1.4	112	100		4.5	147	68
1A*	48*	1502*	120.832*									

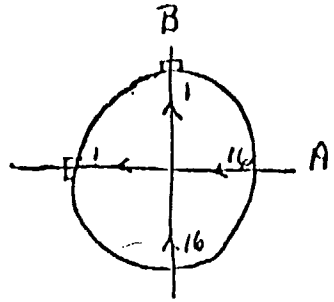
* Corrections made 5-13-80 by L.W. Rawgiewicz

25.387

COMMENTS:

EPA (Dur) 235
4 72

PLANT Union oil California
DATE March 29, 1979
SAMPLING LOCATION Dryer
SAMPLE TYPE Modified Method 5
RUN NUMBER # 1 D
OPERATOR Thickett
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.96
STATIC PRESSURE, (P_s) -2.9 "H_2O
FILTER NUMBER (s)



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE
NOZZLE I.D. 0.235 ARC SET A
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

Initial leak check (new probe) .004 cfm/minute

READ AND RECORD ALL DATA EVERY 3 MINUTES

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 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
13B	0	1820	121.32	.27	.88	.88	156	76		3.5	132	68
13B	3	1823	122.85	.27	.88	.88	156	78		3.5	153	73
13B	6	1826	124.30	.32	1.05	1.05	156	79		3.5	161	75
13B	9	1829	125.92	.49	1.6	1.6	156	81		5	167	76
12B	12	1832	127.92	.50	1.65	1.65	156	83		5	171	76
11B	15	1835	129.91	.54	1.75	1.75	156	85		5	185	74
10B	18	1838	132.07	.55	1.8	1.8	156	88		5	195	73
9B	21	1841	134.29	.57	1.85	1.85	156	90		5	175	73
8B	24	1844	136.41	.56	1.85	1.85	156	91		5	171	72
7B	27	1847	138.62	.56	1.85	1.85	156	93		5	170	72
6B	30	1850	140.85	.59	1.9	1.9	156	95		5	167	71
5B	33	1853	143.15	.6	1.95	1.95	155	96		5.5	166	71
5B	36	1856	146.32	.71	2.3	2.3	156	97		6	167	71
5B	39	1859	147.77	.7	2.3	2.3	155	99		6.5	167	71
5B	42	1862	149.50	.7	2.3	2.3	155	100		6.5	168	70
5B	45	1905	152.77	.65	2.1	2.1	156	102		6	168	69
5B*	48*	1908*	155.202*									
			56.837				153					
* Corrections made 5-13-80 by F.W. Rangiewicz												
				13.91		15.42						
				.43		1.42						

COMMENTS:

EPA (Dec) 235

ANALYTICAL DATA

PLANT Union Oil Co./Brea CA

DATE 3/29/79

SAMPLING LOCATION AN - Dryer

SAMPLE TYPE Modified M-5

RUN NUMBER # 1

SAMPLE BOX NUMBER Team #2

CLEAN-UP MAN Denada / Willi

COMMENTS:
Time in : 1915
broken glassware in 1st impinge and probe

FRONT HALF

LABORATORY RESUL

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	H_2O	H_2SO_4
FINAL VOLUME	232 ml	199.8 ml
INITIAL VOLUME	200 ml	200 ml
NET VOLUME	32 ml	

SILICA GEL			
FINAL WEIGHT	596.6 g	_____ g	_____ g
INITIAL WEIGHT	582.7 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

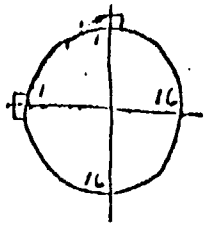
Total Rinse Volume
Container #1 = 415 ml
(without probe & teflon tube rinses)
Container #2 = 405 ml

TOTAL MOISTURE _____

EPA (Dur) 231
4/72

R-1-D

PLANT Union Oil of Calif.
DATE March 30, 1979
SAMPLING LOCATION Dryer
SAMPLE TYPE Modified Method 5
RUN NUMBER # 2 D
OPERATOR Mike Hackett
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 30.43
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 2' SS PYREX
NOZZLE I.D. .235
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 2
METER BOX NUMBER 1
METER $\Delta H_@$ 1.
C FACTOR 1.05
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp .61

SCHEMATIC OF TRAVERSE POINT LAYOUT

Initial leak check 0.00 cfm/15 sec.

READ AND RECORD ALL DATA EVERY 3 MINUTES

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 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
16A				0								
15A				0								
14A	0	0951	157.774	false	start	- Probe	clogged					
14A	0	1003	157.997	false	start	- Probe	clogged					
14A	0	1008	157.276	false	start	- Probe	clogged		STARTED			
A	0	1015	157.417	false	start	- Probe	clogged					
13A	0	1020	157.848	false	start	- Probe	clogged					
13A	0	1051	158.315	false	start	- Probe	clogged					
→ 13A	0	1231	174.516	.45	1.36	1.36	166	10	2	3.5	82	70
12A	3	1234	176.780	.41	1.25	1.25	166	10	4	3.5	140	78
11A	6	1237	176.500	.38	1.18	1.18	165	10	4	3.5	175	80
10A	9	1240	180.460	.28	.85	.85	165	10	5	3	184	79
9A	12	1243	181.900	.24	.74	.74	165	10	4	3	190	77
8A	15	1246	183.310	.31	.97	.97	164	10	5	3	179	76
7A	18	1249	184.950	.4	1.22	1.22	164	10	5	3.5	174	76
6A	21	1252	186.750	.41	1.29	1.29	163	10	5	4	171	76
5A	24	1255	188.600	.45	1.4	1.4	163	10	5	4	171	76
4A	27	1258	190.5	0.46	1.42	1.42	163	10	5	4.0	171	75
3A	30	1301	192.4	0.43	1.35	1.35	163	10	6	4.0	172	74
2A	33	1304	194.5	0.45	1.40	1.40	162	10	6	4.0	171	74
1A	36	1307	196.6	0.45	1.40	1.40	162				173	74
			198.569									

COMMENTS

STARTED FIRST POINT AT 13A

EPA (Dim) 235

36

36

NUMBER	SAMPLING TIME, min	CLOCK	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE 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
13B	0	1332	198.573	.70	2.15	2.15	159	103		5.5	155	76
12B	3	1335	200.620	.85	2.6	2.6	159	104		6.5	157	79
11B	6	1338	202.700	.88	2.7	2.7	160	105		7	157	81.
10B	9	1341	205.430	.85	2.6	2.6	160	107		6.5	160	77.
9B	12	1344	208.120	.77	2.4	2.4	160	107		6	165	74.
8B	15	1347	210.778	.27	.96	.96	160	106		4.5	172	73.
7B	18	1350	212.580	.04	.125	.125	160	106		1	177	70.
6B	21	1353	213.5	.05	.15	.15	160	105		1	183	70.
5B	24	1356	214.19	.03	.09	.09	153	104		0.5	187	69.
4B	27	1359	214.79	.05	.15	.15	161	104		0.5	188	69.
3B	30	1402	215.39	.03	.09	.09	160	104		0.5	188	69.
5B	33	1405	215.95	.03	.09	.09	160	104		0.5	189	68.
5B	36	1408	216.59	.03	.09	.09	161	104		0.5	196	68.
5B*	39*	1411	217.090*									
		36	18.517									

* Corrections made 5-13-80 by L.W. Karazienicz

EPA (Dur) 236
4 72

NOTE: FIRST 3 POINTS WERE NOT SAMPLED

ANALYTICAL DATA

PLANT Union Oil Co / Brea CA

DATE 3/30/79

SAMPLING LOCATION A N - Dryer

SAMPLE TYPE Modified M-5

RUN NUMBER # 2

SAMPLE BOX NUMBER Team # 2

CLEAN-UP MAN Demada / Willi

COMMENTS:

Impinger backflow from impinger #3 to #2. This filter was rinsed and added to container #1. The H_2SO_4 that was held in the filter holder was place into container #2

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 _____

Total Rinse Volume

Container #1 : 590 ml (without probe & line wash)

container #2 : 415 ml

MOISTURE

IMPINGERS	H_2O	H_2SO_4
FINAL VOLUME	245 ml	176 ml
INITIAL VOLUME	200 ml	200 ml
NET VOLUME	45 ml	

SILICA GEL			
FINAL WEIGHT	589.6 g	_____ g	_____ g
INITIAL WEIGHT	581.4 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

TOTAL MOISTURE _____

EPA (Dur) 231
4/72

FIELD DATA

PLANT Union Oil of California
DATE March 30, 1979
SAMPLING LOCATION Dryer
SAMPLE TYPE Modified Method 5
RUN NUMBER #3 D
OPERATOR Hackett
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 30.43
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)

PROBE LENGTH AND TYPE 2' SS PYREX
NOZZLE I.D. .235"
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 2
METER BOX NUMBER 1
METER $\Delta H_@$
C FACTOR 1.05
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp .61

0
1
2
3
4
5
6
F

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

Initial leak check 0.012 0.00 CFM/15 sec
Final leak check 0.18 CFM/Minute

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	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
16A				0								
15A				0								
14A				0								
13A	0	1642	224.023	.38	.86	.86	150	10	0	3	188	77
12A	3	1645	225.580	1.4	4.2	4.2	152	10	1	11	157	86
11A	6	1648	228.750	1.3	3.95	3.95	152	10	5	10	143	82
10A	9	1651	231.920	1.25	3.7	3.7	152	10	8	9.5	151	76
9A	12	1654	235.200	1.15	3.5	3.5	152	10	8	9	152	75
8A	15	1657	238.280	1.05	3.2	3.2	152	10	9	8.5	163	72
7A	18	1700	241.185	1.05	3.2	3.2	152	10	9	8.5	173	71
6A	21	1703	244.170	.98	2.95	2.95	152	10	9	7.5	182	70
5A	24	1706	247.100	.96	2.8	2.8	152	10	9	7.5	171	69
4A	27	1709	249.850	.57	1.7	1.7	152	10	8	6	158	69
3A	30	1712	251.720	.73	2.2	2.2	152	10	8	6	155	69
2A	33	1715	253.650	.7	2.1	2.1	151	10	7	6	151	70
1-A* ~~2A~~	36	1718	256.738	.61	1.9	1.9	152	10	7	5.5	153	69
1-A*	39*	1721*	258.998*									

* Corrections made 5-13-80 by L.W. Rurojielwing

NUMBER	SAMPLING TIME, min	CLOCK	GAS METER READING (V_m, ft³)	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	VACUUM, in Hg	BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
16B				0								
15B				0								
14B				0								
13B		1427	258.998	.65	2.0	2.0	151	103		5.5	137	70.
12B		1430	261.190	.81	2.4	2.4	152	102		6	137	73.
11B		1433	263.680	.94	2.8	2.8	152	102		7.5	163	73.
10B		1436	266.360	.93	2.7	2.7	152	104		7	165	72.
9B		1439	269.180	.9	2.7	2.7	152	104		7	159	71
8B		1442	271.950	1.1	3.3	3.3	153	105		8.5	159	70.
7B		1445	274.930	1.3	3.9	3.9	151	107		10.0	158	70.
6B		1448	278.150	1.4	4.2	4.2	146	108		10.5	158	68.
5B		1451	281.750	1.5	4.4	4.4	145	109		11	158	66.
5B		1454	285.250	1.4	4.2	4.2	151	110		10.5	158	65.
5B		1457	288.330	1.4	4.2	4.2	150	110		11	158	65.
5B		1500	291.750	1.4	4.2	4.2	151	111		11	159	65.
5B		1503	295.170	1.4	4.2	4.2	151	111		10.5	159	65.
5B*		1506*	298.610*									

* Corrections made 5-13-80 by F.W. Rarogiewicz

EPA (Dul) 236
4 72

ANALYTICAL DATA

PLANT Union Oil Co. / Brea CA

DATE 3/30/79

SAMPLING LOCATION AN - Dryer

SAMPLE TYPE Modified M-5

RUN NUMBER Run # 3

SAMPLE BOX NUMBER Team #2

CLEAN-UP MAN Deriada / Willi

COMMENTS:

Time in : 1830

Condensate on side walls of impinger #5

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

Total Rinse Volume

Container #1 : 325 ml

Container #2 : 440 ml

MOISTURE

IMPINGERS	H_2O	H_2SO_4
FINAL VOLUME	210 ml	200 ml
INITIAL VOLUME	200 ml	200 ml
NET VOLUME	_____ ml	

SILICA GEL			
FINAL WEIGHT	603.9 g	_____ g	_____ g
INITIAL WEIGHT	585.1 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

TOTAL MOISTURE _____

EPA (Dur) 231
4/72

R-3-D

SAMPLING SUMMARY SHEET

Plant: Union Oil Location: Brea Calif.

Sampled source: Ammonium Nitrate Dryer

Run	Date	N_p	P_m	P_b	V_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
D-1	3-29-79	32	1.46	29.96	56.837	92	54.612	11.5	0.5428	2.2	.978
D-2	3-30-79	26	1.15	30.43	40.101	105	38.204	11.5	0.5428	2.2	.978
D-3	3-30-79	26	3.13	30.43	68.887	107	65.709	11.5	0.5428	2.2	.978

Run	MW_d	MW	P_{st}	P_s	C_p*	$\sqrt{\Delta P_s \times (T_s+460)}$ c	V_s	T_s	T_t	D_n	%I
D-1		29	-.21	29.75	0.846	16.26	2402	148	90	0.235	98.6
D-2		29	-.21	30.22	0.846	13.89	2036	161	72	0.235	102
D-3		29	-.21	30.22	0.846	25.00	3664	151	72	0.235	96

$$V_{m_{std}} = \frac{17.64 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

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

$$V_{w_{gas}} = 0.0474 \times V_w$$

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

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + (\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18\,(1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5128.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

% M Moisture by Volume

M_d Mole Fraction of Dry Gas

$\%CO_2$ Volume % Dry

$\%O_2$ Volume % Dry

% CO Volume % Dry

$\%N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

% I Percent Isokinetic

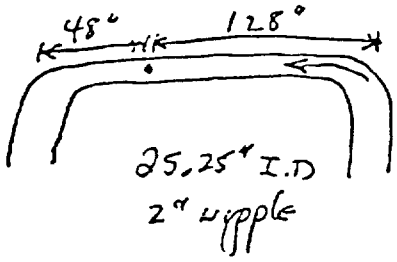
[a] Dry standard cubic feet at 70°F, 29.92 in. Hg.

[b] Standard conditions, at 70°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute st[illegible] porat[illegible] [illegible]m ea[illegible] [illegible]pling [illegible]t.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Union Oil Fertilizer Plant
DATE 3/27/79
SAMPLING LOCATION Cooler of Ammonium Nitrate
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE A) 27 1/4"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE B) 2"
STACK I.D., (DISTANCE A - DISTANCE B) 25 1/4"
NEAREST UPSTREAM DISTURBANCE 128"
NEAREST DOWNSTREAM DISTURBANCE 48"
CALCULATOR Lincott



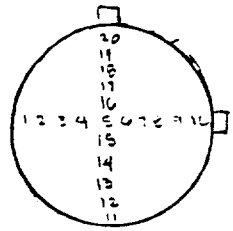
SCHEMATIC OF SAMPLING LOCATION

1	2	3	4	5	
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 LOCA FROM OUTSIDE OF NIPP (SUM OF COLUMNS 4 &
1	0.026	25 1/4"	0.656	2"	2.656 2 5/8"
2	0.082		2.070		4.070 4 1/8"
3	0.146		3.686		5.686 5 5/8"
4	0.226		5.706		7.706 7 3/4"
5	0.342		8.635		10.635 10 5/8"
6	0.658		16.614		18.614 18 5/8"
7	0.774		19.543		21.543 21 1/2"
8	0.854		21.563		23.563 23 5/8"
9	0.918		23.179		25.179 25 1/8"
10	0.974		24.593		26.593 26 5/8"

EPA (Dur) 232
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT Union Oil Co of California
DATE March 29, 1979
LOCATION Ammonium Nitrate Cooler
STACK I.D. 25.25 inches
BAROMETRIC PRESSURE, in. Hg 29.96
STACK GAUGE PRESSURE, in. H_2O -3.5
OPERATORS A.L. Wilson / Steve Hernandez



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1007 1	0.70	124
2	0.74	125
3	0.76	126
4	0.72	126
Break 5	0.80	126
6	0.70	118 *
Break 7	0.76	123
8	0.58	112*
9	0.67	106*
10	0.74	99*
11	Sediment on bottom of duct	
12	0.44	120
13	0.51	124
14	0.65	126
15	0.75	126
16	0.64	126
17	0.64	113
18	0.65	102
19	0.62	114
1031 - 20	0.75	107
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1034 1	0.67	109
2	0.79	119
3	0.75	124
4	0.70	126
5	0.67	127
6	0.77	128
7	0.80	128
8	0.78	123
9	0.69	120
1038 10	0.63	108
11	Sediment on bottom	
12	0.64	106
13	0.70	115
14	0.73	121
15	0.75	124
16	0.66	127
17	0.69	127
18	0.66	127
19	0.65	125
20	0.60	114
AVERAGE		

EPA (Dur) 233
4/72

* suspect air leakage around probe into duct
P_s = 3.5 inches H_2O

NOMOGRAPH DATA

PLANT Union Oil Co. Brea, CA

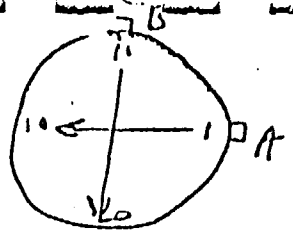
DATE 3/25/75

SAMPLING LOCATION AN-Cooler

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.90
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	2.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	25.96
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	25.70
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.55
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	114
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.62
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	1.2
C FACTOR	1.60	
CALCULATED NOZZLE DIAMETER, in.	0.25	
ACTUAL NOZZLE DIAMETER, in.	0.246	
REFERENCE Δp, in. H_2O	0.48	

EPA (Dur) 234
4/72

PLANT Union Oil of Calif
DATE March 29, 1979
SAMPLING LOCATION AN Cooler
SAMPLE TYPE Mod. EPA Method 5
RUN NUMBER W 1 C
OPERATOR A L Wilson / SH
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.56
STATIC PRESSURE, (P_s) 29.70
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 4' SS liner $C_p = 0.84$
NOZZLE I.D. 0.246 7E31
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 3
METER BOX NUMBER 2
METER $\Delta H_@$ 1.9
C FACTOR 1.10
PROBE HEATER SETTING 40
HEATER BOX SETTING —
REFERENCE Δp 0.48
Initial leak check = 0.000 cfm @ 15" Hg

SCHEMATIC OF TRAVERSE POINT LAYOUT

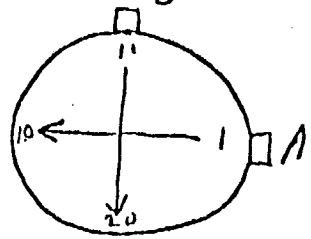
READ AND RECORD ALL DATA EVERY 3 MINUTES

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 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 Probe liner	IMPINGER TEMPERATURE, °F
A 9	0	1409	236.569	0.41	1.60	1.60	121	8	2	7.0	127	68
A 9	3	1412	238.0	0.39	1.50	1.50	120	8	3	6.5	128	67
A 8	6	1415	240.60	0.43	1.66	1.66	120	8	5	6.5	130	67
A 7	9	1418	242.90	0.44	1.70	1.70	120	8	7	7.0	131	68
A 6	12	1421	245.0	0.41	1.60	1.60	120	8	8	6.5	132	69
A 5	15	1424	247.0	0.40	1.55	1.55	120	9	0	6.5	132	69
	18	1427	249.041	Plant Down			Shut system		ft at	1427		
A 4	18	1432	249.041	0.43	1.66	1.66	118	8	8	6.5	135	69
A 3	21	1435	251.4	0.37	1.42	1.42	115	9	0	6.0	135	69
A 2	24	1438	253.5	0.28	1.13	1.13	111	9	0	6.0	133	69
A 2	27	1441	255.3	0.16	0.69	0.69	119	9	0	9.0	132	69
A 2	30	1444	256.371	Changed		ports						
B 19	30	1820	256.371	0.53	2.00	2.00	126	7	0	8.0	116	51
B 19	33	1823	258.50	0.53	2.00	2.00	126	7	1	8.0	117	48
B 18	36	1826	261.0	0.67	2.52	2.52	126	7	4	10.0	125	50
B 17	39	1829	263.4	0.71	2.70	2.70	126	7	6	10.5	130	54
B 16	42	1832	265.8	0.73	2.75	2.75	126	8	0	10.5	133	57
B 15	45	1835	268.0	0.69	2.60	2.60	126	8	1	11.0	135	58
B 14	48	1838	271.2	0.67	2.52	2.52	125	8	4	11.2	134	59
B 13	51	1841	273.9	0.64	2.40	2.40	123	8	6	11.5	127	60
B 12	54	1844	276.6	0.64	2.40	2.40	124	8	8	14.0	123	61
B 12	57	1847	279.0	0.67	2.52	2.52	125	9	0	20.0	119	62
B 12	60	1850	281.599									

COMMENTS

EPA (Dual) 235
4/72

PLANT Union Oil Co. of Cal
DATE March 30, 1979
SAMPLING LOCATION AN cooler
SAMPLE TYPE Mod EPA Method 5
RUN NUMBER # 2 C
OPERATOR A.L. Wilson / Steve H
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 30.43
STATIC PRESSURE, (P_s) 29.70
FILTER NUMBER (s)



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' SS Pitot $C_p = 0.84$
NOZZLE I.D. 0.246
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 3
METER BOX NUMBER 2
METER $\Delta H_@$ 1.9
C FACTOR 1.10
PROBE HEATER SETTING 40
HEATER BOX SETTING —
REFERENCE Δp 0.48

Initial Leak check = 0.004 cfm @ 15" Hg
No Final Leak check, it was forgotten

READ AND RECORD ALL DATA EVERY 3 MINUTES

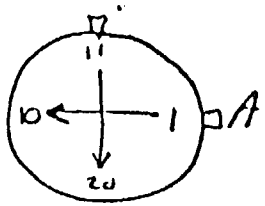
TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	~~SAMPLE BOX~~ TEMPERATURE, °F Probe Liner	IMPINGER TEMPERATURE, °F
B19	0	1003	281.694	0.63	2.35	2.35	122	72		7.0	137	60
B19	3	1006	284.3	0.60	2.28	2.28	122	74		7.0	136	53
B18	6	1009	286.9	0.68	2.55	2.55	122	76		7.5	135	56
B17	9	1012	289.3	0.68	2.55	2.55	122	79		7.5	132	61
B16	12	1015	292.1	0.75	2.85	2.85	122	82		8.5	129	65
B15	15	1018	294.6	0.65	2.45	2.45	122	85		7.5	127	67
B14	18	1021	297.2	0.60	2.28	2.28	122	86		7.0	127	69
B13	21	1024	299.7	0.65	2.45	2.45	121	88		7.0	128	69
B12	24	1027	302.2	0.5	2.05	2.05	113	90		6.5	129	69
B12	27	1030	304.7	0.55	2.10	2.10	116	90		7.0	130	70
	30	1033	307.038	Chosed		Ports						
A-9	0	1347	307.038	0.54	2.05	2.05	120	78		6.0	116	52
A-9	3	1350	309.4	0.63	2.35	2.35	121	78		6.5	117	49
A-8	6	1353	12.0	0.70	2.65	2.65	121	80		7.0	117	52
A-7	9	1356	314.6	0.78	2.95	2.95	122	82		7.5	118	56
A-6	12	1359	317.5	0.85	3.20	3.20	122	84		8.0	116	59
A-5	15	1402	320.2	0.92	3.45	3.45	121	86		8.0	115	62
A-4	18	1405	323.2	1.00	3.85	3.85	122	89		8.0	114	63
A-3	21	1408	—	1.10	4.10	4.10	121	92		9.0	115	65
A-2	24	1411	329.6	1.10	4.10	4.10	119	94		9.0	114	66
A-2	27	1414	332.9	1.20	4.50	4.50	121	97		10.0	113	67
	30	1417	336.559	Stop test.								

COMMENTS

EPA (Dol) 235
4 72

FIE

PLANT Union Oil Co. of Cal
DATE March 20, 1975
SAMPLING LOCATION A-1 Cooler
SAMPLE TYPE Mod. EPA Method 5
RUN NUMBER # 3 C
OPERATOR ACW / SH
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 30.35
STATIC PRESSURE, (P_s) 29.70
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 4'55 Liner Cp = 0.84
NOZZLE I.D. 0.246
ASSUMED MOISTURE, % 2
SAMPLE BOX NUMBER 3
METER BOX NUMBER 2
METER $\Delta H_@$ 1.9
C FACTOR 1.10
PROBE HEATER SETTING 40
HEATER BOX SETTING —
REFERENCE Δp 0.48

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

Initial Leak check = 0.001 cfm @ 15 in
Final Leak check = 0.009 cfm @ 15 in

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 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 Probe Liner	IMPINGER TEMPERATURE, °F
A9	0	1645	336.844	0.70	2.63	2.63	115	8	3	7.0	113	54
A9	3	1648	339.7	0.68	2.55	2.55	116	8	4	7.0	112	50
A8	6	1651	342.2	0.68	2.55	2.55	116	8	5	7.0	113	55
A7	9	1654	344.8	0.67	2.50	2.50	116	8	7	7.0	115	60
A6	12	1657	347.5	0.65	2.45	2.45	116	8	9	7.0	115	63
A5	15	1700	349	0.70	2.63	2.63	116	9	0	7.0	116	65
A4	18	1703	352.6	0.65	2.45	2.45	116	9	2	7.0	116	66
A3	21	1706	355.3	0.65	2.45	2.45	115	9	2	7.0	112	67
A2	24	1709	358.0	0.66	2.50	2.50	114	9	3	7.0	107	68
A2	27	1712	360.5	0.68	2.55	2.55	114	9	4	7.0	106	68
	30	1715	363.129	Changed Parts								
B19	0	1733	363.129	0.58	2.20	2.20	112	9	0	6.0	106	59
B19	3	1736	65.5	0.56	2.13	2.13	115	9	2	6.0	107	57
B18	6	1739	368.0	0.65	2.45	2.45	116	9	4	7.0	109	60
B17	9	1742	370.6	0.67	2.50	2.50	116	9	4	7.0	111	63
B16	12	1745	373.1	0.67	2.50	2.50	116	9	6	7.0	115	65
B15	15	1748	375.8	0.65	2.45	2.45	117	9	6	7.0	120	66
B14	18	1751	378.4	0.64	2.40	2.40	117	9	7	7.0	121	66
B13	21	1754	381.0	0.58	2.20	2.20	116	9	7	7.0	122	66
B12	24	1757	383.5	0.60	2.28	2.28	110	9	8	7.0	122	66
B12	27	1800	385.9	0.58	2.20	2.20	105	9	8	7.0	123	66
	30	1803	388.330	Stop test								

COMMENTS

EPA (Oct) 235
4 72

Leak check 11

ANALYTICAL DATA

PLANT Union Oil Co/Brea CA

DATE 3/29/79

SAMPLING LOCATION AN - Cooler

SAMPLE TYPE Modified M-5

RUN NUMBER # 1

SAMPLE BOX NUMBER Team #3

CLEAN-UP MAN Deriada / Willi

COMMENTS:

Time in : 7:15 pm

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

IMPINGERS	H_2O	H_2SO_4
FINAL VOLUME	215 ml	195 ml
INITIAL VOLUME	200 ml	200 ml
NET VOLUME	15 ml	

SILICA GEL			
FINAL WEIGHT	1595.9 g	_____ g	_____ g
INITIAL WEIGHT	1593.9 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

Total Rinse Volume

Container # 1 : 340 ml
(without probe & teflon tube wash)

Container # 2 : 390 ml

TOTAL MOISTURE _____ g

EPA (Dur) 231
4/72

-1-c

ANALYTICAL DATA

PLANT Union Oil Co / Brea, CA

DATE 3/30/79

SAMPLING LOCATION AN- Cooler

SAMPLE TYPE Modified M-5

RUN NUMBER Run # 3

SAMPLE BOX NUMBER Team # 3

CLEAN-UP MAN Denada / Willi

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

IMPINGERS	H_2O		H_2SO_4
FINAL VOLUME	215	ml	200 ml
INITIAL VOLUME	200	ml	200 ml
NET VOLUME	15	ml	

Total Rinse Volume
container # 1 : 440 ml
(without probe & liner wash)
container # 2 : 393 ml

SILICA GEL			
FINAL WEIGHT	597.25 g	_____ g	_____ g
INITIAL WEIGHT	584.0 g	_____ g	_____ g
NET WEIGHT	_____ g	_____ g	_____ g

TOTAL MOISTURE _____ g

EPA (Dur) 231
4/72

-2-c

ANALYTICAL DATA

PLANT Union Oil Co / Brea CA

DATE 3/30/79

SAMPLING LOCATION AN - Cooler

SAMPLE TYPE Modified M-5

RUN NUMBER Run # 3

SAMPLE BOX NUMBER Team #3

CLEAN-UP MAN Demada / Willi

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

IMPINGERS	H_2O		H_2SO_4
FINAL VOLUME	210	ml	200 ml
INITIAL VOLUME	200	ml	200 ml
NET VOLUME		ml	

SILICA GEL			
FINAL WEIGHT	595.1 g	g	g
INITIAL WEIGHT	582.6 g	g	g
NET WEIGHT	g	g	g

Total Rinse Volume

container # 1: 550 ml

container # 2: 400 ml

TOTAL MOISTURE _____

EPA (Dur) 231
4/72

2-3-C

SAMPLING SUMMARY SHEET

Plant: Union Oil Location: Brea California

Sampled source: Ammonium Nitrate Cooler

Run	Date	N_p	P_m	P_b	V_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
C-1	3-29-79	20	1.94	29.96	45.030	83.65	43.983	11.5	0.5428	2.2	.978
C-2	3-30-79	20	2.86	30.43	54.865	83.6	54.552	11.5	0.5428	2.2	.978
C-3	3-30-79	20	2.43	30.35	51.486	92	50.229	11.5	0.4428	2.2	.978

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}$ [c]	V_s	T_s	T_t	D_n	%I
C-1		29	-0.26	29.70	0.84	17.00	2496	122	60	0.246	100.3
C-2		29	-0.73	29.70	0.84	20.78	3050	121	60	0.246	102
C-3		29	-0.65	29.70	0.84	19.24	2825	115	60	0.246	100

$$V_{m_{std}} = \frac{17.7 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

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

$$V_{w_{gas}} = 0.0474 \times V_w$$

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

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + (\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18\,(1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5128.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

% M Moisture by Volume

M_d Mole Fraction of Dry Gas

$\% CO_2$ Volume % Dry

$\% O_2$ Volume % Dry

% CO Volume % Dry

$\% N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

% I Percent Isokinetic

[a] Dry standard cubic feet at 70°F, 29.92 in. Hg.

[b] Standard conditions at 70°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute st[illegible]npera[illegible]rom c[illegible]mpli[illegible]t.

APPENDIX D

NITRATE ANALYSIS DATA

Part I - Discussion of Analytical Methods
Part II - Laboratory Data
Part III - Lab Notebook

APPENDIX D

AMMONIA AND NITRATE ANALYSIS

The analysis for ammonia and nitrate followed methods prepared by EPA. Complete copies of these methods can be found in Appendix I.

The ammonia analysis was performed by a direct Nesslerization. However, all the field samples were too concentrated for direct analysis. Several dilutions of a sample aliquot were required before the sample could be analyzed. All the dilution data and absorbance values for the Nesslerization are presented in Table D-1. To determine the final concentration of ammonia, a calibration curve was prepared by plotting known concentrations of ammonia versus absorbance. The ammonia calibration curve is presented in Figure D-1.

The determination of nitrate was performed by using a nitrate specific ion electrode and an Orion Model 901 meter with a digital millivolt readout. Several dilutions were also required prior to analysis for nitrate. The final concentration of nitrate was determined from a calibration curve prepared by plotting the millivolt potential versus the log of the nitrate concentration of prepared standards.

TABLE D-1

SUMMARY OF LABORATORY ANALYSES

PREDRYER

Location/ Run No.	Sample No.*	Collected Sample Vol. (ml)	Analyzed Sample Vol. (ml)	Ammonia Analysis: Sample Dilution Factors		Aliquot Absorb. (A.U.)	Aliquot Conc. (µg/ml)	Sample Conc. (µg/ml)	Mass (µg)	Nitrate Analysis: Sample Dilution Factors	Potential (mv)	Aliquot Conc. (mg/ml)	Sample Conc. (mg/ml)	Mass (mg)	Filter Wt. (mg)
Predryer															
Run 1	C-1-A	1240	620.0							5x	70	1.26	6.28	7794	
	1										70				
	2										69				
	3										70				
	C-1-B		620.0	1.6x	100x	0.00	0.00	0.0	0.0						
	C-2	450	225.0	4.4x	50x	0.18	1.13	247.5	111.4	5x	104	0.32	1.62	728	
	Filter														51.6
Run 2	C-1-A	910	455.0							5x	76	0.99	4.95	4502	
	1										77				
	2										75				
	3										76				
	C-1-B		455.0	2.2x	100x	0.53	3.31	728.8	663.2						
	C-2	455	222.5	4.5x	100x	0.01	0.06	28.1	12.5	5x	169	0.02	0.12	54	
	Filter														13.3
Run 3	C-1-A	1000	500.0							5x	78	0.91	4.57	4568	
	1										79				
	2										78				
	3										76				
	C-1-B		500.0	2.0x	250x	0.75	4.69	2344	2344						
	C-2	405	202.5	4.9x	50x	0.11	0.69	168.4	68.2	5x	195	0.01	0.04	17	
	Filter														44.2

*Samples labeled C-1 contained washings in distilled-deionized water. These were divided into 2 aliquots, A and B. Aliquot C-1-A was divided into 3 smaller aliquots for nitrate analysis. The collected mass was calculated based on the average potential as determined from the 3 aliquots.

Samples labeled C-2 contained washings in 1N H_2SO_4.

TABLE D-2

SUMMARY OF LABORATORY ANALYSES

DRYER

Location/ Run No.	Sample No.*	Collected Sample Vol. (ml)	Analyzed Sample Vol. (ml)	Ammonia Analysis: Sample Dilution Factors		Ammonia Analysis: Aliquot Absorb. (A.U.)	Ammonia Analysis: Aliquot Conc. (µg/ml)	Ammonia Analysis: Sample Conc. (µg/ml)	Ammonia Analysis: Mass (mg)	Nitrate Analysis: Sample Dilution Factors	Nitrate Analysis: Potential (mv)	Nitrate Analysis: Aliquot Conc. (mg/ml)	Nitrate Analysis: Sample Conc. (mg/ml)	Nitrate Analysis: Mass (mg)	Nitrate Analysis: Filter Wt. (mg)
Dryer															
Run 1	C-1-A	940	470.0							5x	53	2.48	12.39	11,642	
	1										54				
	2										53				
	3										52				
	C-1-B		470.0	2.1x	100x	0.08	0.5	105.0	98.7						
	C-2	460	230.0	4.3x	50x	0.09	0.6	120.9	55.6	5x	103	0.34	1.68	775	
	Filter														57.1
Run 2	C-1-A	1170	585.0							5x	49	2.91	14.53	16,999	
	1										54				
	2										43				
	3										50				
	C-1-B		585.0	1.7x	500x	1.35	8.4	7172	8391						
	C-2	445	222.5	4.5x	500x	0.01	0.1	168.8	75.1	5x	167	0.03	0.13	58	
	Filter														84.0
Run 3	C-1-A	795	397.5							5x	89	0.59	2.95	2341	
	1										87				
	2										91				
	3										89				
	C-1-B		397.5	2.5x	250x	0.45	2.8	1758	1398						
	C-2	405	202.5	4.9x	50x	0.09	0.6	137.8	55.8	5x	193	0.01	0.05	19	
	Filter														46.9

*Samples labeled C-1 contained washings in distilled-deionized water. These were divided into 2 aliquots, A and B. Aliquot C-1-A was divided into 3 smaller aliquots for nitrate analysis. The collected mass was calculated based on the average potential as determined from the 3 aliquots.

Samples labeled C-2 contained washings in 1N H_2SO_4.

TABLE D-3

SUMMARY OF LABORATORY ANALYSES

COOLER

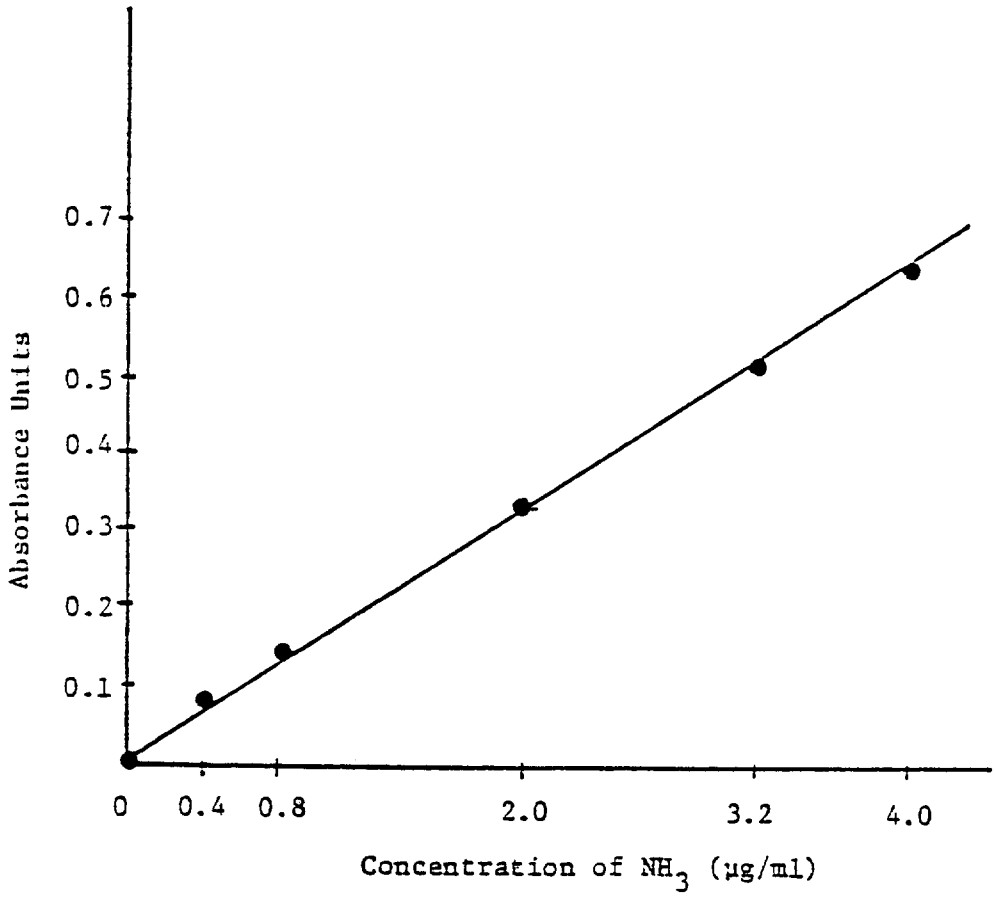
Location/ Run No.	Sample No.*	Collected Sample Vol. (ml)	Analyzed Sample Vol. (ml)	Ammonia Analysis: Sample Dilution Factors		Aliquot Absorb. (A.U.)	Aliquot Conc. (µg/ml)	Sample Conc. (µg/ml)	Mass (mg)	Nitrate Analysis: Sample Dilution Factors	Potential (mv)	Aliquot Conc. (mg/ml)	Sample Conc. (mg/ml)	Mass (mg)	Filter Wt. (mg)
Cooler															
Run 1	C-1-A	1000	500.0							5x	65	1.53	7.67	7673	
	1										65				
	2										65				
	3										64				
	C-1-B		500.0	2.0x	100x	0.07	0.4	81.3	81.3						
	C-2	450	225.0	4.4x	50x	0.07	0.4	96.3	43.3	5x	103	0.34	1.68	758	
	Filter														36.1
Run 2	C-1-A	1020	510.0							5x	57	2.11	10.56	10,770	
	1										54				
	2										58				
	3										60				
	C-1-B		510.0	2.0x	250x	1.45	9.1	4531	4622						
	C-2	420	210.0	4.8x	250x	0.01	0.1	75.0	31.5	5x	165	0.03	0.14	60	
	Filter														94.3
Run 3	C-1-A	1020	510.0							5x	84	0.72	3.60	3672	
	1										87				
	2										80				
	3										85				
	C-1-B		510.0	2.0x	250x	1.40	8.8	4375	4463						
	C-2	430	215.0	4.7x	50x	0.10	0.6	148.3	63.8	5x	181	0.01	0.07	32	
	Filter														20.9

*Samples labeled C-1 contained washings in distilled-deionized water. These were divided into 2 aliquots, A and B. Aliquot C-1-A was divided into 3 smaller aliquots for nitrate analysis. The collected mass was calculated based on the average potential as determined from the 3 aliquots.

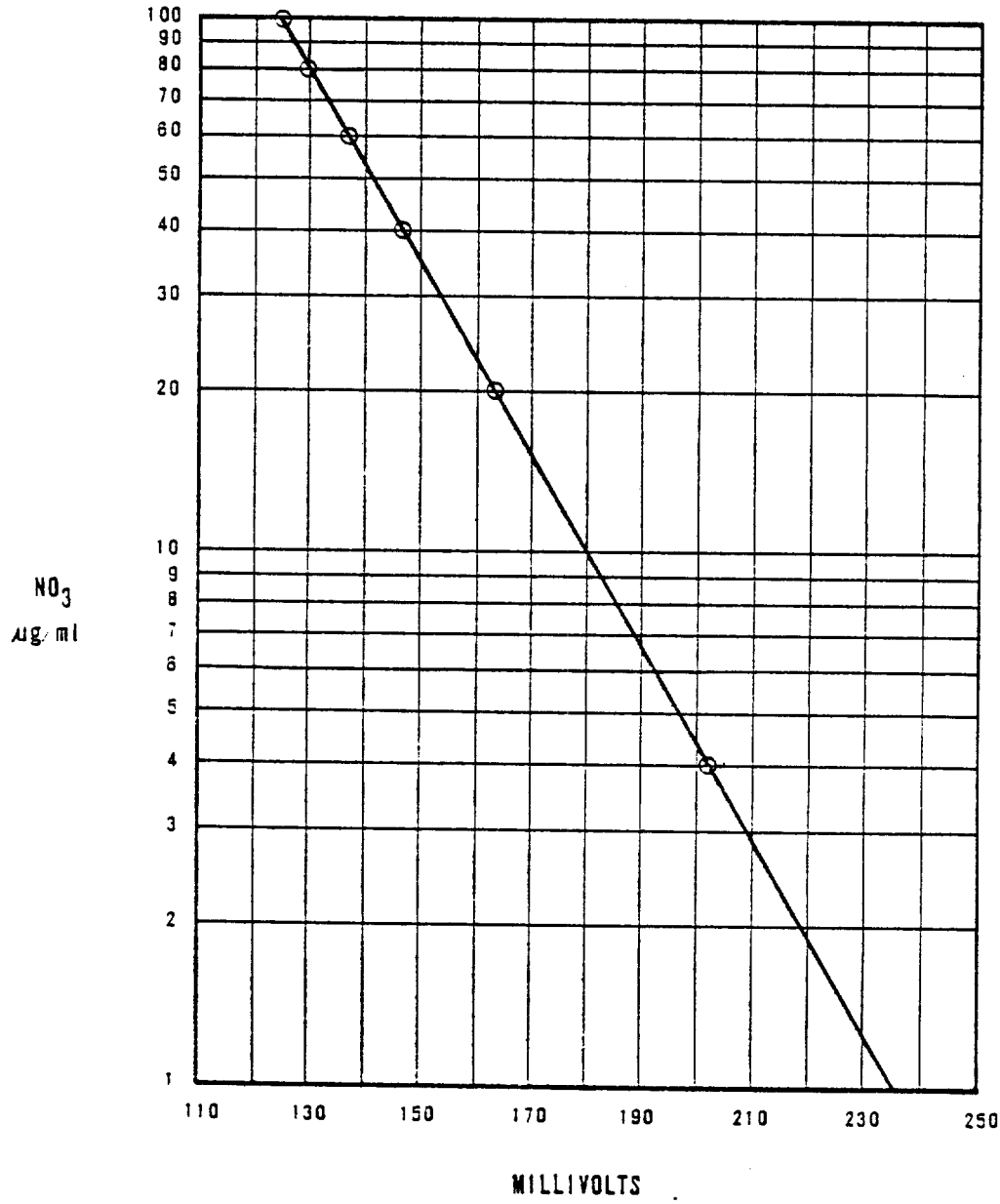
Samples labeled C-2 contained washings in 1N H_2SO_4.

FIGURE D-1

DIRECT NESSLERIZATION CALIBRATION CURVE
(Absorbance vs. Concentration)



NITRATE CALIBRATION CURVE
(Millivolts vs. Concentration)



Date: 3/29/79
Time: 1520
Temp: 70°F
B.P.: 29.83

Amonium Nitrate

1 liter volumetric: 143.0 conc. H_2SO_4 dilute to 1 liter w/ H_2O } 25% H_2SO_4

1 liter volumetric: 8.0 g NH_4NO_3 dilute

Calibration Standards

6 250 ml volumetrics: NH_4NO_3 standard solution

① .1N
② .08N
③ .05N
④ .02N
⑤ H_2O

} dilute w/ H_2O

.1N = 10 to 1	NH_4NO_3 to H_2O	25 ml NH_4NO_3	225 ml H_2O
.08N = 12.5 to 1		20 ml NH_4NO_3	230 ml H_2O
.05N = 20.0 to 1		12.5 ml NH_4NO_3	237.5 ml H_2O
.02N = 50.0 to 1		5 ml NH_4NO_3	245 ml H_2O

Date: 3/30/79
Time: 1525
Temp: 72°F
B.P.: 30.17

Boric Acid

100 ml volumetric: 6.2 g Boric Acid (H_3BO_3)
90 ml boiling H_2O
dilute to 100 ml w/ H_2O

Ionic Strength Adjuster

100 ml volumetric: 26.4 g Amonium Sulfate
50 ml H_2O
dilute to 100 ml w/ H_2O

Reference Electrode Solution

100 ml volumetric: 2 ml Ionic Strength Adjuster
H_2O to 100 ml

Standard Amonium Nitrate

1 liter volumetric: 1.290 g Amonium Nitrate
500 ml H_2O to dissolve
dilute to 1000 ml w/ H_2O

7 250 ml volumetrics:

		① 0	Amonium	Nitrate	+2 ml Boric Acid
	+ 204	② 1	"	"	
	+ 166	③ 5	"	"	
Nitrate Concentration	+ 149	④ 10	"	"	
2.5 mg/ml of final solution	+ 139	⑤ 15	"	"	
	+ 132	⑥ 20	"	"	+2 ml Ist
	+ 127	⑦ 25	"	"	

to 250 ml w/ H_2O

Date: 3/30/79
Time: 1000
Temp: 71°F
BP: 30.17

Consolidation & Volumetric Measure of Samples from Plant

SAMPLE TYPE	VOLUME COLLECTED
Union Oil Co. 3/29/79 - 1915 NH_4NO_3 Dryer Run-1 Container #1	950 ml
Union Oil Co. 3/29/79 - no time NH_4NO_3 Pre Dryer Run-1 Container-1	1000 ml + 240 = 1240 ml
Union Oil Fertilizer 3/28/79 (date probably in error) - no time Amonium Nitrate Pre-Dryer Run-1 Container #2	450 ml
Union Oil Co. 3/29/79 - no time NH_4NO_3 Run-1 Cooler Container #2	450 ml

Date: 3/30/
Time: 17
Temp: 72°
BP: 30.1

Consolidation & Volumetric Mesure of Samples from

SAMPLE TYPE	VOLUME COLLECTE
Union Oil Co.	
3/29/79 - no time	
NH_4NO_3	
Dryer	460 ml
Run #1	
Container #2	

Date: 4/2/79
Time: 1100
Temp: 74°F
BP: 29.95" Hg

Glass Fiber Filter Wt.'s (grams)

	original wt	wt w/sample	wt gain	
1	.4234	.4750	0.0516	R1 AN Pre Dryer Cont 1
2	.4256	.4617	0.0361	R1 AN Cooler Cont 1
3	.4209	.4780	0.0571	R1 AN Dryer Cont 1
4	.4299	.5012	0.0713	R1 Composite Scrubber H_2O
5	.4382	.5145	0.0763	R2 Composite Scrubber H_2O
6	.4275	.5058	0.0783	R Composite Scrubber H_2O
7	.4270	.5029	0.0759	R2 Feed Composite Scrubber H_2O
8	.4340	.5123	0.0783	R3 Feed Composite Scrubber H_2O
9	.4192	.4325	0.0133	R2 AN Pre-Dryer Cont 1
10	.4343	.5183	0.0840	R2 AN Dryer Cont 1 (glass)
11	.4282	.5225	0.0943	R2 AN Cooler Cont 1
12	.4317	.4759	0.0442	R3 AN Pre-Dryer Cont 1
13	.4156	.4365	0.0209	R3 AN Cooler Cont 1
14	.4215	.4684	0.0469	R3 AN Dryer Cont 1 (glass)
15	.4317			
16	.4326	.5118	0.0792	R3 Feed Composite Scrubber H_2O
17	.4277			
18	.4199			
19	.4203			
20	.4259			
21	.4206			
22	.4229			
23	.4225			
24	.4205			

Pre Dryer
R1
R2
R3

Dryer
R1
R2
R3

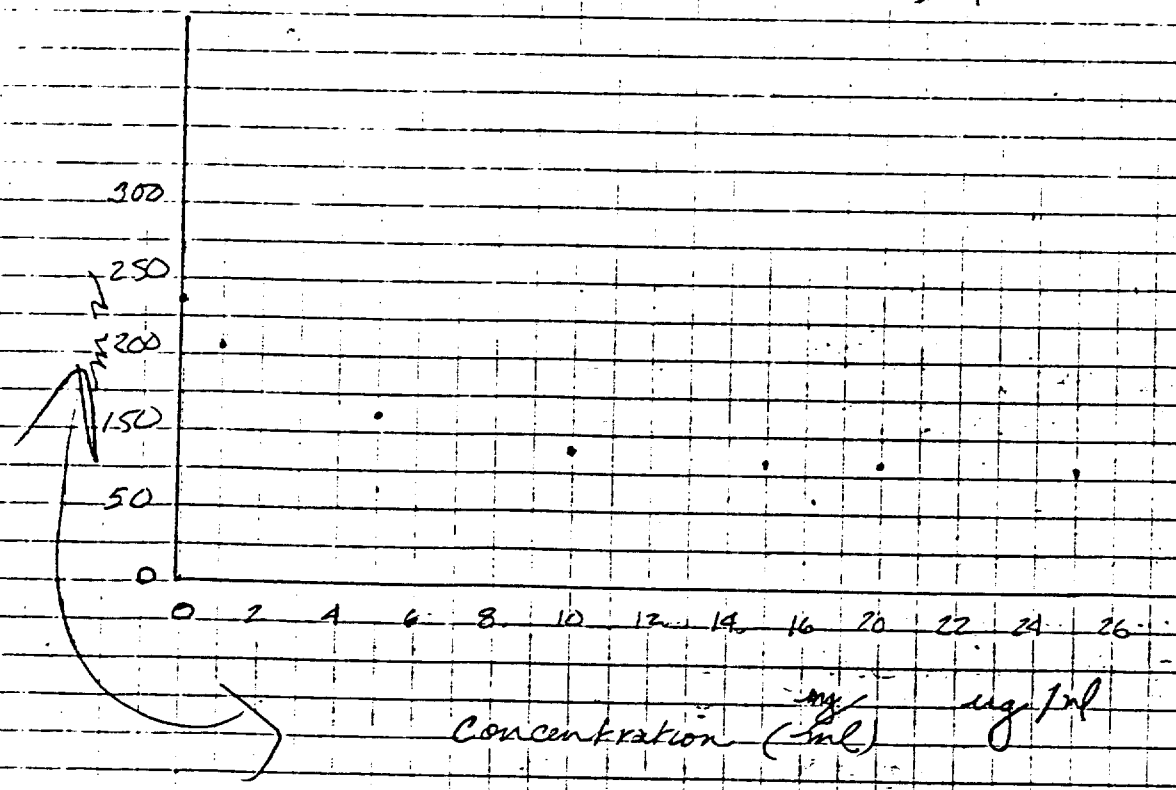
Cooler R1
R2
R3

Date: 4/2/79
Time: 2030
Temp: 72°F
B.P: 29.95" Hg

Amonium Nitrate - Specific Ion Exchange Standard Curve

(2.5 mg nitrate / ml solution)

	Solutions' Concentrations					mV
1	0	only	Amonium Nitrate	0	Y	+242
2	1	2.5 mg =	2500 ug		5.2	+204 X
3	5	12.5	12500		25.8	+166
4	10	25.0	25000		51.6	+148
5	15	37.5	37500		77.4	+132
6	20	50.0	50000		103.2	+132
7	25	62.5	62500	100 NO_3^-	129.0 NH_4NO_3	+127



4-26

Date: 4/3/79
Time: 14.30
Temp: 72°F
BP: 30.11" Hg

Amonium Nitrate Analysis of Container #2's, samples Collected at the Plant on 3/29/79

- Amonia Concentrations based on Nessler's Curve
- Nitrate Concentrations based on Amonium Nitrate Specific Ion exchange curve.

Amonia Analysis: Field sample → 1 liter volumetric rince with 1N H_2SO_4

Dilute to 1 liter with 1N H_2SO_4

(28 ml H_2SO_4 / l H_2O)

Transfer 10 ml of this solution to a 500 ml volumetric & dilute with 1N H_2SO_4

Transfer 20 ml of this solution to a 125 ml volumetric
- 10 N $NaOH$ untill pH is 8-10
- 0.5 ml Nessler
- dilute to 25 ml w/ H_2O
- note color development time
- read absorbance at λ 405 nm

Nitrate Analysis: 100 ml of field sample + 2 ml ISA + 2 ml Boric Acid → read mv on specific ion exchange

Container #1's
1. 100 ml sample dilute to 500 ml w/ H_2O
2. 100 ml of this solution (3x) into 250 ml beakers
3. add 2.0 ml ISA to each
4. Read mv

Date: 4/3/79
Time: 1500
Temp: 72°F
B.P.: 30.11" Hg

- RESULTS -

NH_4NO_3 - Specific Ion Exchange for Nitrates

Sample	mv	absorbance
Union Oil Fertilizer 3/29/79 (no time) Ammonium Nitrate Predryer Run -1 Container #2	See pg 31 +104	0.18
Union Oil Fertilizer Co. 3/29/79 (no time) NH_4NO_3 Cooler Run -1 Container #2	+103	0.07
Union Oil Co. 3/29/79 (no time) NH_4NO_3 Dryer Run -1 Container #2	+103	0.09

4-4-79
1525
74°F
30.15
Note: These are compared to std's made w/ H_2O dilutions (NOT IN H_2SO_4)

Date: 8/4/79
Time: 1400
Temp: 72°F
B.P.: 30.15" Hg

Analysis of Ammonium Nitrate Samples from Plant

(Water solution samples – container #1's)

- Transfer field sample to Büchner funnel w/ glass fiber filter
- Split sample in half

NO_3^- (nitrate)

- add 2 ml Boric Acid per 100 ml of sample
- transfer to 500 ml volumetric dilute to 500 ml w/ H_2O
- split this solution into 3 100 ml aliquots and add 2.0 ml Ionic Strength Adjuster to each beaker
- use electronic stirrer & measure mV

NH_3 (amonia)

- explained on pg 30 of this book

1 → 5

Date: 4/4/79
Time: 1450
Temp: 72°F
BP: 30.15" Hg

- RESULTS -

Amonia Analysis (Ab)	Sample	Nitrate Analysis (mv)
.065	Union Oil Co 3/29/79 1915 AN - Cooler Run - 1 Container 1	+065 +065 ~~+064~~ +064
.08	Union Oil Co. 3/29/79 (no time) NH_4NO_3 Dryer Run - 1 Container #1	+054 +053 ~~0+~~ +052
0.0	Union Oil Co. 3/29/79 (no time) NH_4NO_3 Pre-Dryer Run - 1 Container - 1	+070 +069 +070

NH_3 Analysis By Nessler's

① Transfer field sample to 1 ℓ volumetric & rinse container w/ H_2SO_4 - Dilute to 1 ℓ w/ H_2O

→ ② Take 10 ml solution and transfer to a 500 ml volumetric and dilute to 500 ml w/ H_2O

③ Take 20 ml & transfer to a 25 ml volumetric
- add 10 N $NaOH$ drop-wise until pH is 8-10
- add 0.5 ml Nesslers
- read on spectrophotometer (Bausch & Lomb) at 405 λ

SAMPLE TYPE	VOLUME
Union Oil Fert S3 3/30/79 Time: 1430 NH_4NO_3 Prey Dryer Run 2 Container 1	910 ml
Union Oil Co. S1 3/30/79 Time: 1430 NH_4NO_3 Prey Dryer Run 2 Container #2	445 ml
Union Oil Fert. S2 NH_4NO_3 Time: 1430 3/30/79 Cooler Run 2 Container 1	1020 ~~910~~ ml
Union Oil Co. S5 3/30/79 Time 1415 NH_4NO_3 Dryer Run 2 Container 2	445 ml
S4 Union Oil Fert. 3/30/79 Dryer Time 14:20 NH_4NO_3 Run 2 Container 1	1170 ml
S6 Union Oil Co. 3/30/79 Time: 1430 NH_4NO_3 Cooler Run 2 Container #2	420 ml

SAMPLE TYPE	VOLUME
Union Oil Fert. 3/30/79 Time: Amonium Nitrate Pre-Dryer Run 3 Container #1	1000 ml
Union Oil Co 3/30/79 Time: Amonium Nitrate Pre-Dryer Run 3 container #2	405 ml
Union Oil Fertilizer 3/30/79 Time: Ammonium Nitrate Dryer Run #3 Container #1	795 ml
Union Oil Co. 3/30/79 Time: Amonium Nitrate - Dryer Run 3 container #2	405 ml
Union Oil Fertilizer 3/30/79 Time: Amonium Nitrate Cooler Run 3 Container #1	1020 ml
Union Oil Co. 3/30/79 Time: Amonium Nitrate - Cooler Run 3 container #2	430 ml

dilutions (beyond zero)

- 5 ml diluted
- to 500 ml

- 5 ml diluted
to 500 ml
- then 2 ml
- then 1 ml

- 5 ml diluted
to 500 ml
then 2 ml

Date: 4/11/79
Time: 1120
Temp: 72°F
BP: 29.30" Hg

Date: 4/10/79
Time: 1745
Temp: 72°F
BP: 29.77" Hg

- RESULTS -

Amonia & Nitrate Analysis of Samples from Union Oil Fert. Plant

SAMPLE	absorbance (amonia)	mv (nitrate)	
Union Oil Co. 3/30/79 Time: 1430 NH_4NO_3 Pre-Dryer Run #2 Container #1	~~.040~~ .53	+077 +075 +076	+076
Union Oil Co 3/30/79 Time 1430 NH_4NO_3 Pre-Dryer Run #2 Container #2	~~.019~~ .010	+168 +170 +169	+165
Union Oil CO. 3/30/79 Time: 1415 NH_4NO_3 Dryer Run #2 Container #1	~~.045~~ 1.35	+054 +043 +050	+049
Union Oil Co. 3/30/79 Time 1415 NH_4NO_3 Dryer Run #2 Container #2	.012	+168 +166 +166	+166.6
Union Oil Fert NH_4NO_3 Cooler 3/30/79 Time 1430 Run #2 Container #1	~~.045~~ 1.45	+054 +058 +060	
Union Oil Co. 3/30/79 Time 1430 NH_4NO_3 Cooler Run #2 Container #2	.010	+162 +164 +165	

— continued from page 45

	Absorbance (ammonia)	mV (nitrate)
Union Oil Fert		
3/30/79 Time		+079
NH_4NO_3 Pre-Dryer	~~.050~~	+078
Run 3 Container #1	.75	+076
Union Oil Co.		
3/30/79 Time:		+192
Ammonium Nitrate Pre-Dryer	.11	+197
Run 3 Container #2		+196
Union Oil Fert		
3/30/79 Time	1.40	+087
NH_4NO_3 ~~Pre Dryer~~ Cooler		+080
Run #3		+085
Container #1		
Union Oil Co.		
3/30/79 Time:		+180
Ammonium Nitrate Cooler	.101	+182
Run #3 Container #2		+180
Union Oil Fert.		
3/30/79 Time:		+087
NH_4NO_3 Dryer	.45	+097
Run 3 Container #1		+089
Union Oil Co.		
3/30/79 Time:		+193
Ammonium Nitrate - Dryer	.09	+193
Run 3 Container #2		+192

dilusions for NH_4 Analysis by Nessler

- for container # 2's, 10 ml of field sample were diluted into 490 ml H_2O (500 ml total volume)

- for container #1's, 2 ml of field sample were diluted into 498 ml H_2O (500 ml total volume

$\frac{abs}{1.61} \times Vol \times dilution$

8/10/79

Nitrate Standard Solution

38.70 g NH_4NO_3 diluted in 1 l H_2O
yields 30 mg/ml NO_3

Standard Solutions diluted to 250 ml inclusn of 5 ml Boric Acid, 5 ml Ionic Strength Adjuster

		conc
0.0 ml	NH_4NO_3	0.00
.5 ml	NH_4NO_3	0.06
1.0 ml	NH_4NO_3	0.12
5.0 ml	NH_4NO_3	0.60
10.0 ml	NH_4NO_3	1.20
15.0 ml	NH_4NO_3	1.80
20.0 ml	NH_4NO_3	2.40
25.0 ml	NH_4NO_3	3.00
50.0 ml	NH_4NO_3	6.00
100.0 ml	NH_4NO_3	12.00

Date: 8/10/79
Time: 1300
Temp: ≈ 72°F

Nitrate Calibration Curve

ml's. of NH_4NO_3	conc. mg/ml	stirred mV	10 sec. stirred (mV)	then settled for 20 sec. read value 20 sec after probe inserted ½ into beaker
0.0	0.00	+223	+219	
0.5	0.06	+209	+205	
1.0	0.12	+188	+182	
5.0	0.60	+109	+102	
10.0	1.20	+094	+087	
15.0	1.80	+074	+069	
20.0	2.40	+066	+063	
25.0	3.00	+038	+035	
50.0	6.00	+022	+018	
100.0	12.00	+007	+005	

Distilled H_2O = +206 mV

8/13/79

Nitrate Curve Standards using 1.290g NH_4NO_3

~~g~~ mg NH_4NO_3	mv
1	+210
5 " "	+088
10 " "	+070
15 " "	+060
20 " "	+053
25 " "	+047

8/13/79

→ Nitrate Calibration Curve Using Standard made with 38.70 g NH_4NO_3

mls. of Ammonium Nitrate St.	NO_3 conc	mv*
0.0	0.00	+224
0.5	0.06	+142
1.0	0.12	+126
5.0	0.60	+088
10.0	~~0.~~ 1.20	+071
15.0	1.80	+061
20.0	2.40	+053
25.0	3.00	+048
50.0	6.00	+031
100.0	12.00	+014

distilled H_2O 237 mv

* timed as per page 57 of this book

8/14/79

Nitrate Standard Curve (1.290 NH_4NO_3)

	mv					
0.0 ml NH_3NO_3	+237	+238	+236	+235		
1.0 " "	+211	+212				
5.0 " "	+173	+174				
* 10.0 " "	+159	+160	+161	+162	+163	+167 (probe had been left dry for 30 minutes)
15.0 " "	+147	+148	+149			
20.0 " "	+138	+139				
25.0 " "	+132	+133	+134			

Distilled H_2O
+252 while being stirred
↓
+224 two minutes later (no stirring)
45 minutes later
Same Distilled H_2O +233, +234 (while stirring)
231, 232, 228, 227 (no stirring

* Rerun 10 ml NH_4NO_3 mv = +156, +157

8/14/79

Nitrate Curve - 1.29 g NH_4NO_3 + 5 mls ISA & 5 mls Boric Acid

	mv
0.0 mls NH_4NO_3	+227
1.0 " "	+207
5.0 " "	+172
10.0 " "	+155
15.0 " "	+145
20.0 " "	+139
25.0 " "	+133

Check Samples prepared by ALW 8/14/79

#1 +016, +016, +016 6.2443 g

#2 +033, +034, +034 2.9537 g

#3 +078, +079, ~~+079~~, +080 0.4545 g

$y = ae^{bx}$

$a = 12147.5$

$b = -0.04159$

$y = (12147.5)\{e^{[(-0.04159)x]}\}$

x = 16 mv

x = 34 mv

x = 79 mv

3-29-79 cont'd.

NESSLER'S CALIBRATION

Prepared 3:20 pm Developed for 15 mins

Read Time ~ 3:35 pm - NO RESULTS

Reprepared #1 at 6:20 pm Developed for 15 min

Read time ~ 6:35 pm - NO RESULTS

3-29-79

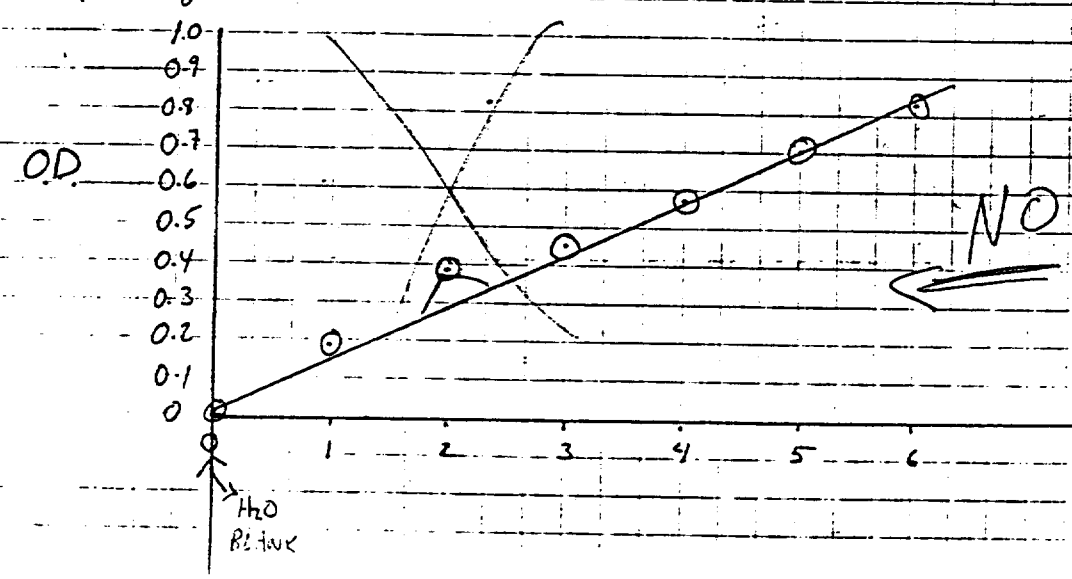
3-30-79 NESSLER'S CALIBRATION

Tube #	%T	or OD
1	(17	0.77) → Bad calib. sample
2	41.5 ~~37.5~~	~~0.425~~ 0.385
3	35.5	0.45
4	27.0	0.57
5	20.0	0.70
6	15.5	0.825

Tube #1 remade at 3:30 pm - developed for 15 mins and read

Tube #	%T	or OD
1	64.0	0.195

Graph 1 of Nessler Calibration Std's



3-31-79

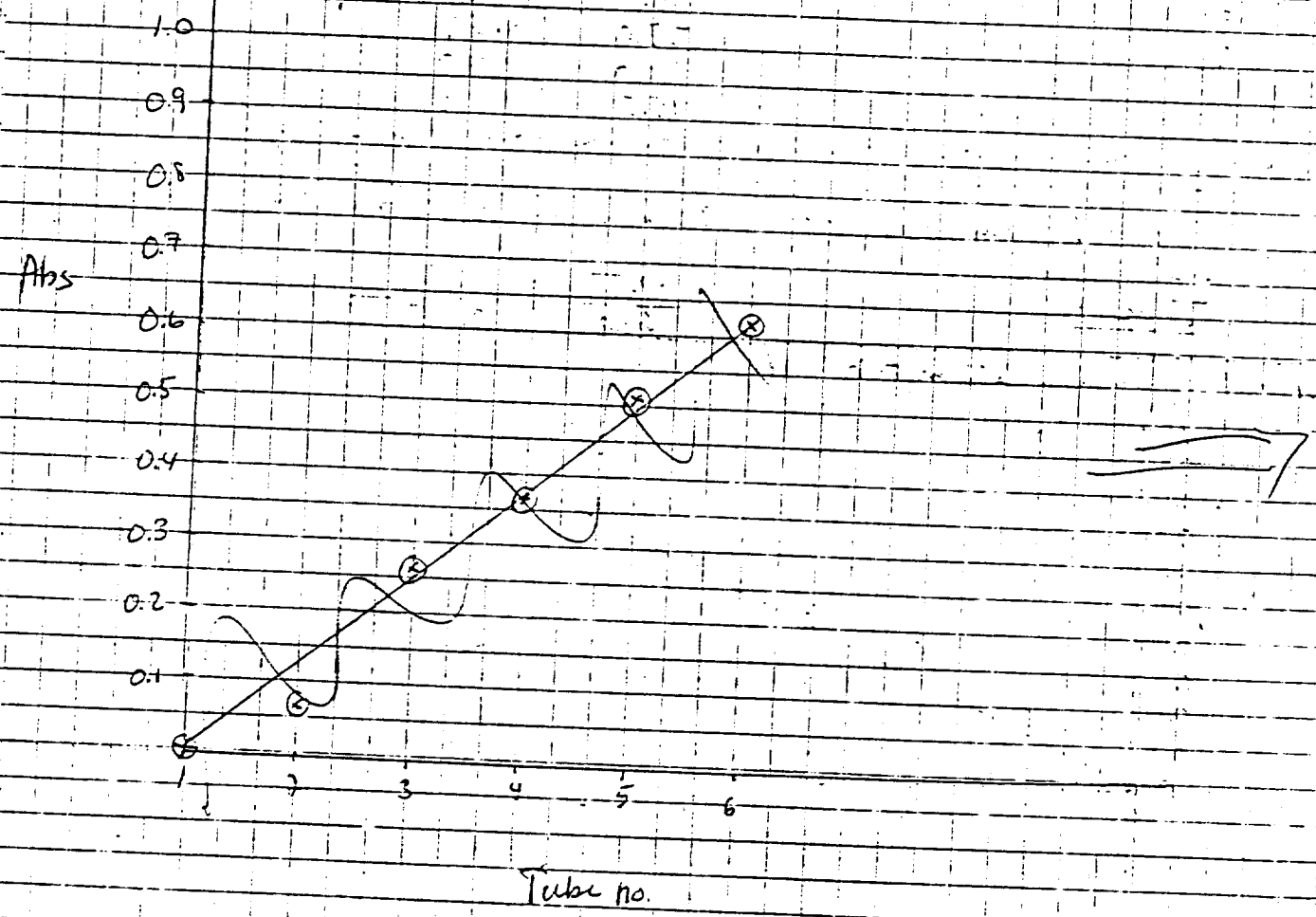
LW. Nessler Calibration Soln's

Time = 1040

BP = 30.17 Temp = 70°F

Tube #	% T	Abs
1	100	0
2	94.9	0.07
3	58.5	0.27
4	43.5	0.370
5	30	0.52
6	~~32.5~~ 24	0.62

Tube #	% T	Abs
1	100	00
2	94.9	0.07
3	58.5	0.27
4	43.5	0.37
5	31.0	0.51
6	24.0	0.62

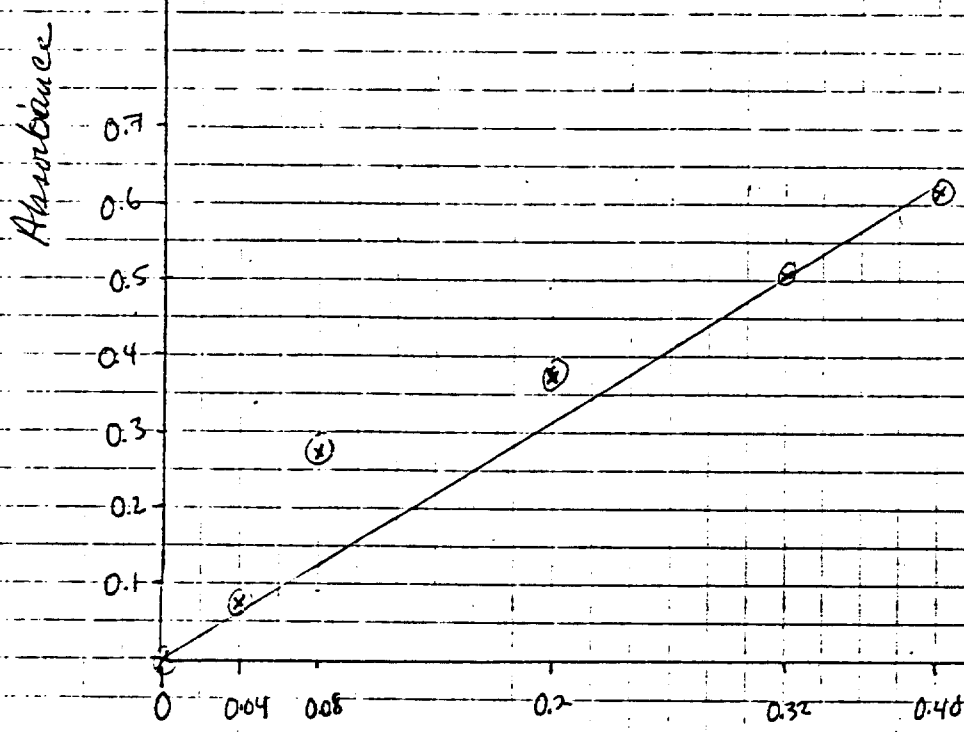


Received:

① 3 nitrate and 3 urea practice samples from Dennis B. at 0.730, 3-28-79

3 nitrates were cl. solns
3 urea were white solid (powder)

Nessler's Calibration Curve 3-31-79



Ammonium Nitrate Calibrations 3-30-79
1920

Solé tube #	mV
1	+060
2	+061
3	+061
4	+063
5	+061
6	+062
7	+060

?

Actual Sample Results:

1. Union Oil Co // 3-29-79 - no time // NH_4NO_3 // Pre Dryer // Run - 1 // Container - 1 SASF
   +100
2. Union Oil Co // 3-29-79 - no time // NH_4NO_3 // Run - 1 // Cooler Container #2 SASF
   +363
3. Union Oil Co // 3-29-79 - 1915 // NH_4NO_3 // Dryer // Run - 1 // Container #1
   +013
4. Union Oil Test // 3-28-79 (error) // Ammonium Nitrate // Pre Dryer // Run - 1 // Container #2
   +381
5. Union Oil Co. // 3-29-79 - no time // NH_4NO_3 // Dryer // Run - 1 ; Container #2

Nessler's Calib. Curve

(6) 25 ml vol.

4-4-79
1030 Tp 73.5°F
Bp 30.15

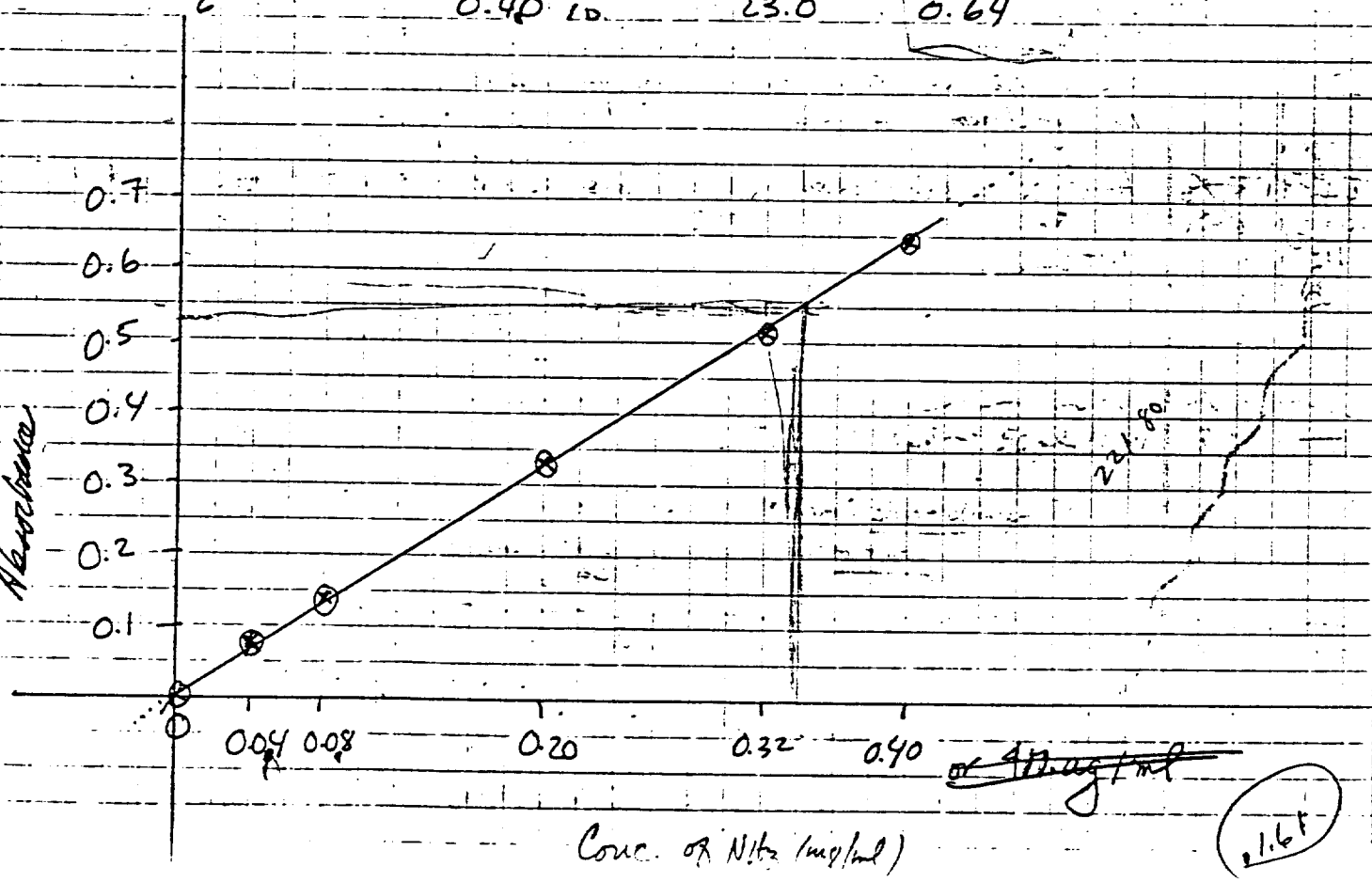
						H_2O
1	0 ml	working	std. NH_4Cl		+	20 ml
2	1 ml	"	"	"	+	19
3	2 ml	"	"	"	+	18
4	5 ml	"	"	"	+	15
5	8 ml	"	"	"	+	12
6	10 ml	"	"	"	+	10

then add 5-10N NaOH dropwise to achieve a pH between 8-10.
Then add 0.5 ml Nessler's Reagent
and dilute to 25 ml w/ H_2O.

4-4-79 Results:

4-4-79
1500 74°F
BP. 30.15

Tube #	NH_3 Conc (~~µg~~/ml)		%T	Abs.
1	0	0	100	0
2	0.04	1	85	0.07
3	0.08	2	72.5	0.14
4	0.20	5	47.0	0.33
5	0.32	8	30.0	0.51(3)
6	0.40	10	23.0	0.64



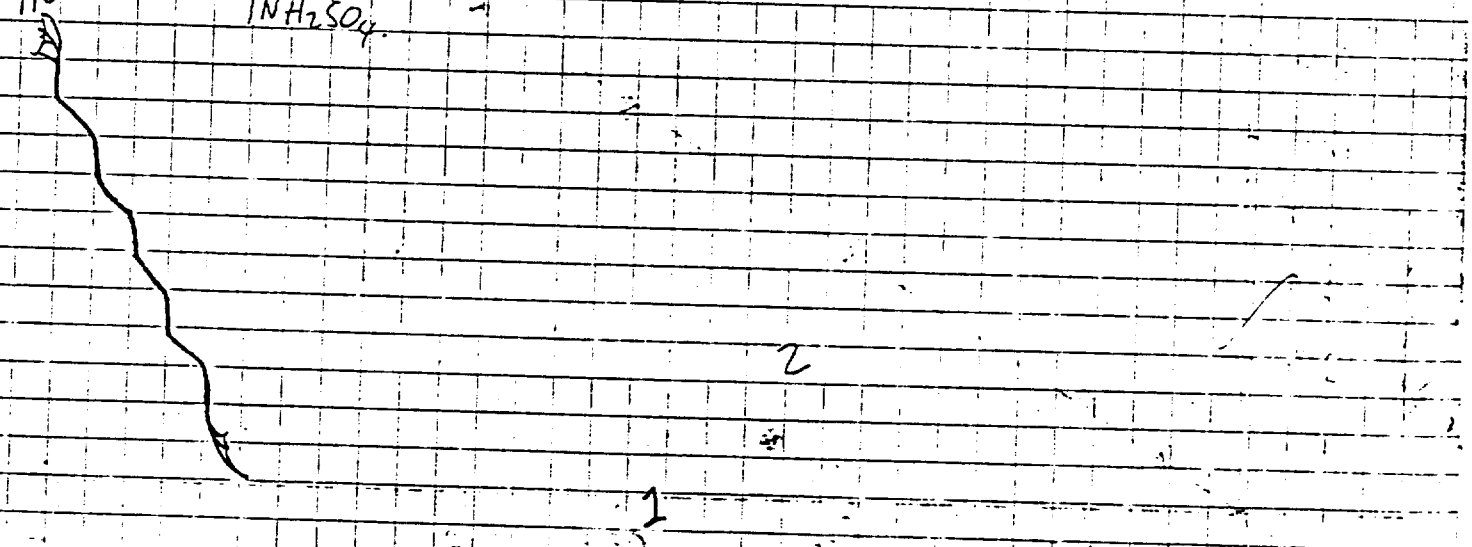
1.6

4-4-79 Nessler's Analysis for NH_3 of Samples

SAMPLE	%T	Abs.
Union Oil Fertilizer 3/29/79 (no time) NH_4NO_3 Prilling Run 1 Container #2 (N3)	66.0	0.18
Union Oil Fertilizer Co. 3/29/79 (no time) NH_4NO_3 Coater (N2) Probably CONT #2	85.0	0.07
Union Oil Co. 3/29/79 (no time) NH_4NO_3 Dryer Run-1 Container #2 (N1)	81.5	0.09

Compared to a H_2O diluted set of standards (NOT 1N H_2SO_4) on Note that these samples were diluted w/ 1N H_2SO_4 as described in the directions. H_2O has been substituted for the 1N H_2SO_4 in all following samples

4-5-79 ☆ As of Now, all Nessler's dilutions will be made w/ H_2O and NOT 1N H_2SO_4.



Tay-HH (4-6-79) BP=30.01
0800

Nessler's Anal. Continued for 4-2-79 + 3-29-79 samples

		%T	Abs.
(8) Union Oil Co. 4-2-79 Urea - Fertilizer grade — Cooler Run-3 Container #1	Small Amount of Sample (10ml) 1st Dil = 5 ml → 25ml (1:5) (Questionable clarity)	58.5	0.27
(10) Union Oil Co. 3-29-79 (no time) NH_4NO_3 Dryer Run-1 Container #1	1st Dil = 20ml to 1000ml (1:50) 2nd Dil = 20ml to 1000ml (1:50)	83.5	0.08
(9) Union Oil Co. 4-2-79 Urea - Fertilizer grade RUN-3 Container #1	1st Dil = 10ml → 50ml (1:5)	16.0	0.80
(11) Union Oil Co. 3-29-79 (no time) NH_4NO_3 Pre-Dryer Run-1 Container #1	1st Dil = 20ml → 1000ml (1:50) 2nd Dil = 20ml → 1000ml (1:50)	100	0.0
(12) Union Oil Co. 3-29-79 1915 AN - Cooler Run-1 Container #1	1st Dil = 20ml → 1000ml (1:50) 2nd Dil = 20ml → 1000ml (1:50)	86.5	0.065

For calculations, note that the field sample was first diluted once or twice, as noted to the right of each sample description, and then 20mls of the last dilution was placed in a 25ml volumetric flask, the pH corrected between 8-10, 0.5ml Nessler's Reagent added, and finally diluted up to the 25ml mark w/ DI-H_2O.

NITRATE STANDARD CURVE

6.3.3 Revised by ALW 8/9/79

Standard ~~Ammonium~~ Nitrate Solution

Prepare by weighing exactly 38.70 g of NH_4NO_3 into a 1 liter flask. Add 500 ml of deionized distilled water and dissolve. Dilute to exactly 1 liter with deionized distilled water. This solution contains 30 mg/ml of NO_3^-.

8.2.1 Revised by ALW 8/9/79

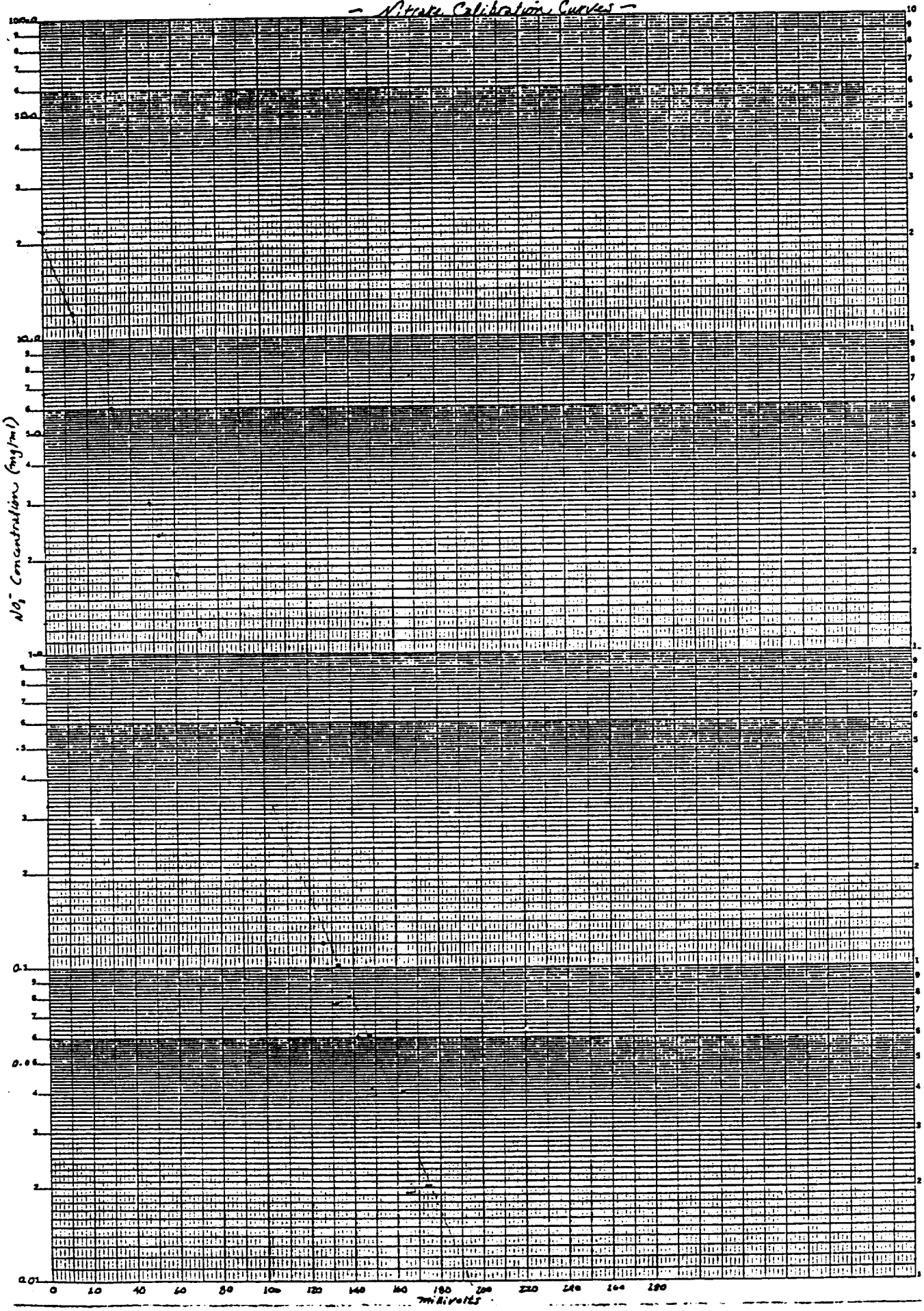
Prepare standards solutions by adding zero, 0.50, 1.0, 5.0, 10.0, 15.0, 20.0, 25.00, 50.00 and 100.00 ml of the NH_4NO_3 standard solution to a series of ~~eight~~ ten volumetric flasks (250 ml ~~ml~~) along with ~~7~~5 ml of ISA and ~~7~~5 ml of boric acid preservative. The concentration of the standards will be 0.00, 0.06, 0.12, 0.60, 1.20, 1.80, 2.40 and 3.00, 6.00 and 12.00 mg/ml of NO_3^- respectively

ENGINEERING-SCIENCE 150 NORTH SANTA ANITA AVENUE ARCADIA, CALIFORNIA 91006	PROJECT Union Fert Test JOB NO. DETAIL	DATE 8/9/79 BY ALW	SHT. OF

• 700 g Ammonium Nitrate (NH_4NO_3)
• 1.250 g Ammonium Nitrate (NH_4NO_3)

K+E SEMI-LOGARITHMIC 3 CYCLES X 200 DIVISIONS KEUFFEL & ESSER CO. 46 5253

— Nitrate Calibration Curves —



Nitrate Calibration Curve
Equations + Calculation

```
Ready
RUN ESI:CURFIT
ENTER A 1 IF OUTPUT IS TO BE ORDERED IN
INCREASING VALUES OF THE INDEPENDENT VARIABLE
OTHER WISE ENTER A 0? 1
ENTER INPUT FILE NAME OR DEVICE? KB:
014,012
031,006
048,003
053,2.4
61,1.8
071,1.3\3\2
088,0.6
126,0.12
2 11,0.004
173,0.02
163,0.04
148,0.06
138,0.08
1323\32\3,0.10
Z
```

conc of standard in mg/ml

mV

[-0.0399x]

$y = 20.528e$

y = mg/ml NO_3^-

x = mv

L E A S T - S Q U A R E S C U R V E F I T
F O R 14 D A T A P O I N T S

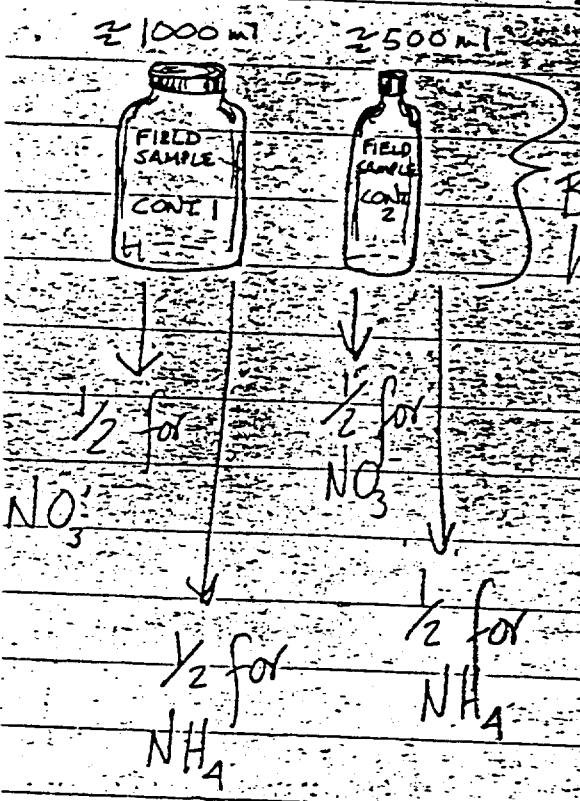
CURVE TYPE	COEFFICIENT OF DETERMINATION	A	B
1. Y=A+(B*X)	.545119	6.27056	-.414019E-1
2. Y=A*EXP(B*X)	.999491	20.528	-.399241E-1
3. Y=A*(X^B)	NEGATIVE	140472	-2.93222
4. Y=A+(B/X)	.988158	-1.17388	189.582
5. Y=1/(A+B*X)	NEGATIVE	-47.3206	.71265
6. Y=X/(A*X+B)	NEGATIVE	44.11	-1041.68

FOR WHICH CURVE ARE DETAILS DESIRED (GIVE NUMBER)? 2

2. Y=A*EXP(B*X) IS AN EXPONENTIAL FUNCTION
(SORTED IN ORDER OF INCREASING VALUES OF THE INDEPENDENT VARIABLE)

X-ACTUAL	Y-ACTUAL	Y-CALC	PCT DIFFER
14	12	11.7382	2.2
31	6	5.95447	.7
48	3	3.02053	-.6
53	2.4	2.47394	-2.9
61	1.8	1.79754	.1
71	1.2	1.20584	-.4
88	.6	.611688	-1.9
126	.12	.13417	-10.5
133	.1	.101457	-1.4
138	.08	.830976E-1	-3.7
148	.06	.557443E-1	7.6
163	.04	.306279E-1	30.5
173	.02	.205461E-1	-2.6
211	.004	.450665E-2	-11.2

Analysis for Nitrate (NO_3^-) of the Samples from Union Oil Fertilizer



Both Samples analyzed seperately however, identically

Sample shook vigorously
100 mls of sample trasfered by graduated cylinder to 500 ml flask & diluted to 600 mls (2ml of Boric acid added by pipette to sample prior to dilution) This solution shook vigorously and 3, 100 ml aliquots were poured into 3, 250 ml beakers 2 mls of ISA pipetted into each beaker Beakers one at a time stirred with electronic stirrer & mv read on specific ion analyzer

APPENDIX E

PRODUCT SAMPLE DATA

Part I - Discussion of Bulk Density and Sieve Analysis Analytical Method
Part II - Bulk Density and Sieve Analysis Data
Part III - Product Sample Laboratory Analysis
Part IV - Relative Humidity and Ambient Temperature Data

APPENDIX E

BULK DENSITY AND SIEVE ANALYSIS ANALYTICAL METHODS

Determination of bulk density and sieve analysis were conducted by a method supplied by EPA. Copies of these methods are presented in Appendix I.

The sieves used for the sieve analysis were constructed of stainless steel and included U.S. mesh sizes 8, 10, 12, 14, 16, and 20. All were contained in 8-inch diameter frames.

All bulk density and sieve analyses were conducted within thirty minutes of sample collection.

PRODUCT SAMPLE

PLANT BREA

DATE 3-29-79

PROCESS AMMONIA NITRATE

SAMPLE LOCATION PREDRYER ENTRANCE, DRYER, COOLER IN, COOLER OUT

SAMPLE TYPE

RUN NUMBER 1

OPERATOR TAMLINSON

~~210~~ TEST START 1410

250 ml

	Time Hr:Min	Actual Time	Sample ID	Bulk Density (units)	Sieve Analysis (Mesh) 8	10	12	14	16	20	Pan
PREDRYER	1412			212.5 gr.	2.4	13.2	50.9	118.3	78.7	30.6	1.5 gr.
DRYER	1444			209.4 gr	1.1	8.0	34.8	98.4	73.0	37.8	3.3 g
Cooler IN	1512			200.5 g	1.6	8.2	41.0	113.1	82.2	50.4	5.7
Cooler OUT	1532			189.9 g	1.6	10.2	42.1	102.2	66.9	33.8	3.5

PRODUCT SAMPLE

PLANT BREA

DATE 3-30-79

PROCESS AMMONIA NITRATE

SAMPLE LOCATION PREDRYER, DRYER, COOLER IN, COOLER OUT

SAMPLE TYPE

RUN NUMBER 2

OPERATOR TOM LIWSON

250 ml

	Time Hr:Min	Actual Time	Sample ID	Bulk Density (units)	Sieve Analysis (Mesh) 8	10	12	14	16	20	Pan	
PREDRYER	1036			216.6 g	4.0	17.8	63.3	122.2	65.8	31.4	3.1	gr.
DRYER	1054			194.8	1.8	10.3	40.2	90.2	47.2	21.9	3.4	
Cooler In	1115			188.3	1.7	10.4	39.5	81.3	44.2	22.2	7.4	
Cooler OUT	1134			185.8	2.8	15.1	51.2	101.0	45.9	23.9	9.8	

PRODUCT SAMPLE

PLANT BREA

DATE 3-30-79

PROCESS Ammonia Nitrate

SAMPLE LOCATION Pre Dryer, Dryer, Cooler in, Cooler out

SAMPLE TYPE

RUN NUMBER 3

OPERATOR Tomlinson

250 ml

	Time Hr:Min	Actual Time	Sample ID	Bulk Density (units)	Sieve Analysis (Mesh) 8	10	12	14	16	20	PAN
Pre Dryer	1614			215.5 g	9.1	15.0	44.9	112.3	74.9	33.3	2.8 g
Dryer	1632			201.2	2.1	11.8	38.2	104.4	69.1	36.5	9.4
Cooler In	1698			199.6	2.5	11.6	40.0	97.5	66.8	40.0	8.2
Cooler Out	1704			192.5	3.0	14.3	48.2	102.0	69.7	35.7	5.7

PRODUCT SAMPLE LABORATORY ANALYSIS

During the stack tests conducted at the Union Oil Co. ammonium nitrate plant, composite samples of product were collected at each of the following points:

- Predryer Inlet
- Dryer inlet
- Cooler inlet
- Cooler outlet

Each of these samples was analyzed for temperature, pH, moisture, percent ammonium nitrate and percent ammonia. The product temperature data were recorded by GCA and can be found in Appendix H. The remaining tests were conducted by Union Oil laboratory personnel. These data are considered proprietary by Union Oil and therefore are not included in this report.

METEOROLOGICAL DATA

PLANT Union Oil, Rosa

DATE 29 March 1979

PROCESS Ammonium Nitrate

SAMPLE LOCATION Tubes — Cooler

SAMPLE TYPE T_a, T_w and RH (Psychrom)

RUN NUMBER 1 AN

OPERATOR Herman Wong

Time Hr. Min	Actual Time	Ambient Temp. °F	Wet Bulb Temp. °F	Relative Humidity %
	1030	62.0	53.0	55
	1045	64.0	54.0	52
	1100	64.0	54.0	52
	1115	64.0	54.0	52
	1130	64.0	54.0	52
	1145	63.0	54.0	54
	1200	67.0	56.0	50
	1215	68.0	57.0	50
	1230	67.0	56.0	50
	1245	67.5	56.5	50
	1300	69.0	57.0	48
	1315	68.0	56.5	48
	1330	67.5	56.5	50
	1345	66.5	56.5	53
	1400	66.5	56.5	53
	1415	65.5	55.5	53
	1430	65.5	55.5	53
	1445	66.5	56.5	53
	1500	66.0	56.0	53
	1515	67.0	57.0	53
	1530	66.0	56.0	53
	1545	66.0	56.0	53

METEOROLOGICAL DATA

PLANT Union Oil, Rosa

DATE 30 MARCH 1979

PROCESS Ammonium Nitrate

SAMPLE LOCATION Intake - Boiler

SAMPLE TYPE Ta, Tw and RH (Psychron)

RUN NUMBER 1 [Cont'd] AN

OPERATOR Herman Wong

Time Hr. Min	Actual Time	Ambient Temp.	Wet Bulb Temp.	Relative Humidity
	1600	67.0	57.0	53
	1615	65.5	55.0	50
	1630	65.5	55.5	53
	1645	65.5	55.5	53
	1800	65.5	55.5	53
	1815	64.0	55.5	58
	1830	64.0	55.5	58
	1845	63.5	55.5	60
	1900	63.0	55.5	62
	1915	62.0	55.5	68
NOTE:	Data was	verified against	sling	psychrometer

METEOROLOGICAL DATA

PLANT Union Oil - Rosa

DATE 20 March 1979

PROCESS Ammonium Nitrate

SAMPLE LOCATION Intake - cooler

SAMPLE TYPE T_a, T_w and RH (PSYCHRON)

RUN NUMBER 2 AN

OPERATOR Thomas Wells

Time Hr. Min	Actual Time	Ambient Temp. °F	Wet Bulb Temp. °F	Relative Humidity %
	0900	62.0	55.0	54
	0915	64.0	55.5	58
	0930	64.0	55.5	56
	0945	64.0	55.0	54
	1000	66.0	56.5	55
	1015	65.0	56.0	57
	1030	66.0	56.5	55
	1045	66.0	56.5	55
	1100	66.5	56.5	53
	1115	67.5	58.0	50
	1130	67.0	57.0	53
	1145	67.0	57.0	53
	1200	67.5	58.0	53
	1215	67.0	57.0	53
	1230	68.5	57.0	53
	1245	67.0	57.0	62* used sling psychrom
	1315	68.5	57.5	50
	1330	67.0	57.0	53
	1345	67.0	56.0	50
	1400	68.0	57.0	50
	1415	68.0	56.5	45

NOTE: Data was verified against sling psychrometer

METEOROLOGICAL DATA

PLANT Hawaii Oil - Kapa

DATE 30 March 1979

PROCESS Ammonium Nitrate

SAMPLE LOCATION Tubes - Cooler

SAMPLE TYPE Ta, Tw, and RH (Psychrom)

RUN NUMBER 2 AN

OPERATOR Thomas Young

Time Hr. Min	Actual Time	Ambient Temp. °F	Wet Bulb Temp. °F	Relative Humidity %
	1500	69.0	57.5	49
	1515	68.5	56.5	47
	1545	67.5	56.0	49
	1600	68.0	56.5	48
	1615	68.0	56.5	48
	1630	68.5	57.0	49
	1645	67.5	56.5	50
	1700	67.5	57.0	51
	1715	66.5	56.5	53
	1730	66.0	56.5	55
	1745	64.5	55.5	57
	1800	64.5	56.0	59
	1815	64.5	56.0	59

NOTE: Data was verified against sling psychrometer

APPENDIX F

SAMPLE TRAIN CALIBRATIONS

Date 8/25/77 Box No. ES-1

Barometric pressure, P_b = 30.23 in. Hg Dry gas meter No. _____

Orifice manometer setting, ΔH, in. H_2O	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test: Meter t_w, °F	Temperature: Dry gas meter: Inlet t_{di}, °F	Temperature: Dry gas meter: Outlet t_{do}, °F	Temperature: Dry gas meter: Average t_d, °F	Time θ, min	Y	ΔH@
0.5	3.629	3.500	68.0			86.5	10	0.99	2.03
1.0	5.155	~~5.342~~	68.4			89.5	10	1.00	2.01
2.0	7.745	8.040	68.0			89.0	10	1.00	1.78
4.0	10.217	10.697	68.0			93.8	10	0.99	2.02
6.0									
8.0									
						Average		0.995	1.96

Calculations

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b (t_d + 460)}\left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368	0.9972	2.031
1.0	0.0737	1.0010	2.005
2.0	0.147	0.9968	1.775
4.0	0.294	0.9921	2.023
6.0	0.431		
8.0	0.588		

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in. H_2O. Tolerance - ± 0.15

J F Cof
8/25/77

Date 12/18/78 Box No. ES-2

Barometric pressure, P_b = 29.94 in. Hg Dry gas meter No. 625504

Orifice manometer setting, ΔH, in. H_2O	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test: Meter t_w, °F	Temperature: Dry gas meter: Inlet t_{di}, °F	Temperature: Dry gas meter: Outlet t_{do}, °F	Temperature: Dry gas meter: Average t_d, °F	Time θ, min	Y	ΔH@
0.5	3.990	4.072	76.5	90.5	85.75	88.125	10	1.00	1.75
1.0	5.445	5.609	76.5	93.25	85.75	89.50	10	1.00	1.84
2.0	7.850	7.832	76.5	103.75	87.25	95.50	10	1.01	1.97
4.0	10.665	10.981	76.5	107.25	90.25	98.75	10	1.00	1.92
6.0	10								
8.0	10								
						Average		1.00	1.85

Calculations

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b (t_d + 460)}\left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368	1.00	1.75
1.0	0.0737	1.00	1.84
2.0	0.147	1.01	1.97
4.0	0.294	1.00	1.92
6.0	0.431		
8.0	0.588		

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in. H_2O. Tolerance = ± 0.15

Date 9/25/78 Box No. ES-3

Barometric pressure, P_b = 29.97 in. Hg Dry gas meter No. GM-2

Orifice manometer setting, ΔH, in. H_2O	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test: Meter t_w, °F	Temperature: Dry gas meter: Inlet t_{di}, °F	Temperature: Dry gas meter: Outlet t_{do}, °F	Temperature: Dry gas meter: Average t_d, °F	Time θ, min	Y	$\Delta H_@$
0.5	3.751	3.791	75.5			84.2	10	1.00	
1.0	5.575	5.646	75.5			87.2	10	1.01	
2.0	7.201	7.324	75.5			91.2	10	1.01	
4.0	10.310	10.573	75.5			98.4	10	1.01	
6.0	10								
8.0	10								
						Average		1.01	

Calculations

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	$\Delta H_@$: $\frac{0.0317\ \Delta H}{P_b (t_d + 460)}\left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
2.0	0.147		
4.0	0.294		
6.0	0.431		
8.0	0.588		

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

$\Delta H_@$ = Orifice pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in. H_2O. Tolerance - ± 0.15

Nutech CORPORATION

(919) 682-0402

CALIBRATION SHEET

MODEL 201

SERIAL 91-1

CUSTOMER Engineering - Science

DATE 1-10-79

BAROMETRIC PRESSURE, P_B 30.35

RUN #	1	2	3	4	5	6	7
ORIFICE SETTING, ΔH	.5		2		5		
FINAL READING (TEST)	82.266		86.440		90.727		
INITIAL READING (TEST)	80.337		82.632		87.203		
VOLUME, V_T	1.929		3.808		3.524		
TEMP, T_T	72		72		71		
FINAL READING (BOX)	16.044		20.257		24.600		
INITIAL READING (BOX)	14.102		16.404		21.028		
VOLUME, V_B	1.942		3.853		3.572		
TEMP, T_B	75.5		77		80		
ELAPSED TIME, θ	5		5		3		
ΔH_a	1.85		1.89		1.97		1.90
γ	.998		.993		.991		0.992

$$\Delta H_a = \frac{(0.0317)\Delta H}{P_B(T_B + 460)}\left[\frac{(T_T + 460)}{V_T}\theta\right]^2 \qquad \gamma = \frac{V_T\ (P_B)\ \ (T_B + 460)}{V_B\ \left(P_B + \frac{\Delta H}{13.6}\right)\ (T_T + 460)}$$

CALIBRATION PERFORMED BY S. Brawley

AVG = 1.90

2-76

2806 Cheek Road Durham, N.C. 27704 P.O. Box 12425 Research Triangle Park, N.C. 27709

Nutech CORPORATION

(919) 682-0402

CALIBRATION SHEET

MODEL 201

SERIAL 91-2

CUSTOMER Engineering - Science

DATE 1-10-79

BAROMETRIC PRESSURE, P_B 30.35

RUN #	1	2	3	4	5	6	7
ORIFICE SETTING, ΔH	.5		2		5		
FINAL READING (TEST)	97.008		101.383		105.823		
INITIAL READING (TEST)	95.105		97.618		102.303		
VOLUME, V_T	1.903		3.765		3.520		
TEMP, T_T	70		70		70		
FINAL READING (BOX)	8.709		13.124		17.601		
INITIAL READING (BOX)	6.796		9.324		14.044		
VOLUME, V_B	1.913		3.807		3.557		
TEMP, T_B	74		76		80		
ELAPSED TIME, θ	5		5		3		
ΔH_a	1.89		1.93		1.97		1.93
γ	1.00		.995		.996		0.997

$$\Delta H_a = \frac{(0.0317)\Delta H}{P_B(T_B + 460)}\left[\frac{(T_T + 460)}{V_T}\theta\right]^2 \qquad \gamma = \frac{V_T\,(P_B)\,(T_B + 460)}{V_B\left(P_B + \frac{\Delta H}{13.6}\right)(T_T + 460)}$$

CALIBRATION PERFORMED BY S. Brawley

AVG = 1.93

2-76

2806 Cheek Road Durham, N.C. 27704 P.O. Box 12425 Research Triangle Park, N.C. 27709

S-TYPE PITOT TUBE CALIBRATION

PITOT TUBE IDENTIFICATION: # ES-3-1 DATE: 2/12/79

CALIBRATED BY: Jerry L. Cox

PITOT NOZZLE: NONE

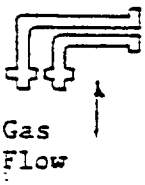
PITOT THERMOCOUPLE: Attached

PITOT SHEATH: Attached

COMMENTS:

SIDE A

"PITOTS DOWN"

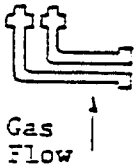


Run No.	ΔP Std	ΔP (s)	Cp(s) $= 0.99\sqrt{\frac{\Delta P Std}{\Delta Ps}}$	DEVIATION (Cp(s) - $\overline{Cp}$(A)
1	0.385	0.51	0.860	0.013
2	0.38	0.525	0.842	0.005
3	0.385	0.535	0.840	0.007
			$\overline{Cp}$(A)	Avg. Deviation (σ)
			0.847	0.0083

Must be (≤0.01)

SIDE B

"PITOTS UP"



Run No.	ΔP Std	ΔP (s)	Cp(s) $= 0.99\sqrt{\frac{\Delta P Std}{\Delta Ps}}$	DEVIATION (Cp(s) - $\overline{Cp}$(B)
1	0.385	0.535	0.840	0.002
2	0.385	0.540	0.836	0.002
3	0.380	0.530	0.838	0
			$\overline{Cp}$(B)	Avg. Deviation (σ)
			0.838	0.0013

Must be (≤0.01)

$\overline{Cp}$(A) - $\overline{Cp}$(B) = 0.847 - 0.838 = 0.009 (must be ≤0.01)

ENGINEERING-SCIENCE ES

S-TYPE PITOT TUBE CALIBRATION

PITOT TUBE IDENTIFICATION: # 5' (ES-5-2) NEW DATE: 3/19/79

CALIBRATED BY: Jerry Coy & MIKE HACKETT

PITOT NOZZLE: none

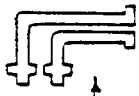
PITOT THERMOCOUPLE: none

PITOT SHEATH: none

COMMENTS: This pitot replaces previous ES-5-2 which was destroyed

SIDE A

"PITOTS DOWN"



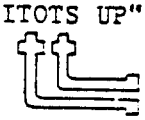
Gas Flow

Run No.	ΔP Std	ΔP (s)	Cp(s) = 0.99 $\sqrt{\frac{\Delta P Std}{\Delta Ps}}$	DEVIATION (Cp(s) - $\overline{Cp}$(A)
1	0.19	0.26	0.846	0
2	0.19	0.26	0.846	0
3	0.19	0.26	0.846	0
			$\overline{Cp}$(A)	Avg. Deviation (σ)
			0.846	0

Must be (≤0.01)

SIDE B

"PITOTS UP"



Gas Flow

Run No.	ΔP Std	ΔP (s)	Cp(s) = 0.99 $\sqrt{\frac{\Delta P Std}{\Delta Ps}}$	DEVIATION (Cp(s) - $\overline{Cp}$(B)
1	0.19	0.26	0.846	0
2	0.19	0.26	0.846	0
3	0.19	0.26	0.846	0
			$\overline{Cp}$(B)	Avg. Deviation (σ)
			0.846	0

Must be (≤0.01)

$\overline{Cp}$(A) - $\overline{Cp}$(B) = 0 (must be ≤0.01)

ENGINEERING-SCIENCE ES

PITOT TUBE IDENTIFICATION NO. _____ DATE: _____

CALIBRATED BY Scott Lambert & Jerry Cox

PITOT NOZZLE: No

PITOT THERMOCOUPLE: NO

PITOT SHEATH: yes

COMMENTS:

Side A tubes low

Run No.	Δp_{STD}	$\Delta p_{(s)}$	$C_{p(s)} = C_{p(STD)}\sqrt{\frac{\Delta p_{STD}}{\Delta p_s}} = 0.99\sqrt{\frac{\Delta p_{STD}}{\Delta p_s}}$	Deviation $(C_{p(s)} - \bar{C}_p(A))$
1	.37	.51	.843	0
2	.37	.51	.843	0
3	.37	.51	.843	0
			$\bar{C}_p(A)$	Average Deviation (σ)
			.843 (Avg)	0 $\left(\frac{\sum \lvert \text{Deviation} \rvert}{3}\right)$

← Must be ≤ 0.01

Side B tubes low

Run No	Δp_{STD}	$\Delta p_{(s)}$	$C_{p(s)} = 0.99\sqrt{\frac{\Delta p_{STD}}{\Delta p_s}}$	Deviation $(C_{p(s)} - \bar{C}_p(B))$
1	.38	.53 ~~.38~~	.838	.004
2	.37	.53	.827	.007
3	.38	.53	.838	.004
			$\bar{C}_p(B)$	Average Deviation (σ)
			.834 (Avg)	.005 $\left(\frac{\sum \lvert \text{Deviation} \rvert}{3}\right)$

← must be ≤ 0.01

$|\bar{C}_p(A) - \bar{C}_p(B)| =$ .009 (must be ≤ 0.01)

ES

ENGINEERING-SCIENCE, INC.

7903 WESTPARK DRIVE · McLEAN, VIRGINIA 22101 · 703/790-9300

CABLE ADDRESS: ENGINSCI
TELEX: 89-9401

SOURCE SAMPLING NOZZLE CALIBRATION

CALIBRATED BY BECIAR

DATE 9/21/78

CALIBRATION INSTRUMENT Mitutoyo Microruler

NOZZLE NUMBER	NOMINAL SIZE	Reading 1	2	3	AVG.
11	0.125	0.120	0.120	0.120	0.120
21	0.187	0.179	0.176	0.175	0.177
22	0.187	0.170	0.173	0.170	0.172
31	0.250	0.245	0.251	0.243	0.246
32	0.250	0.244	0.250	0.250	0.248
33	0.250	0.239	0.244	0.243	0.242
34	0.250	0.240	0.239	0.243	0.241
35	0.250	0.241	0.243	0.240	0.241
36	0.250	0.240	0.238	0.249	0.242
37	0.250	0.249	0.250	0.249	0.249
41	0.375	0.373	0.375	0.371	0.373
42	0.375	0.370	0.370	0.370	0.370
43	0.375	0.371	0.372	0.372	0.372
44	0.375	0.369	0.367	0.369	0.368

ES

ENGINEERING-SCIENCE, INC.

7903 WESTPARK DRIVE · McLEAN, VIRGINIA 22101 · 703/790-9300

CABLE ADDRESS ENGINSCI
TELEX. 89-9401

SOURCE SAMPLING NOZZLE CALIBRATION

CALIBRATED BY BECVAR

DATE 9/21/78

CALIBRATION INSTRUMENT Mitutoyo Micrometer

NOZZLE NUMBER	NOMINAL SIZE	Reading 1	2	3	AVG.
51	0.50	0.490	0.500	0.493	0.494
52	0.50	0.501	0.500	0.500	0.500
53	0.50	0.500	0.500	0.500	0.500
54	0.50	0.500	0.500	0.495	0.499
38	0.250	0.234	0.240	0.240	0.238
[illegible]	0.18	0.175	0.175	0.175	0.175
[illegible]	0.185	0.175	0.175	0.175	0.175
[illegible]	0.500	0.490	0.500	0.500	[illegible]

APPENDIX G

SAMPLING TASK LOG

SAMPLING TASK LOG

Plant Union Oil
Date

Plant Location Brea, California
Recorded by L.L. Lloyd

3-29-79 Comments	Run	Sampling location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Predryer Test #1A	1PD	A	AN	1409	1427	18	PD-R1 C1
Plant Shutdown	1PD	A		1427	1432		and
Predryer Test resumed to completion	1PD	A	AN	1432	1444	12	PD-R1-C2
Changed ports & leak check	1PD	A to B		1444	1823		↓
Predryer Test #1B	1PD	B	AN	1823	1853	30	
Predryer Test #1 Completed	1PD	–	–	1853		60 total	
3-30-79							
Predryer Test #2A	2PD	A	AN	1044	1114	30	PD-R2-C1
Changed Ports	2PD	–	–	1114	1338		and
Predryer Test #2B	2PD	B	AN	1338	1408	30	PD-R2-C2
Predryer Test #2 Completed	2PD	–	–	1408		60 total	↓
Predryer Moisture Test	M-1	A	Moisture	1523	1553	30	
Predryer Moisture Test Completed	M-1	–	–	1553			–
Predryer Test #3A	3PD	A	AN	1642	1651	9	PD-R3-C1
Repair Glassware	3PD	A	–	1651	1658		
Predryer Test #3A Resumed to Completion	3PD	A	AN	1658	1719	21	AND
Changed Ports	3PD	–	–	1719	1727		
Predryer Test #3B	3PD	B	AN	1727	1757	30	PD-R3-C2
Predryer Test #3 Completed	3PD	–	–	1757		60 total	–

SAMPLING TASK LOG

Plant Union Oil
Date

Plant Location Brea, California
Recorded by L. L. Lloyd

3-29-79 Comments	Run	Sampling location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Dryer Test #1A	1D	A	AN	1409	1427	18	D-R1-C1
Plant Shutdown	1D	A	–	1427	1432		–
Dryer Test resumed to Completion	1D	A	AN	1432	1459	27	And
Changed Ports	1D	–	–	1459	1820		–
Dryer Test #1B	1D	B	AN	1820	1905	45	D-R1-C2
Dryer Test #1 Completed				1905		90 total	–
3-30-79							–
Dryer Test #2A Probe Clogged	2D	A	AN	0951	1231		–
Dryer Test #2A	2D	A	AN	1231	1307	36	D-R2-C1
Changed Ports	2D	–	–	1307	1332		And
Dryer Test #2B	2D	B	AN	1332	1408	36	D-R2-C2
Dryer Test #2 Completed	2D	–	–	1408		72 total	–
Dryer Test #3B	3D	B	AN	1427	1503	36	D-R3-C1
Changed Ports	3D	–		1503	1642		and
Dryer Test #3A	3D	A	AN	1642	1718	36	D-R3-C2
Dryer Test #3 Completed	3D			1718		72 total	–

SAMPLING TASK LOG

Plant: Union Oil
Date:

Plant Location: Brea, California
Recorded by: L. L. Lowe

3-29-79 Comments	Run	Sampling location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Cooler Test #1A	1C	A	AN	1409	1427	18	C-R1-C1
Plant Shutdown	1C	A	—	1427	1432		—
Cooler Test #1A Resumed to Completion	1C	A	AN	1432	1444	12	And
Changed Ports	1C	—	—	1444	1820		—
Cooler Test #1B	1C	B	AN	1820	1850	30	C-R1-C2
Cooler Test #1 Completed	1C	—	—	1850		60 total	—
3-30-79							
Cooler Test #2B	2C	B	AN	1003	1033	30	C-R2-C1
Changed Ports	2C	—	—	1033	1347		And
Cooler Test #2A	2C	A	AN	1347	1417	30	C-R2-C2
Cooler Test #2 Completed	2C	—	—	1417		60 total	—
Cooler Test #3A	3C	A	AN	1645	1715	30	C-R3-C1
Changed Ports	3C	—	—	1715	1733	18	And
Cooler Test #3B	3C	B	AN	1733	1803	30	C-R3-C2
Cooler Test #3 Completed	3C	—	—	1803		60 total	—

SAMPLING TASK LOG

Plant: Union Oil
Date:

Plant Location: Pregs California
Recorded by: L.L. Lloyd

3-29-79 Comments	Run	Sampling location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Predryer Particle Size Test #1	AN-PRE-1	A	Part	1112	1127	15	
Test Complete				11	27		
Predryer Particle Size Test #2	AN-PD-2	A	Part	1632	1702	30	
Test Complete				17	02		
Predryer Particle Size Test #3	AN-PD-3	A	Part	1951	2021	30	
Test Complete				20	21		
3-30-79							
Cooler Particle Size Test #1 (Plugged)	AN-C-1	A	Part	1239	1239	—	
Cooler Particle Size Test #1 (Plugged)	AN-C-1	" A	Part	1224	1244	—	
Cooler Particle Size Test #1	AN-C-1	A	Part	1250	1305	15	
Test Complete				13	05		
Cooler Particle Size Test #2 (plugged)	AN-C-2	A	Part	1528	—	—	
Cooler Particle Size Test #2 (Plugged)	AN-C-2	A	Part	1532	—	—	
Cooler Particle Size Test #2 (Plugged)	AN-C-2	A	Part	1537	—	—	
Cooler Particle Size Test #2	AN-C-2	A	Part	1541	1556	15	
Test Complete				15	56		
Cooler Particle Size Test #3	AN-C-3	A	Part	1842	1857	15	
Test Complete		"		18	57		
3-31-79							
Dryer Particle Size Test #1	AN-D-1	A	Part	1007	1022	15	
Test Complete				10	22		
Dryer Particle Size Test #2	AN-D-2	A	Part	1203	1233	30	
Test Complete				12	33		
Dryer Particle Size Test #3	AN-D-3	A	Part	1406	1430	24	
Test Complete				14	30		

3/27 Tuesday – Set-up Day

10^{20} Departed Ascalon with equipment
J. Cox, D Becker, M. Hackett, F. Willi, B. Dearborn
S. Lambert

11^{00} Arrived at Plot, met c̄ Gene Pirly,
Erin Noble, (EPN) Mark Borstein (MCA)

12^{30} Lunch (@ Dump) heavy rain during entire day. Plot down most of the day due to protest being met

4^{15} Return to Ascalon – Equipment set-up, stereo cords have been arranged c̄ electrician.

3/28 Wednesday

0800 Departed from Anchorage:
D Brown, A Wilson, J. Lee, Tomlinson, Lambert,
Willis, Dearborn, Dziada, Wong, Piatek,
Hackett, Hernandez

0900 Safety briefing

10 30 Set-up for testing PO, O, Carbon

12 15 Lunch

1 30 Plant Problems, motor burned out on
PO, plant is replacing it.

2 15 Clean-up & evaluation with Hans Riley
Hackett & Frank - 10 Problems.

3 00 Testing looks bleak - may have to start
fresh in the morning

4 00 Decision made to return to Anchorage

3/29 Thursday

0730 Depart Arcadia for plant - all 12 people on time

0815 Arrive at plant

- Performed velocity traverse

1100 - Test sample train in position, leak checks 2-3 leaked

- Plant still having problems - equipment not up to correct temperatures

1405 - Started Run 1 PD - O - Cooler

1427 - Plant down - Scrubber Problem

Mark Bristol ~~[illegible]~~ asked us to shut down - (bad decision - Bruce says he has no authority to tell us anything!)

1455 - Run 1 Complete Part A
1820 - 1905 Run 1 Complete Part B
1915 - Clean-up west wall - (slow, but will probably get better).

1935 - Stack Tester left for Arcadia

2030 - DPB, Herbert, Willie finished clean-up and left for Arcadia.

3/30 Friday

0730 Departed Arcadia - all 12 in train

0820 Arrived at Plant

0951 Started Run 2 on PD, D & Cooler

1411 Stop Run 2 D
1417 " " " C
1408 " " " PD - liner of cone loose, probably may have leaked

1645 Started all Train - all looks good Run 3
1758 Run 3 PD STOP
1803 Run 3 C - STOP

1718 Run 3 D - STOP

1830 Stack Sampler left for Arcadia
All equipment is packed and ready for transfer to the Ocean Plant

2005 Tomlinson, Bean, Willi, Alexander left for Arcadia

APPENDIX H

PROCESS DATA (GCA)

Part I - Summary of Recorded Data
Part II - Correspondence
Part III - Field Notebook

TABLE H-1 SUMMARY OF PROCESS EQUIPMENT PARAMETERS DURING MASS EMISSION TESTS

Parameter	3/29/79 14:09-14:40, 18:00-19:30				3/30/79 9:45-14:30				3/30/79 16:40-18:30			
	Mean value	Standard deviation	Minimum	Maximum	Mean value	Standard deviation	Minimum	Maximum	Mean value	Standard deviation	Minimum	Maximum
Air temperature into Predryer, °F	291	1.9	215	220	220	0	220	220	220	0	220	220
Air temperature out of Predryer, °F	155	0	155	155	167	5.4	155	175	152	2.4	150	155
Air temperature into Dryer, °F	216	3.0	210	220	201	1.6	200	205	200	0	200	200
Air temperature out of Dryer, °F	158	5.6	150	163	166	2.9	160	170	160	0	160	160
Air temperature into Cooler, °F	50	0.5	49	51	46	0.3	45	46	46	0.4	45	46
Air temperature out of Cooler, °F	133	2.2	130	135	133	1.4	130	135	125	0	125	125
Temperature of AN to Head Tank, °F	273	0.3	272	273	269	1.5	265	270	271	2.0	270	275
AN Head Tank level	44	1.7	42	46	41	1.3	40	44	45	2.7	42	48
Draft setting into Predryer	0.57	0.16	0.2	0.7	0.42	0.8	0.3	0.5	0.59	0.02	0.55	0.6
Draft setting into Dryer	0.39	0.12	0.1	0.5	0.43	0.8	0.3	0.5	0.58	0.04	0.5	0.6
Percent moisture product from Prill Tower	0.30‡	0.03	0.27	0.34	0.25	0.05	0.19	0.32	0.29*	—	—	—
Product temperature into Predryer, °F	138‡	1.7	136	140	149	7.8	134	155	122.5^	2.5	120	125
Product temperature into Dryer, °F	158‡	2.8	154	160	179	3.0	174	183	172^	1.5	170	173
Product temperature into Cooler, °F	165‡	6.6	156	172	163	2.9	158	166	157^	1.5	155	158
Product temperature out of Cooler, °F	91‡	0.5	91	92	91	0.4	90	91	90^	0	90	90

Number of readings taken during test period: *One ^Two ‡Three

TABLE H-2 SUMMARY OF PROCESS EQUIPMENT PARAMETERS DURING TEST PERIOD

Parameter	Thursday, 3/29/79				Friday, 3/30/79				Saturday, 3/31/79			
	Mean value	Standard deviation	Minimum	Maximum	Mean value	Standard deviation	Minimum	Maximum	Mean value	Standard deviation	Minimum	Maximum
Air temperature into Predryer, °F	219	1.8	215	220	220	0.4	220	222	216	5.6	205	222
Air temperature out of Predryer, °F	154	6.2	135	165	160	8.5	150	175	149	8.0	139	163
Air temperature into Dryer, °F	216	4.1	205	220	201	1.9	200	207	200	0	200	200
Air temperature out of Dryer, °F	161	5.6	150	170	163	3.5	140	170	151	9.8	140	164
Air temperature into Cooler, °F	50	0.7	48	52	46.2	1.4	45	52	47	1.0	46	48
Air temperature out of Cooler, °F	135	2.9	130	140	130	3.5	125	135	127	2.2	125	130
Temperature of AN to Head Tank, °F	273	0.5	272	273	270	2.2	265	275	270	0	270	270
AN Head Tank level	44	1.9	42	47	43	2.5	40	48	42	0.3	41	42
Draft setting into Predryer	0.57	0.15	0.2	0.8	0.50	0.10	0.3	0.6	0.58 0.95	0.04 0.11	0.5 0.8	0.6 1.1 *
Draft setting into Dryer	0.42	0.09	0.1	0.5	0.49	0.09	0.3	0.6	0.51	0.08	0.4	0.6
Percent moisture product from Prill Tower	0.30	0.05	0.24	0.39	0.25	0.05	0.19	0.32	0.27▲	0.02	0.25	0.29
Product temperature into Predryer, °F	137	3.8	130	140	142	13.8	120	155	133▲	3.0	130	136
Product temperature into Dryer, °F	162	5.8	154	171	177	4.5	170	183	146▲	6.0	140	152
Product temperature into Cooler, °F	168	7.3	166	178	161	4.1	155	166	154▲	3.5	150	157
Product temperature out of Cooler, °F	93	2.6	91	97	91	0.5	90	91	91▲	0	91	91

*Damper changed at 12:00 Noon.

▲Only two readings taken during test period.

PART II

LETTERS OF CONFIRMATION FOR PRODUCTION RATE DATA SUPPLIED BY UNION OIL COMPANY

The first letter contained in this section is the letter confirming the production rate data supplied over the telephone to GCA by Mr. Robert Waddell of Union Oil. In the second paragraph, it was noted that according to notes taken during testing a production rate change occurred at 12:00 on 30 March 1979. Production rate changes in ammonium nitrate plant generally involve little more than shutting off or turning on a sprayhead at the top of the prill tower. When the plant begins to experience high moisture in the product leaving the prill tower, it is routine procedure to shut off a sprayhead.

The time that the production change on 30 March occurred was originally thought to be 12:00, as stated in the letter dated 16 May to Mr. Waddell. A thorough review of the notes taken during testing revealed that the change in production occurred at 17:30 and not 12:00. Union Oil was contacted to confirm the time of 17:30 for the time of change. The plant log sheets confirm that a change from eight sprayheads to seven occurred at 17:30. The second letter contained in this Appendix confirms that fact. All other information contained in the letter of 16 May 1979 is accurate.

RECEIVED
JUN 7 1979
GCA/TD/RH

15 May 1979

RECEIVED
MAY 29 1979
GCA/TECH. DIV.
BEDFORD, MA.

Mr. Robert W. Waddell
Process and Control Superintendent
Union Chemicals Division: Nitrogen Group
Union Oil Company of California
P. O. Box 1280
Brea, CA 92621

Subject: Confirmation of Telephone Conversations

Dear Mr. Waddell:

In our telephone conversations during the week of 16 April 1979, you provided ammonium nitrate production rate information for 29 March 1979 through 31 March 1979.

This information included a sprayhead throughput value of 28.6 tons/day/sprayhead. Production rates were then given as 201 tons/day on 29 March, 229 tons/day on 30 March, and 172 tons/day on 31 March. According to notes taken during testing, the number of sprayheads in operation was reduced from eight to seven at 12:00 on 30 March. It has, therefore, been assumed by GCA that the production rate on 30 March between 12:00 and 19:00 was 200 tons/day.

In a telephone conversation during the week of 23 April 1979, you provided urea production rate information for 4 April 1979 through 6 April 1979. The quoted rates were 356 tons/day on 4 April, 347 tons/day on 5 April, and 214 tons/day on 6 April. Feed grade production was begun on 5 April 1979 at around 16:00. Based on process parameters readings, it has been assumed by GCA that the production rate figure for 6 April, 214 tons/day, is also representative of production on 5 April between 16:00 and 22:00.

Should any of the information presented with your account of our conversations, please send a corrected version of the information.

Should you find all information presented here to be correct and representative of our conversations, please indicate your concurrence by signing the duplicate copy enclosed and returning it to me. This procedure will insure that I am in possession of accurate process information. Thank you for your cooperation.

Sincerely,

Stephen K. Harvey
Senior Engineer

SKH/mjl

Enclosure

cc E.A. Noble, EPA
T. Curtin, GCA/Chapel Hill
A. Werner, GCA/Chapel Hill

RECEIVED
JUN 7 1979
GCA/TD/CH

I agree that the information contained in this letter is an accurate account of our telephone conversations and that the two assumptions made by GCA are an acceptable interpretation of the available information.

Signed: Robert W Waddell
5/21/79

RECEIVED
MAY 29 1979
GCA/TECH. DIV.
BEDFORD, MA.

GCA

Technology Division

27 June 1979

Mr. Mark Holderman
Process Engineer
Union Chemicals Division: Nitrogen Group
Union Oil Company of California
P.O. Box 1280
Brea, CA 92621

RECEIVED
JUL 17 1979
GCA/TECH. DIV.
BEDFORD, MA.

Dear Mr. Holderman:

Subject: Confirmation of Telephone Conversations

In our telephone conversations on 26 June 1979, the ammonium nitrate production rate change which occurred on 30 March 1979 was discussed. In a previous letter addressed to Mr. Robert Wadell, dated 16 May 1979, I stated that the change occurred at 12:00 noon. A review of the notes taken during testing on 30 March has revealed that the change occurred at 17:30 and not at 12:00 as originally believed. Based on operator notes in the ammonium nitrate plant log sheets for 30 March, you confirmed that production was reduced from eight sprayheads to seven sprayheads at 17:30.

If the account presented above is an accurate representation of our conversation, please indicate your concurrence by signing the duplicate copy enclosed and returning it to me. Should any of the information presented conflict with your account of our conversation, please send a corrected version of the information.

This procedure will serve to confirm that the production rate change on 30 March 1979 did occur at 17:30 rather than 12:00 as originally assumed. Thank you for your cooperation.

Sincerely,

Stephen K. Harvey

Stephen K. Harvey
Senior Engineer

SKH/lmb
Enclosure
cc: E. A. Noble, EPA
T. Curtin, GCA/Chapel Hill
A. Werner, GCA/Chapel Hill

I agree that the information contained in this letter is an accurate account of our conversation.

Signed: Mark Holderman

PART III

COPY OF RAW DATA RECORDED DURING EMISSION TESTS

Jim ~~Fenton~~ S. Epson process engineer

* Mark Holderman 28 spray tube

production rate during test will be provided by plant for test period

product type prior to, [illegible]

✓ [illegible]

4-TRC-354 +A

4-TRC-356 +A

~~4-TRC-352 in~~ 4-TRC-360 outlet

~~Tage~~ Top to Acid Tank recorded and monitor

4-TR-352A

✓ % moisture every 2 hours off log sheet

✓ 4-PRC-333 ~~A~~ 4-PRC-336 draft on inlet air damper position

Lead Tank level indicator in Control room

4-LI-325 3 ft diameter 5 feet high

Slurry scrubber	Slurry scrubber
Predryer Dryer	Cooler
60 HP Motor	40 Hp Motor
Min 16 gpm to plates	Min 25 gpm to plates
Min 18 gpm to spray	Min 20 gpm to spray
Max AN conc 41%	Max AN conc 42%

Relaxer

2 10:44 - 14:08

[illegible] (1:13)

Coolers

1 [illegible]

2 10:43 - 14:17

3 16:[illegible] - 16:[illegible]

Dryers

1 14:09 - 14:59, 18:20 - 19:05

2 9:51 - 13:07, 13:32 - 14:11

3 12:42 - 17:19, 14:27 - 15:03

1 2:01p - 2:28p

2:52p - 3:03p

6:26p - 6:53p [illegible]

TIME	AIR TEMP INTO PREDRYER	AIR TEMP OUT PREDRYER	AIR TEMP INTO DRYER	AIR TEMP OUT DRYER	AIR TEMP INTO COOLER	AIR TEMP OUT COOLER	TEMP AN. TO HEAD TANK	AN. HEAD TANK LEVEL
9:30	215	135	205	150	50	130	272	46
9:8 HEAD VELOCITY TRANSDUCE 10:00	220	145	220	160	50	135	272	47
10:40	220	150	220	165	50	137	272	42
11:05	220	158	220	165	50	138	272	42
11:30	220	162	220	170	48	140	272	42
12:00	220	165	220	170	50	140	272	42
12:30	220	150	210	165	51	138	273	42
1:00	225	160	210	160	52	136	273	42
2:09	215	155	210	150	51	131	273	42
2:40	220	155	220	150	50	131	273	42
3:10	217	155	215	155	50	130	273	42
3:30	220	155	215	162	50	132	273	42
4:40	220	155	215	162	50	135	273	42
5:30	220	155	215	162	50	135	273	42
6:00	220	155	215	163	50	135	273	44
6:30	220	155	215	162	49	135	273	45
7:00	220	155	218	163	50	135	273	46
7:30	220	150	218	162	50	135	272	46
7:55	220	150	218	162	50	135	273	46
8:20	220	150	216	162	50	135	272	46
			Ammonium	Nitrate	Test 1	3/29/79 - THURSDAY		

28 Hoods operating during relining tissue at 9:30 AM

#1 particle size on Prilling started 11:10

#1 Mass test started 2:09p 3/29/79

shut down plant problem (2:28 - 2:32) back up 4 minutes later

A.N solution concentration 87.2 % AN to evaporator = 184°F

shutdown 3:05 for changeover to 2nd prill - pipe ~~[illegible]~~ to long cooling in the tower

2nd particle size prilling ~~[illegible]~~ 7:30 - 5:01

start-up (2nd prill) 6:20p down around 6:53

particle size start around 7:30p - 8:00

[illegible] 2:60

Draft out P. Dryer Dryer	DRAFT SETTING P. DRYER	DRAFT SETTING INTO COOLER DRYER	O/A MOISTURE	PROD TEMP INTO PRE DRYER	PROD TEMP INTO DRYER	PROD TEMP INTO COOLER	PROD TEMP OUT COOLER	DRAFT SETTING COOLER
100	0.5	0.5						100
100	0.5	0.5	0.39					100
100	0.4	0.4						100
100	0.5	0.5	0.27	130	166	168	96	100
100	0.5	0.4						100
100	0.2	0.4	0.24	140	171	178	97	100
100	0.7	0.4						100
100	0.6	0.3	0.34 (2p)					100
100	0.6	0.5	0.34 (2p)	140	154	156	91	100
100	0.2	0.1						100
2:00 100	0.7	0.5						100
100	0.8	0.5		139	160	166	91	100
4:00 100	0.7	0.4	0.27 (4p)					100
100	0.7	0.4						100
100	0.6	0.4	0.28 (6p)					100
100	0.6	0.4		136	160	172	92	100
100	0.6	0.4						100
100	0.7	0.4						100
100	0.6	0.5						100
100								100
			Ammonium	Nitrate	Test 1	3/29/79	THURSDAY	

2nd run. as previous, bore probably will be dull - cause not light.

Dryer exhaust had ~ 4" backlash.

TIME	Air Temp into Prelyer	Air Temp into PreDryer	Air Temp into Dryer	Air Temp out Dryer	Air Temp into Cooler	Air Temp out Cooler	Temp Hot Tank	Hot Tank Level
9:15	222	158	207	180	52	130	273	42
9:45	220	155	205	160	46	133	265	40
10:15	220	168	207	162	45	132	269	44
10:45	220	166	202	165	46	132	269	40
11:15	220	170	200	166	46	135	270	40
11:45	220	170	200	166	46	133	270	40
12:15	220	175	200	170	46	133	270	41
1:0	220	170	200	170	46	134	270	41
1:30	220	170	200	166	46	132	270	42
2:00	220	168	200	165	46	131	270	42
2:30	220	160	200	165	46	130	268	42
3:00	220	156	200	160	46	130	266	42
3:30	220	155	200	160	46	127	267	42
4:00	220	155	200	160	46	127	267	42
4:40	220	155	200	160	46	125	270	42
5:00	220	155	200	160	46	125	270	42
5:30	220	150	200	160	46	125	270	42
6:00	220	150	200	160	46	125	272	42
6:30	220	150	200	160	45	125	275	42
7:00	220	150	200	158	45	125	270	42
9:45	222	155	200	160	46	126	270	42
10:15	220	163	200	163	46	130	270	42
10:45	220	155	200	164	46	130	270	42
12:00	220	150	200	156	48	130	270	42
12:30	210	140	200	145	48	127	270	42
1:00	205	139	200	140	48	125	270	42
2:00	215	142	200	140	48	125	270	42
11:30	213	145	200	143	48	125	[illegible]	
			A.N	Test 2	TOD Friday	3/30		

8:30 am Running with 32 spaghetti.
Draft to prediger at 7:50 am, required and back up at 10:30 am
1st mass was finished at 2:15 p
Appears slight change around 2:15 p - the passage to spring spring [illegible]
for the production.

Start mill at 4:10 p - 17:57
Cut production to 24 heads at 5:30 p - high moisture (0.72)

Set - Pellets size, operating w/ 24 heads

Draft in Predryer Dryer	Draft Setting into Predryer	Draft setting into Dryer	% Moisture	Prod Temp into Predryer	Prod Temp into Dryer	Prod Temp into Cooler	Prod Temp out of Cooler	Prod Feed Rate (lb/hr)	Time
100	out of service at 7:50 am reading 0.6	0.5	0.29 (8a)					100	9:15
"		0.5						"	9:45
100	0.3 (10:30a)	0.4		150	179	164	91	100	10:15
"	0.4	0.4	0.27 (10a)						10:45
"	0.3	0.4		153	181	166	91	"	11:15
"	0.4	0.3						"	11:45
100	0.25	0.3	0.19 (12n)	155	183	166	91	100	12:15
100	0.5	0.5						100	1:10
100	0.5	0.5						100	1:30
100	0.5	0.5	0.19 (2p)	154	180	163	91	100	2:00
100	0.5	0.5						100	2:30
100	0.5	0.5		134	174	158	90	100	3:00
100	0.6	0.5						100	3:30
100	0.5	0.5	0.32 (4p)					100	4:00
100	0.6	0.5		125	170	155	90	100	4:40
100	0.6	0.6						100	5:00
100	0.6	0.6						100	5:30
100	0.6	0.6		120	173	158	90	100	6:00
100	0.55 increase at 12:00	0.6						100	6:30
100	0.6	0.6						100	7:00
100	0.5	0.6	0.29 (8a)					100	
"	0.6	0.6						"	
"	0.6	0.55						"	
"	0.6	0.45	0.25 (12n)	130	152	157	91		
"	1.0	0.5							
"	1.1	0.6						"	
"	0.8	0.4						"	
"	0.9	0.4		136	140	150	91		

A.N Test 2

(1)

4/2 Started at 11:03 AM. 11:10 - 12:31

2nd Evap heated to remove over build-up [illegible] vacuum
drawer exit. Done 2-3 times/shift when vacuum [illegible]
temp's of melt & pail, increase in dust content from [illegible] pail not
cooler

[illegible] - using [illegible]

2nd evap heated 1:45p

(2) 14:00 - 15:24

(3) 16:13 - 17:31

5:55p - heated 2nd evap

APPENDIX I

DETAILED SAMPLING AND ANALYTICAL PROCEDURES

Part I - Sampling and Analytical Procedures
Part II - Ammonia
Part III - Bulk Density
Part IV - Sieve Analysis

APPENDIX I

SAMPLING AND ANALYTICAL PROCEDURES

SAMPLING METHODS

Modified Method 5 sampling was conducted concurrently at the outlet ducts of the predryer, dryer and cooler. Each traverse point was sampled three minutes per point. A total of 20, 32 and 20 traverse points, for the predryer, dryer and cooler, respectively, was sampled.

Because of product accumulation on the inside of the duct, it was necessary for the task teams to forego sampling points near the duct walls in order to prevent plugging of the sampling probe and pitot tube. When a troublesome point could not be sampled, the last point sampled would be sampled an additional time to compensate for those points that could not be sampled.

Borosilicate heated glass probes were used for all sampling. Between the probe and the sample box, an unheated 5/8" OD Teflon® tube was used. The sample box contained six impingers. The second and fourth were Greenburg-Smith impingers, the remainder were 1/2" straight tube impingers with the open within 1/2" of the bottom of the impinger jar. The first two impingers contained deionized-distilled water. The third and fourth contained 1N sulfuric acid (1N H_2SO_4). The fifth impinger was dry and the sixth contained silica gel. All impingers were contained in an insulated container and kept under ice during sampling.

All sampling was performed isokinetically. Sampling and meter box conditions were recorded every three minutes. During port changes all three sampling trains completed one port and would then begin sampling the second port concurrently.

During sampling, operation parameters for the predryer, dryer and cooler were recorded. Sampling occurred only during normal operating conditions, as determined by GCA.

Occasionally, plugging of the probe and pitot tube would occur. Rinsing with deionized-distilled water would dissolve the particulate and sampling would continue. On the vertical traverse, sampling was limited by the amount

of dust accumulated at the bottom of the duct. Particularly troublesome was the dryer duct which had product accumulation of several inches. When this occurred, the traverse point would not be sampled and only those points which provided continuous sampling would be used.

SAMPLE CLEAN-UP

At the conclusion of each sample run the Method 5 sample box, Teflon® tube, and probe for each team were delivered to a mobile field laboratory setup at the Union Oil plant. During transport from the test site to the laboratory, rubber plugs were inserted into all open probes, Teflon® tubes and sample box openings to prevent loss of sample and contamination.

Before clean-up began, two borosilicate glass bottles with Teflon®-lined caps were labeled to identify the sample run, location, date, and time. One container was identified as "Container #1" and always contained the contents of the first two impingers (deionized-distilled water), and all deionized water washings, which included the first two impingers, connecting glassware, Teflon® tube and probe. The second glass container was identified as "Container #2" and always contained the contents and rinses of the third, fourth (the impingers which contained the 1N N_2SO_4) and fifth impingers. When these impingers were emptied and rinsed, all rinses were performed using 1N H_2SO_4. After emptying each impinger into the appropriate container, the impinger and associated glassware were rinsed three times with the corresponding liquid wash. During the clean-up procdedures the impingers remained assembled, i.e., the impinger tube assembly was not removed from the impinger jar.

The Teflon® tube was washed with three separate deionized-distilled water rinses. Prior to each washing, a glass flask with 28/12 ground glass joint was attached to the tube. The flask was filled with approximately 75 mls of deionizeddistilled water and then washed three times by rinsing the rinse water from one end of the tube to the other. The rinse was then emptied into Container #1 and the procedure repeated two additional times.

The probe was washed with the nozzle attached. Seventy-five mls of rinse water were placed into the same flask used for the Teflon® tube washings. The rinsing for the probe was performed in the same manner as the Teflon® tube washings above. In addition to the rinsings, the probe was brushed and rinsed an additional three times to remove all particulates.

After the clean-up procedure was completed the liquid levels in Container #1 and Container #2 were marked and the caps sealed. The containers were then transported to the ES laboratory in Arcadia for analysis. All clean-up procedures were identical for all sample runs and were the responsibility of the same two field technicians.

LABORATORY PROCEDURES FOR AMMONIUM NITRATE

The ammonium nitrate samples were brought into the lab from the field in glass sample jars with the lids taped to prevent sample loss and the solution levels marked on the sample containers. Each sample was logged in the lab notebook and measured volumetrically to determine the initial sample volume.

There were two types of sample solutions; deionized-distilled water and one normal sulfuric acid (1N H_2SO_4). The water solutions (referred to as Container #1) contained the in-line glass fiber filter. Prior to analysis, the sample jar was placed in an ultra sonic bath to dislodge any trapped particulates. The Container #1 samples were then each filtered through a glass fiber filter and Buchner funnel. These filters were individually placed in plastic petri dishes and dried in a dessicator. Each glass fiber filter was numbered and weighed prior to its use. Once these filters were dry, they were weighed again and percent solids were determined.

Both container one samples and container two samples (those in a sulfuric acid solution) were analyzed for ammonia and for nitrate. The ammonia analysis was colorimetric, utilizing the Nessler's Reagent. The colorimetric absorbance reading was made on a Bausch and Lomb Spec-20 set at a wavelength of 405 nm. The nitrate analysis was conducted using a specific ion exchange electrode and Orion Model 901 digital readout. The sample solution was mixed with a Teflon® coated magnetic stirrer to ensure uniformity of the solution when the ion exchange probe was used.

All of the results were placed in a hard-bound laboratory notebook. The time, date, barometric pressure and room temperature were recorded at the time of analysis. These notes are reproduced in Appendix D.

Washing Procedure for Laboratory Glassware

All of the glassware used in the lab followed a standard washing procedure. Each piece was individually rinsed with tap water, then rinsed 3 to 5 times with a 10 percent hydrochloric acid solution (HCl) and finally rinsed 3 to 5 times with deionized-distilled water. The glassware was then air-dried or oven-dried.

PARTICLE SIZE SAMPLING AND ANALYTICAL METHODS

Particle size determinations were done using a six-stage Andersen Mark III high-temperature inertial cascade impactor. Stack gas samples were drawn isokinetically and the particulate was aerodynamically fractionated by size and captured on Andersen glass fiber collection disks. A single jet inertial preimpactor was used on all of the nine tests to minimize large particle bounce and reentrainment in the stages.

Samples were drawn with a standard Method 5 meter box and impinger train. The impactor was mounted on a five foot long threaded steel probe. A preliminary traverse of the duct was conducted, and a point of average velocity determined by the squared mean of the the square roots of the recorded ΔP readings. A single point corresponding to this average velocity was used for sampling. Three tests each were run on the ammonium nitrate predryer at traverse point 6 on the horizontal port, on the AN-dryer at point 7 on the horizontal port, and on the AN-cooler at point 8 on the horizontal port.

All collection substrates were preweighed at the ES, McLean, Virginia laboratory using a Cahn Model 21 electrobalance. Circular aluminum foil disks were cut for each filter and weighed with the filter. Filters were dessicated until two successive weights were obtained with no more than a 0.10 mg difference. The minimum time between successive weighings was 12 hours.

After sampling, the impactor was disassembled and the collection filters folded into the tared aluminum foil liners and stored in individual petri dishes. Particulate adhering to the crossbars, O-rings, and stage plates were brushed onto the appropriate filter. The nozzle, pre-impactor and inlet cone were brushed into tared glass petri dishes. The normal practice of using a solvent wash could not be used for this material due to the hygroscopic nature of the particulate.

Following the completion of the sampling program the samples were returned to the ES, McLean, Virginia laboratory for analysis. Filters were dessicated and weighed using a $\pm$ 0.05 mg dessication criterion. The petri dishes containing the preimpactor catch were weighed to a $\pm$ 0.5 mg criterion. Particle size stage cutpoints were calculated using a modification of EPA program EPA 600/7-78-072 on an IMB 3033 computer.

Gene Riley
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 lightly packed glass wool is a satisfactory filter.

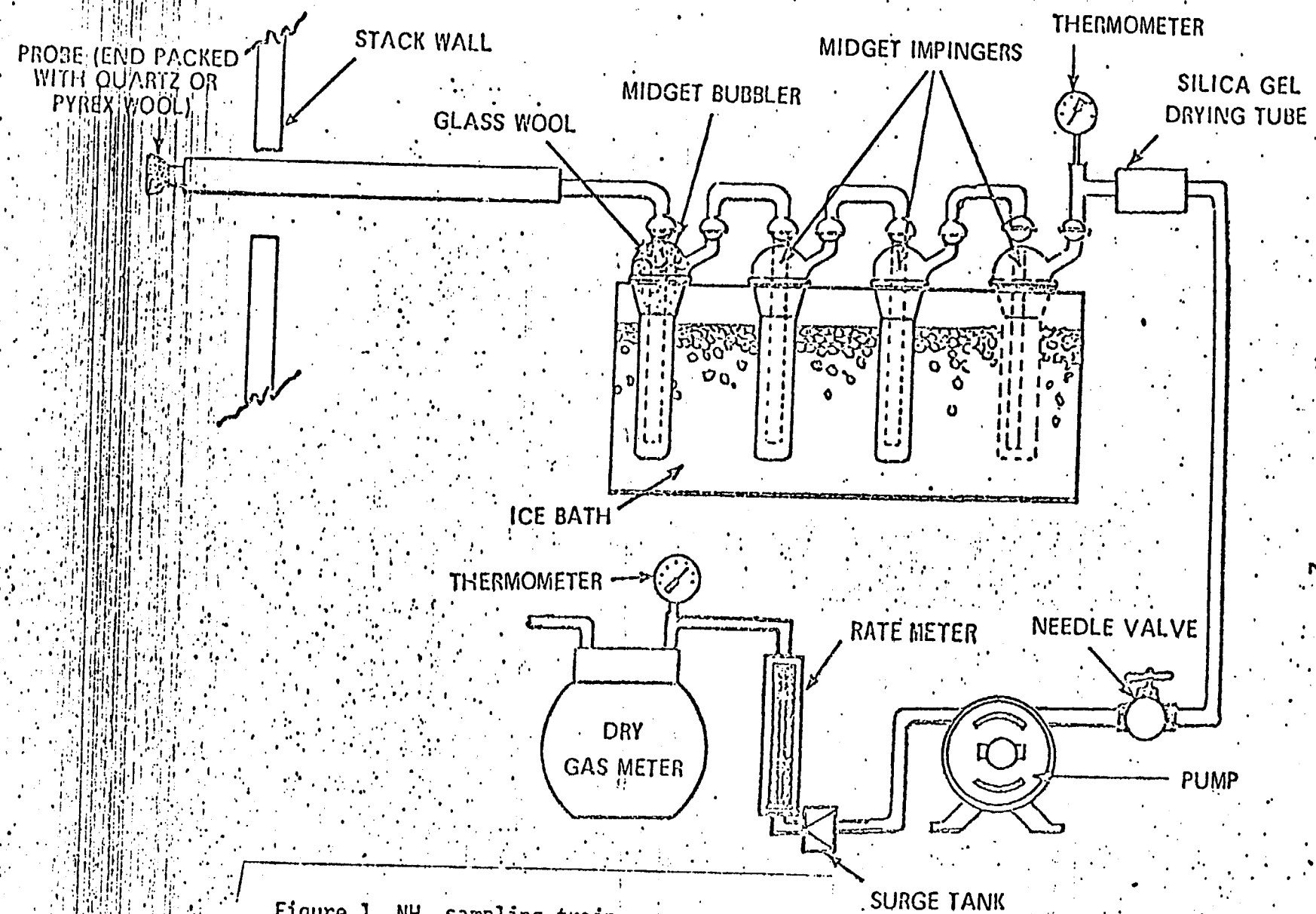


Figure 1, NH_3 sampling train.

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 Nessler 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.e., 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.

NH_3

APR 26 1979

DETERMINATION OF PARTICULATE (AMMONIUM NITRATE) EMISSIONS FROM AMMONIUM NITRATE PLANTS

1. Principle and Applicability

1.1 Principle. Particulate emissions are assumed to be ammonium nitrate. A portion of the emission is withdrawn isokinetically from the source using a sampling train. The ammonium nitrate is collected in the impinger water and on the final filter of the sampling train. The total weight of ammonium nitrate collected is calculated from the determination of nitrate ion concentration using a specific ion electrode method.

1.2 Applicability. This method is applicable for the determination of particulate (ammonium nitrate) emissions from neutralizers, evaporators and prilling towers in ammonium nitrate production facilities only when specified by the appropriate test procedure for determining compliance.

2. Range and Sensitivity

2.1 Range. The range of the procedure is limited only by the lower detection limit of nitrate concentration using a specific ion electrode. A typical linear measurement range is 6×10^{-6} to 1.0 M (gm moles/liter) nitrate ion. This converts to a particulate emission concentration range of about 2.5×10^{-4} to 43 grains per standard cubic foot, using a 90 percent water vapor stream for calculation basis.

2.2 Sensitivity. The sensitivity of the technique will vary depending on the particular combination of electrode and readout meter. The manufacturer's specifications should be consulted when an estimate is required.

3. Interferences

The following ions concentrations are reported by one vendor to cause a 10-percent error when measuring a 10^{-3}M nitrate concentration:[1]

---

[1]Analytical Methods Guide, Orion Research, May 1975.

ClO^{-5} 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

A statistically valid estimate has not been made for the precision of the total technique. However, using a limited amount of data collected during the initial demonstration tests resulted in a precision based on a 95 percent confidence interval of 19.7 percent. No standard reference materials are available to form a basis for the determination of accuracy. Samples collected during the demonstration tests were stored for a period of about 30 days with no apparent degradation of the nitrate ion concentration.

5. Apparatus

5.1 Sampling Train. See Figure 1. Many of the design specifications of this sampling train are described in APTD-0581.

5.1.1 Nozzle. Stainless Steel (316) with a sharp, tapered leading edge.

5.1.1 Probe. Borosilicate[1] glass or stainless steel (316) with a heating system capable of maintaining a gas temperature of about 121° C (250° F) at the exit of the probe when it is desired to prevent condensation in the probe.

5.1.3 Orifice Flow-Meter. Stainless steel (316) constructed and calibrated such that sampling rates can be monitored and adjusted as required. Additional information regarding the construction, calibration, and use of this type meter can be obtained from: Emission Measurement

[1]Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

Branch, Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Caroling 27711.

5.1.4 Pitot Tube. Type S, or equivalent, attached to probe to monitor stack gas velocity.

5.1.5 Impingers. Five impingers connected in series as shown in Figure 1 with ground glass vacuum tight fittings. The first, third, fifth, and sixth impingers are of the Greenburg-Smith design, modified by replacing the tip with a 1.25 cm (1/2 inch) inside diameter glass tube extending to 1.25 cm (1/2 inch) from the bottom of the flask. The second and fourth impingers are of the Greenburg-Smith design with a standard tip.

5.1.6 Filter Holder. Borosilicate glass with a glass frit filter support and a silicone rubber gasket. The holder design shall provide a positive seal against leakage from the outside or around the filter.

5.1.7 Filter Heating System. Capable of maintaining the filter holder at about 121° C (250° F). The filter heating system is required only when necessary to prevent condensation on the filter media.

5.1.8 Metering System. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3° C (∿5° F), dry gas meter with 2 percent accuracy at the required sampling rate, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

5.1.9 Barometer. To measure atmospheric pressure to ±2.5 mm Hg (0.1 in.).

5.2 Sample Recovery.

5.2.1 Probe Brush. At least as long as the probe.

5.2.2 Wash Bottle. Glass or polypropylene.

5.2.3 Sample Storage Containers. One liter, polypropylene, wide mouth, with Teflon cap liner.

5.3 Analysis.

5.3.1 Glass or Polypropylene Beaker. 5000 ml.

5.3.2 Balance. Triple beam or dual pan, 1500 gram 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 used.

5.3.5 Electrometer. A pH meter with millivolt scale capable of ±0.5 mv resolution, or a specific ion meter made especially for specific ion use.

5.3.6 Magnetic stirrer and TFE flourocarbon coated stirring bars.

5.3.7 Graduated Cylinder. 500 ml, graduated in divisions of 2 ml, capable of measuring volume to ±1 ml.

6. Reagents

6.1 Sampling.

6.1.1 Filters. MSA 1108BH glass fiber, or equivalent, to fit filter holder.

6.1.2 Silica Gel. Indicating type, 6-16 mesh, dried at 175° C (350° F) for 2 hours.

6.1.3 Water. Distilled.

6.1.4 Sulfuric Acid, 1 N. Prepare by adding 56 ml of concentrated sulfuric acid to 500 ml of deionized distilled water in a 1 liter volumetric flask. Dilute to exactly 1 liter with deionized distilled water.

6.1.5 Sulfuric Acid, Concentrated. ACS grade, 18 M.

6.1.6 Crushed Ice.

6.2 Sample Recovery.

6.2.1 Water. Distilled, from same container as 6.1.3.

6.2.2 Sulfuric Acid, 1 N. From same container as 6.1.4.

6.3 Analysis.

6.3.1 Ionic Strength Adjustor (ISA). Dissolve 26.4g of ACS-grade ammonium sulfate $(NH_4)_2SO_4$, in 50 ml of deionized distilled water in a 100 ml volumetric flask. Dilute to exactly 100 ml with deionized distilled water.

6.3.2 Preservative Solution. 1 M boric acid solution. Prepare by dissolving 6.2g of ACS grade boric acid in 90 ml of boiling deionized distilled water in a 100 ml volumetric flask. Dilute to exactly 100 ml with deionized distilled water.

6.3.3 Standard Ammonium Nitrate Solution. Prepare by weighing exactly 1.290g of NH_4NO_3 into a 1-liter flask. Add 500 ml of deionized distilled water and dissolve. Dilute to exactly 1 liter with deionized distilled water. This solution contains 1 mg/ml NO_3^-.

6.3.4 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.

6.3.5 Water. Deionized distilled from same container as 6.1.3.

7. Procedure

7.1 Sampling.

7.1.1 Select the sampling site and the minimum number of sampling points; determine the stack pressure, temperature and range of velocity

head as described in Methods 1, 2, and 3 (Federal Register, Vol. 36, No. 247, Thursday, December 23, 1971).

7.1.2 Preparation of Sampling Train. Place glass fiber filter into filter holder. Weigh approximately 200 gm. of silica gel to the nearest gram. Place 100 ml of distilled water in each of the first and second impingers; place 100 ml of 1 N H_2SO_4 in each of the third and fourth impingers; leave the fifth impinger empty, and place the pre-weighed silica gel in the sixth impinger. Assemble the train as shown without the probe in Figure 1, except with the filter between the second and third impinger.

Leak check the sampling train at the sampling site by plugging the inlet to the train and pulling a 380 mm Hg. (15 inch) vacuum, or the maximum vacuum that is expected to occur during the test run, whichever is greater. A leakage rate not in excess of 0.00057 m^3/min (0.02 ft^3/min) at a vacuum of 380 mm Hg. (15 inch) is acceptable. Attach the probe and adjust the probe heater to provide a gas temperature of about 121° C (250° F) at the probe outlet. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 21° C (70° F) or less.

7.1.3 Train Operation. For each run, record the data required on the example sheet shown in Figure 2. Take readings at each sample point at least every 5 minutes, and when changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for the same amount of time at each traverse

point. Maintain isokinetic sampling throughout. Turn off the pump at the conclusion of each run and record final readings. Remove the probe and nozzle from the stack and seal for transport.

7.2 Sample Recovery. Move the impinger train to the cleanup area. If the sample analysis is to be performed in the field, transfer the train contents directly to the analysis beaker. If samples are to be transported, transfer the impinger contents to the sample storage bottles as follows:

7.2.1 Container 1 and 2. Measure the contents of the first two impingers to the nearest ± 1 ml and record the volume on the data sheet. Transfer the liquid to Container 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 particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with water and placing the wash in Container 1.

Carefully remove the probe nozzle and clean the inside surface by rinsing with water from a wash bottle and brushing with a nylon bristle brush. Brush until the water rinse shows no visible particles, after which make a final rinse of the inside surface with water.

Rinse the probe liner with water by tilting and rotating the probe while squirting water into its upper end so that all inside surfaces will be wetted. Let the water drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid in transferring the washes to the container. Follow the water 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 no visible particulate matter is carried out with the water or until none remains in the probe liner 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 be used to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a nylon bristle brush and rinsing with water. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully remove the filter and add it to the washings. Filter the collected sample through a tared glass fiber filter using a vacuum filtration apparatus. Wash the filter several times with small quantities of deionized distilled water. Measure the volume of the filtrate and divide it into two equal volumes. Place the filter used to filter the sample in a glass or plastic shipping container, labeled Container 2, and return to the laboratory for analysis. Place one-half of the filtrate in a shipping container, labeled Container 1A, and add 2 ml of the boric acid preservative solution per 100 ml of sample. Put

the other half of the sample in a container labeled 1B and add concentrated sulfuric acid dropwise until the solution has a pH of 6. Mark the liquid level on each container to determine whether leakage occurred during shipment. Cap and seal the containers and return to the laboratory for analysis.

7.2.2 Container 3. Transfer the contents of impingers 3, 4, and 5 to this container. Wash each impinger with 1 N H_2SO_4 and collect the washings in this container. Measure and record the volume on the data sheet. Mark the liquid level on the container to determine whether leakage occurred during shipment. Cap and seal the container and return to the laboratory for analysis.

7.2.3 Silica Gel Container. Transfer the silica gel from the fifth impinger to this container. Cap and seal.

7.3 Analysis. Treat the contents of each example container as described below:

7.3.1 Container 1A. Transfer the contents of this container to a 500 ml volumetric flask and dilute to exactly 500 ml with deionized distilled water. Pipette 100 ml aliquots of sample into each of three 250-ml beakers. Add 2 ml of ISA to each beaker.

The sample should be at the same temperature as the calibration standards when measurements are made. If ambient laboratory temperature fluctuates more than $\pm 2\ ^{o}C$ from the temperature at which the calibration standards were measured, condition 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 millivolt reading is obtained, record it. Determine the concentration from the calibration curve. Between electrode measurements, rinse the electrodes with distilled water and wipe dry. Report the average of the three aliquot determinations as the sample nitrate concentration in mg/ml.

7.3.2 Container 1B. Measure the ammonia concentration of this sample as described in Section 4.3 of the "Determination of Ammonia."

7.3.3 Container 2. Leave the contents in the shipping container or transfer the filter and any loose particulate from the sample container to a tared glass weighing dish. Desiccate for 24 hours in a desiccator containing annhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg. For purposes of this section, the term "constant weight" means a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between consecutive weighings, with no less than 6 hours of desiccation time between weighings.

7.3.4 Container 3. Transfer the contents of this container to a 500 ml volumetric flask and dilute to exactly 500 ml with deionized distilled water. Pipette 100 ml aliquots of sample into each of three 250 ml beakers. Add 2 ml of ISA to each sample and proceed as in Section 7.3.1.

Measure the ammonia in the remainder of the sample as described in Section 4.3 of the "Determination of Ammonia."

7.3.5 Blank Determination. Treat three 100 ml aliquots of the distilled water used for sampling and sample recovery as in 7.3.1. Report the average blank concentration in mg/ml.

8. Calibrations

8.1 Sampling Train. Use methods and equipment which have been approved to calibrate the orifice meter, pitot tube, dry gas meter, and temperature sensors.

8.2 Analytical Apparatus.

8.2.1 Prepare standardizing solutions by adding 0.0, 1.0, 5.0, 10.0, 15.0, 20.0, and 25.0 ml of the NH_4NO_3 standard solution to a series of seven volumetric flasks along with 2 ml of ISA and 2 ml of boric acid preservative. The concentration of the standards will be 0, 10, 50, 100, 150, 200, and 250 mg/ml NO_3^- respectively.

8.2.2 Zero and standardize the electrometer according to the manufacturer's instructions using the standards in 8.2.1, treated as in 7.3.1. Begin with the most concentrated and proceed to the most dilute. Reverse the order and repeat the millivolt determination. Record the readings for each concentration. Prepare a calibration curve by plotting the millivolt 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: See data sheet, Figure 2.

9.2 Sample gas volume at standard conditions: Calculate the volume of gas sampled on a wet basis at standard conditions (70° F, 29.92" Hg.) using Equation 9-1.

$$V_{ss} = \frac{17.71\ V_m\ P_b}{T_m} + 0.0474\ W_c \qquad \text{Equation 9-1}$$

Where:

V_{ss} = Volume of gas sampled at standard conditions.

V_m = Volume measured by dry gas meter.

P_b = Dry gas meter pressure (barometric) in. Hg.

T_m = Average dry gas meter temperature, °R.

W_c = Weight of water condensed in the sampling train and collected in the silica gel. grams.

17.71 = Conversion to standard conditions, $\frac{530°\ R}{29.92''\ Hg}$.

0.0474 = Conversion factor, ft^3/gm at 70° F, 29.92" Hg.

9.3 Weight of ammonium nitrate collected. Calculate the total weight of ammonium nitrate collected in the sample by Equation 9-2.

$$W_n = 1.29 \times 10^{-3}\ [V_t\ M_a - V_b\ M_b] \qquad \text{Equation 9-2}$$

Where:

W_n = Weight of ammonium nitrate collected, grams.

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.

1.29×10^{-3} = Conversion factor: $(\text{Mg } NH_4NO_3/\text{mg } NO_3^-)\ (\frac{9}{1000\ \text{mg}})$

9.4 Emission Concentration. Calculate the particulate (ammonium nitrate) emission concentration at wet standard conditions by Equation 9-3.

$$C_{ns} = \frac{15.43\ W_n}{V_{ss}} \qquad \text{Equation 9-3}$$

Where:

C_{ns} = Particulate (ammonium nitrate) emission concentration at wet standard conditions, grains/SCF.

15.43 = Conversion factor, grains/gram.

W_n = Weight of ammonium nitrate collected, grams.

9.5 Isokinetic Variation. Calculate the average isokinetic variation by Equation 9-4.

$$\%I = \frac{1032\ V_{ss}\ T_s}{V_s\ P_s\ D_n^{\ 2}\ t} \qquad \text{Equation 9-4}$$

Where:

%I = Isokinetic variation.

1032 = Conversion factor.

V_{ss} = Total sample volume at standard conditions, SCF.

T_s = Average stack temperature, °R.

V_s = Average stack velocity, fpm, from Equation 2-2, Method, Federal Register, Vol. 36, No. 247, December 23, 1971.

P_s = Stack pressure, in. Hg. absolute.

D_n = Nozzle diameter, inches,

t = Test time, minutes.

FIELD DATA

PLANT _____
DATE _____
SAMPLING LOCATION _____
SAMPLE TYPE _____
RUN NUMBER _____
OPERATOR _____
AMBIENT TEMPERATURE _____
BAROMETRIC PRESSURE _____
STATIC PRESSURE, (P_s) _____
FILTER NUMBER (s) _____

PROBE LENGTH AND TYPE _____
NOZZLE I.D. _____
ASSUMED MOISTURE, % _____
SAMPLE BOX NUMBER _____
METER BOX NUMBER _____
METER K_m _____
C FACTOR _____
PROBE HEATER SETTING _____
HEATER BOX SETTING _____
REFERENCE Δp _____

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

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		INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F			

COMMENTS:

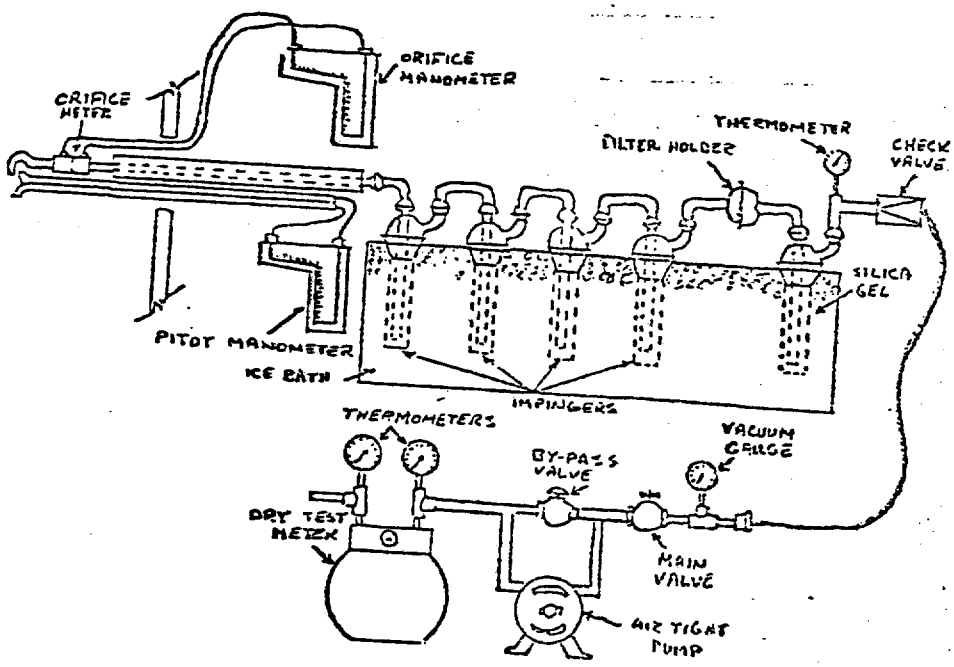


FIGURE 1. NITRATES SAMPLING TRAIN

SAMPLE RECOVERY DATA

Plant: _____

Date: _____

Sampling Location: _____

Sample Type: _____

Run Number: _____

Sample Box I.D.: _____

Cleanup Operator: _____

Comments

Sample Number	Container 1	Container 2	Container 3
1. Container Tare	_____	_____	_____
2. Weight after adding impinger contents	_____	_____	_____
3. Weight after adding washes	_____	_____	_____
Net liquid weight = (3-1)	_____	_____	_____
Net impinger contents weight = (2-1)	_____	_____	_____

A. Total Net Liquid Weight: _____

B. Total Impinger Contents: _____

C. Initial Impinger Contents: _____

D. Net Condensate: _____ = (B-C)

E.* Sample Transfer Rinse Volume: _____

F. Final Silica Gel Weight: _____

G. Initial Silica Gel Weight: _____

H. Net Silica Gel Weight Gain: _____ = (F-G)

I. Total Water Collected: _____ = (D+H)

J. Total Sample Volume: _____ = (A+E)

K. Total Blank Volume: _____ = (A-B+C+E)

B. Emission Calculations

1. Volume of dry gas sampled at standard conditions.

$$V_{ms} = \frac{17.71\ V_m\ P_b}{T_m}$$

2. Volume of water vapor at standard conditions.

$$V_{cs} = 0.0474\ W_c$$

3. Total sample volume at standard conditions.

$$V_{ss} = V_{cs} + V_{ms}$$

4. Percent moisture in stack gas.

$$\%M = \frac{V_{cs}}{V_{cs} + V_{ms}} \quad (100\%)$$

5. Mole fraction dry gas.

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

6. Average molecular weight of dry stack gas

$$MW_d = (\%CO_2)(\frac{44}{100}) + (\%O_2)(\frac{32}{100}) + (\%CO + \%N_2)(\frac{28}{100})$$

7. Molecular weight of stack gas.

$$MW = MW_d\ (M_d) + 18(1-M_d)$$

8. Stack gas velocity at stack conditions.

$$V_s = 5128.8\ Cp\ \sqrt{(\Delta p)(T_s)}\ \left[\frac{1}{(P_s)(MW)}\right]^{\frac{1}{2}}$$

9. Stack gas volumetric flow at standard conditions, wet

$$Q_s = \frac{0.123\ v_s\ A_s\ P_s}{T_s}$$

10. Stack gas volumetric flow at actual conditions.

$$Q_a = \frac{0.05645\ T_s Q_s}{P_s}$$

11. Isokinetic variation.

$$\%I = \frac{1032\ V_{ss} T_s}{v_s T_t P_s D_n^2}$$

12. Weight of ammonium nitrate collected.

$$W_n = 0.08(v_t C_t - V_b C_b)$$

13. Emission concentration at standard conditions.

$$C_{ns} = \frac{15.43\ W_n}{V_{ss}}$$

14. Emission concentration at actual conditions.

$$C_{na} = \frac{17.71\ Cns\ Ps}{T_s}$$

15. Mass emission rate.

$$M_n = 0.008571\ C_{ns}\ Q_s$$

C. <u>Statistics Calculations</u>

1. Percent difference between two results.

$$d = \text{Difference} = \frac{x_{reference} - x_B}{x_{reference}} (100\%)$$

2. Mean percent difference.

$$\bar{d} = \text{mean difference} = \frac{\Sigma d}{n}$$

n = number of data points.
algebraic sign included to determine mean

3. Standard deviation of the differences

$$s(d) = \sqrt{\frac{\Sigma(d_i - \bar{d})^2}{(n-1)}}$$

CHEROKEE NITROGEN ANALYTICAL METHODS	DETERMINATION OF BULK DENSITY IN (AMMONIUM NITRATE) Method to be used at Union Oil	No. 5 Date 5-5-69 Approved [illegible]

SCOPE: For urea and ammonium nitrate tests. This procedure is to be followed for the estimati of the weight of A.N. product per unit volume. In order to obtain results comparable and meaningful, the procedure must be strictly followed. Extimated precision of the method is on the order of ± 0.35 lbs/ft^3 (95% confidence limits) for the average of duplicate samples.

SAMPLING: A representative portion of material to be tested should be taken so as to give a sample between 600 and 700 ml. in volume. (1). The specified sample should be passed through the riffle to obtain two equal samples of 300-350 ml. Volume. When specified, a sieve analysis may be determined on each 300-350 ml. portion. If no sieve analysis is required, each of the samples should be processed for bulk density as given below with a minimum of agitation to the sample

APPARATUS: Platform Balance
Cylinder, graduated, 250 ml. Total volume. This cylinder may be prepared by carefully removing the top of a normal 250 ml. graduate at the 250 ml mark. Straight Edge. Funnel, filling 60° short stem 11 mm I.D. 70 mm O.D. Top (Curtin 8281). Ring stand with ring to fit funnel.

REAGENTS: None.

PROCEDURE: Place the cylinder on the balance and weigh to the nearest 0.2 gram.

Next place the cylinder on a steady table (2), and positioned one half inch below stem of funnel held by ring stand and ring.

Carefully pour the sample through the funnel into the cylinder keeping the funnel at least half full of material, until sample overflows cylinder.

CHEROKEE NITROGEN ANALYTICAL METHODS	DETERMINATION OF BULK DENSITY IN (AMMONIUM NITRATE)	No. 5 (Continued) Date 5-5-69 Approved [illegible]

Next take the straight edge and carefully level sample in cylinder with top of cylinder by striking off excess sample above, cylinder rim.

Weigh the cylinder and contents to the nearest 0.2 gram.

CALCULATIONS: Bulk Density (lbs/ft^3) = (Weight of sample) (0.2497

[illegible] and simple calculation

CHEROKEE NITROGEN ANALYTICAL METHODS	DETERMINATION OF SIEVE ANALYSIS OF AMMONIUM NITRATE PRODUCT method to be used at Union Oil	No. 6 Date 5-5-69 Approved DCA

SCOPE: For urea and ammonium nitrate tests

This method is intended for plant control operation in estimating the particle index of A.N. produced. The reproducibility of duplicate samples on any given sieve should be within ± 5% of the amount of material present on any given sieve.

APPARATUS:

Tyler Sieve Shaker
Tyler Timer
Platform Balance
Weighing Pan with Tare
Small Brush
Sample Splitter
Sieves, stainless steel cloth and frames, 8", U.S. No. 8, 10, 12, 14, 16, 20, 30, 40, 50, 60, 70, 80 and 100 with cover and pans. (Other sizes may be added.

PROCEDURE:

Obtain for the analysis a sample of approximately 200 grams by reducing the accumulated or composite gross sample in the sample splitter. Weigh sample to nearest 0.2 gram.

Arrange the sieves to be used in the test in numerical order with the smallest number sieve on top and a pan on the bottom. Slowly pour the sample on the top sieve while tapping the stack of sieves. Next vigorously shake the stack of sieves in a rotary horizontal motion for one minute.

Insert the entire nest of sieves on the supporting plate.

Plug shaker in for five minutes. When the shaker stops, remove the sieves and weigh the amount of material retained on each sieve and in the bottom pan. The sum of these weighings should agree within ± 0.8 gram of the original sample weight.

For additional information call Gene Riley 919-541-52

CHEROKEE NITROGEN COMPANY

CALCULATIONS: The percent obtained on each sieve or in pan is calculated as follows:

$$\% \text{ Retained} = \frac{(\text{Wt. of Material in Pan}) \times 100)}{\text{Total Weight of All portions}}$$

Tabulate the results in order of increasing sieve number on the daily log sheet or product analysis sheet.

NOTES:

(1) The speed or rate of vibration of the sieve shaker is adjustable within a range of 500 to 900 vibrations per minute. Unless otherwise specified, all samples will be processed at the 500 per minute rate.

(2) For A.N. prilled product, the series of sieves normally used will be 8, 10, 12, 14, 16, 20, 30, 50 and pan.

(3) For the measurement of estimation of material that may be retained on a commercial No. 16 sieve, carefully and slowly add 290 to 320 ml (or 210 to 230 grams) of sample to a weighed No. 16 sieve with pan attached. Shake and/or tap sieve and pan while making the sample addition and then for one minute after sample addition to sieve. Weigh sieve, sample and pan (W_1). Place sieve and pan in shaker. (Rather than adjust the shaker for one sieve and pan, the balance of the space of the shaker, if set as given above, may be filled with sieves not in use. Plug in for five minutes. When the shaker stops, remove sieve and pan. Discard all material in pan and reweigh sieve, pan, and contents of sieve (W_2).

Need list of equipment used and sample collection procedure.

APPENDIX J

CLEAN-UP EVALUATION RESULTS

APPENDIX J

CLEAN-UP ANALYSIS

To standardize the clean-up procedure for all sampling and to determine background concentrations of ammonia and ammonium nitrate, a clean-up evaluation was conducted before testing began. One of the sample trains intended for testing was completely charged and assembled. The first two impingers contained 100 ml each of deionized-distilled water. The third and fourth impingers contained 100 ml each of 1N H_2SO_4.

Two borosilicate glass bottles with Teflon®-lined caps were labeled to identify the sample run, location, date, and time. One container was identified as "Container #1" and contained the contents of the first two impingers along with deionized water washings from the first two impingers, connecting glassware, Teflon® tube and probe. The second glass container was identified as "Container #2" and contained the contents and rinses of the third, fourth and fifth impingers. All of these rinses were performed using 1N H_2SO_4. The impinger and associated glassware were rinsed three times with the corresponding liquid wash. During the clean-up procedures the impingers remained assembled, i.e., the impinger tube assembly was not removed from the impinger jar during the clean-up procedures.

The Teflon® tube was washed with three separate deionized-distilled water rinses. The flask was filled with approximately 75 ml of deionized-distilled water and then washed three times by rinsing the rinse water from one end of the tube to the other. The rinse was then emptied into Container #1 and the procedure repeated two additional times.

The probe was washed with the nozzle attached. Seventy-five ml of rinse water were placed into the same flask used for the Teflon® tube washings. The rinsing for the probe was performed in the same manner as the Teflon® tube washings above. In addition to the rinsings, the probe was brushed and rinsed an additional three times to remove all particulates.

The liquid levels in Container #1 and Container #2 were marked and the caps sealed after the clean-up procedure was completed. The containers were then transported to the ES laboratory in Arcadia for analysis.

After the field testing was completed it was discovered that the clean-up evaluation samples were accidentally discarded by the laboratory technician before the analysis for ammonia and ammonium nitrate were conducted. As a part of all the analysis performed by the laboratory, blank samples were always prepared to determine background levels. No ammonia or ammonium nitrate was found in any of the blank samples prepared during this period of analysis. Also, none of the sample trains used for this testing had ever been used for sampling ammonia or ammonium nitrate. Therefore, it will be concluded that no significant background concentration of ammonia or ammonium nitrate was present.

APPENDIX K

AUDIT SAMPLE RESULTS

APPENDIX K

AUDIT SAMPLE RESULTS

Audit samples of ammonium nitrate were supplied to Engineering-Science by EPA. 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 mls 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 I).

Table K-1 contains the results of the audit samples as analyzed by Engineering-Science. The percent error in the ES results as compared to the EPA results is also tabulated. The error ranged from a low of 1.1% to 5.7%; all ES values were higher than the EPA values.

TABLE K-1

RESULTS OF THE AMMONIUM NITRATE AUDIT SAMPLES ANALYZED BY ENGINEERING-SCIENCE

EPA I.D.	Mg NH_4NO_3/ml		% Error
	ES	EPA	
AN-1	12.9	12.76	+1.1
AN-2	27.1	26.50	+2.3
AN-3	56.8	53.74	+5.7

TABLE K-2

AUDIT SAMPLE RESULTS PREPARED BY EPA
AMMONIUM NITRATE

Sample No.	Mg NH_4NO_3/ml	Molarity	ppm (nitrogen)
AN-1	12.76	0.159	4,460
AN-2	26.50	0.331	9,270
AN-3	53.74	0.671	18,800

CALCULATIONS SHEET NO. 1

Analysis done by S.A. Fullmer 8/15,16/79

AN-1 +58 mv = 2.0 mg NO_3^-

5 X dilution

1% error 5 X 2.0 mg NO_3^- = 10 mg NO_3^- X 1.29 = 12.9 mg/ml of NH_4NO_3

AN-2 +38 mV = 4.2 mg NO_3^-

5 X dilution

2% error 5 X 4.2 mg NO_3^- = 21 mg NO_3^- X 1.29 = 27.1 mg/ml of NH_4NO_3

AN-3 +20 mV = 8.8 mg NO_3^-

5 X dilution

5% error 5 X 8.8 mg NO_3^- = 44 mg NO_3^- X 1.29 = 56.76 of NH_4NO_3

Procedure: 20 ml of sample + 2 mls of Boric Acid diluted to 100 mls.

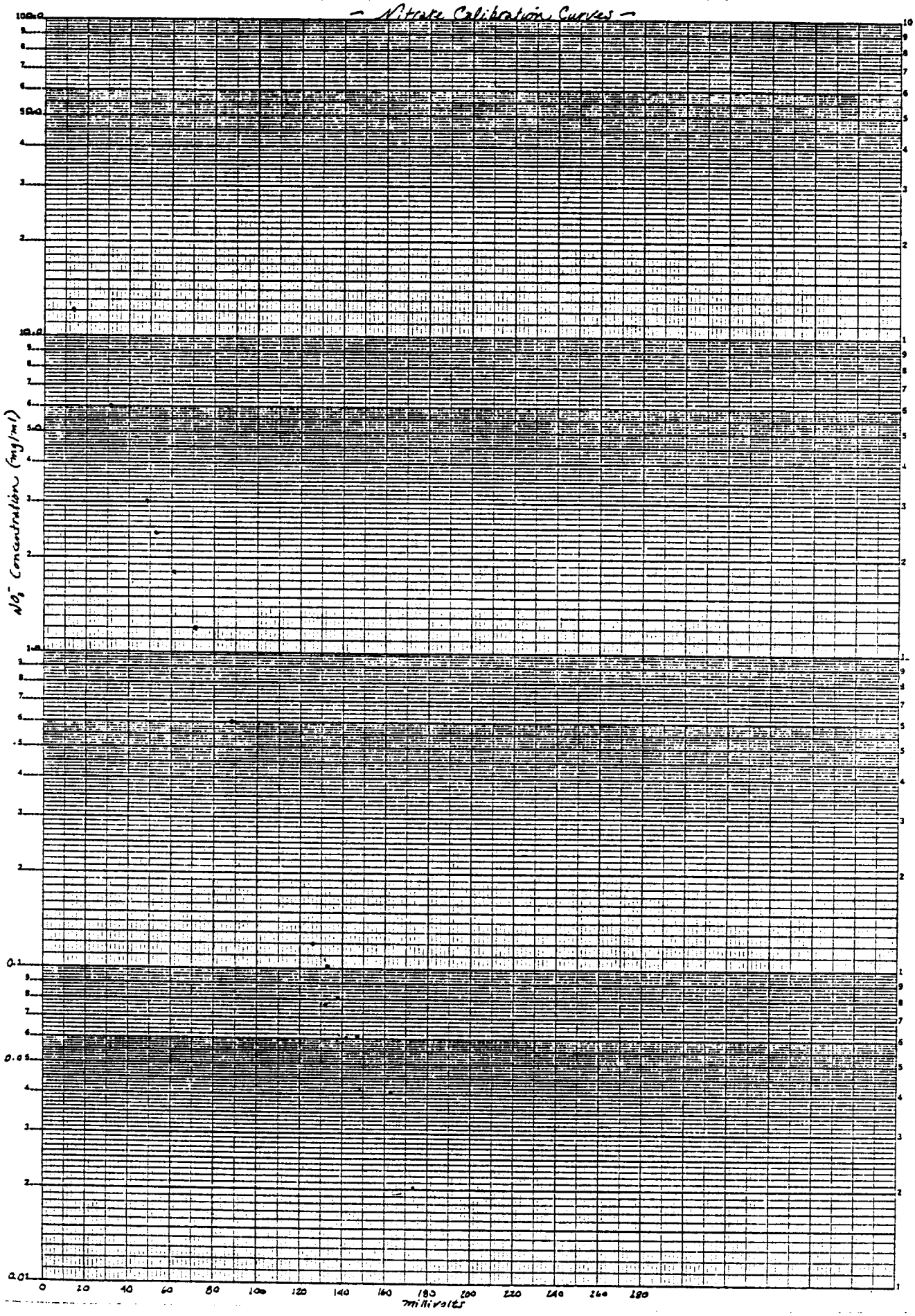
2 ml of ISA added to solution, mV read on ion ~~aly~~ analyzer

Signature [illegible] Date 8/15,16/79

K+E SEMI-LOGARITHMIC 46 5253
2 CYCLES X 300 DIVISIONS
KEUFFEL & ESSER CO.

• 790 g Amonium Nitrate (NH_4NO_3)
• 1.290 g Amonium Nitrate (NH_4NO_3)

— Nitrate Calibration Curves —



APPENDIX L

PROJECT PARTICIPANTS

APPENDIX L

PROJECT PARTICIPANTS

The persons involved in the field studies at Union Oil in Brea, California during April 2-6, 1979 are listed below along with their respective organizations, titles and test level of participation.

Gene Riley	EPA	Engineer	Technical Manager
Eric Noble	EPA	Engineer	Process Engineer
Mark Bornstein	GCA	Engineer	Process Engineer
Steve Harvey	GCA	Engineer	Process Engineer
John Chehaske	ES	Engineer	ES Technical Director
Dennis Becvar	ES	Engineer	Project Manager
Scott Lambert	ES	Engineer	Particle Sizing
Robert Tomlinson	ES	Engineer	Visible Emissions
A. L. Wilson	ES	Engineer	Team Member
Steve Piatek	ES	Engineer	Team Member
Humbert Deriada	ES	Engineer	Sample Clean-up
Chrank Willi	ES	Technician	Sample Clean-up
Jerry Cox	ES	Technician	Team Member
Mike Hackett	ES	Technician	Team Member
Bob Dearborn	ES	Technician	Team Member
Steve Hernandez	ES	Technician	Team Member
Herman Wong	ES	Meteorologist	Team Member
Stefanie Fullmer	ES	Technician	Lab Technician
Linda White	ES	Technician	Lab Technician
Lawrence Lloyd	ES	Engineer	Technical Review

EPA U.S. Environmental Protection Agency

GCA GCA Corporation

ES Engineering-Science

ARLI Analytical Research Laboratories, Inc.

APPENDIX M

PROJECT AUTHORIZATION

WORK ASSIGNMENT

ENVIRONMENTAL PROTECTION AGENCY

Research Triangle Park, N.C. 27711

EPA CONTRACT NO: 68-02-2815

CONTRACTOR: Engineering Science

ASSIGNMENT NO: 26

ASSIGNMENT CHANGE NO.:

DATE: 8 JAN 1979

TITLE: Perform emission test program at an urea and ammonium nitrate manufacturing facility

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: Union Chemical Company
Location: Brea, California
Project No.: 78-NHF-7
Industry: Ammonium Fertilizer

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 20 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, ESED/EMB, Mail Drop 13, Research Triangle Park, NC 27711

ESTIMATE OF	GOVERNMENT ESTIMATE	CONTRACTOR ESTIMATE
LABOR HOURS	1500	
DURATION OF WORK	5 months	
COMPLETION DATE	August 31, 1979	

REQUESTER'S SIGNATURE	ORG. CODE	TELEPHONE	DATE
Clyde E. Riley E. E. Riley 1-2-79	ESED/EMB	(919) 541-5243	1/2/79

APPROVALS (IN APPROVING)	SIGNATURE	DATE
[illegible]	[illegible]	1/2/79
[illegible]	[illegible]	1-3-79
PROJECT MANAGER	[illegible]	1/3/79
CONTRACTING OFFICER	[illegible]	1-8-79

CONTRACTOR'S REPRESENTATIVE ACKNOWLEDGEMENT

SIGNATURE	TITLE	DATE

Industry: Ammonium Nitrate Manufacturing

Plant: Union Oil Company of California

Process Step: Predryer, Dryer and Cooler

Control Device: Sly Scrubbers (tests will only be conducted on inlets to the scrubbers)

Rationale for Selection:

1. This is the only plant where uncontrolled emissions from a predryer, dryer and cooler can be determined simultaneously and where the ductwork is amenable to testing. All sampling points are near ground level and are located within one building.

2. Tests can be performed in conjunction with others at this plant.

Comments:

1. Temperature and moisture content of the air entering each piece of equipment should be taken several times during the test.

2. A sample of the product leaving each piece of equipment should be taken as a series of grab samples and composited into a representative sample for each process.

3. All solid samples will be highly hygroscopic.

SOURCE SAMPLING AND ANALYSIS SCHEDULE

Cont. - See Figure 3

Contract No.: 68-02-28

Assignment Number: 78-NH.

Company Name: Union Oil of California

Company Location: Brea, California

Industry: Ammonium Fertilizer

Process: Ammonium Nitrate Predryer, Dryer, and 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
TP4*	3	Predryer Product IN	Composite	CTR	N.A.	N.A.	Sieve Analysis	TBD	CTR	Bulk Density	TBD
TP5*	3	Dryer Product IN	"	"	"	"	"	"	"	"	"
TP6*	3	Cooler Product IN	"	"	"	"	"	"	"	"	"
TP7*	3	Cooler Product OUT	"	"	"	"	"	"	"	"	"

Note - Ammonium nitrate and ammonia analysis shall be performed within 24 hours after collection of samples (stack samples only).

REMARKS:

1. Sampling shall be performed with ± 10% isokinetic conditions.
2. Methods are EPA unless indicated otherwise.
3. [illegible] and analysis of impinger catch will be per the Federal Register, Volume 36, [illegible] 17, Tuesday, Aug. 17, 1971, unless specifically changed by [illegible]

* Simultaneous Sampling Required

CTR-Contractor EPA-Environmental Protection Agency.

SOURCE SAMPLING AND ANALYSIS SCHEDULE

See Figure 3

Contract No.: 68-02-2815

Assignment Number: 78-NHF

Company Name: Union Oil of California

Company Location: Brea, California

Industry: Ammonium Fertilizer

Process: Ammonium Nitrate Predryer, Dryer and 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			
TP2	1	"	"	"	"	"	"	"	"			
TP3	1	"	"	"	"	"	"	"	"			
TP1	1	Moisture	EPA-4	CTR	15 min	10	Percent Moisture	EPA-4	CTR			
TP2	1	"	"	"	"	"	"	"	"			
TP3	1	"	"	"	"	"	"	"	"			
TP1*	3	Ammonium Nitrate Particulate	Modified EPA-5	CTR	1 hr	30	AN Mass	TBD	CTR	Ammonia	TBD	CTR
TP2*	3	"	"	"	"	"	"	"	"	"	"	"
TP3*	3	"	"	"	"	"	"	"	"	"	"	"
TP8	3	Ambient air tempt	Thermometer	CTR	Data shall be measured and recorded every 15 minutes during test periods							
TP8	3	Relative Humidity	Wet, dry Bulb	CTR	" "	" "	"	" "	" "	" "	"	
TP4	1*	Predryer Product IN	Grab	CTR	N.A.	N.A.	Tempt, pH Moisture	TBD	CTR	% AN % NH_3	TBD	CTR
TP5	1*	Dryer Product IN	"	"	"	"	"	"	"	"	"	"
TP6	1*	Cooler Product IN	"	"	"	"	"	"	"	"	"	"
TP7	1*	Cooler Product OUT	"	"	"	"	"	"	"	"	"	"

N.A. - Not applicable
TBD - To be determined

* Simultaneous Sampling Required
**CTR-Contractor, EPA-Environmental Protection Agency

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, 197[illegible] [illegible]less [illegible] [illegible]ged b[illegible] Proje[illegible]ficer.

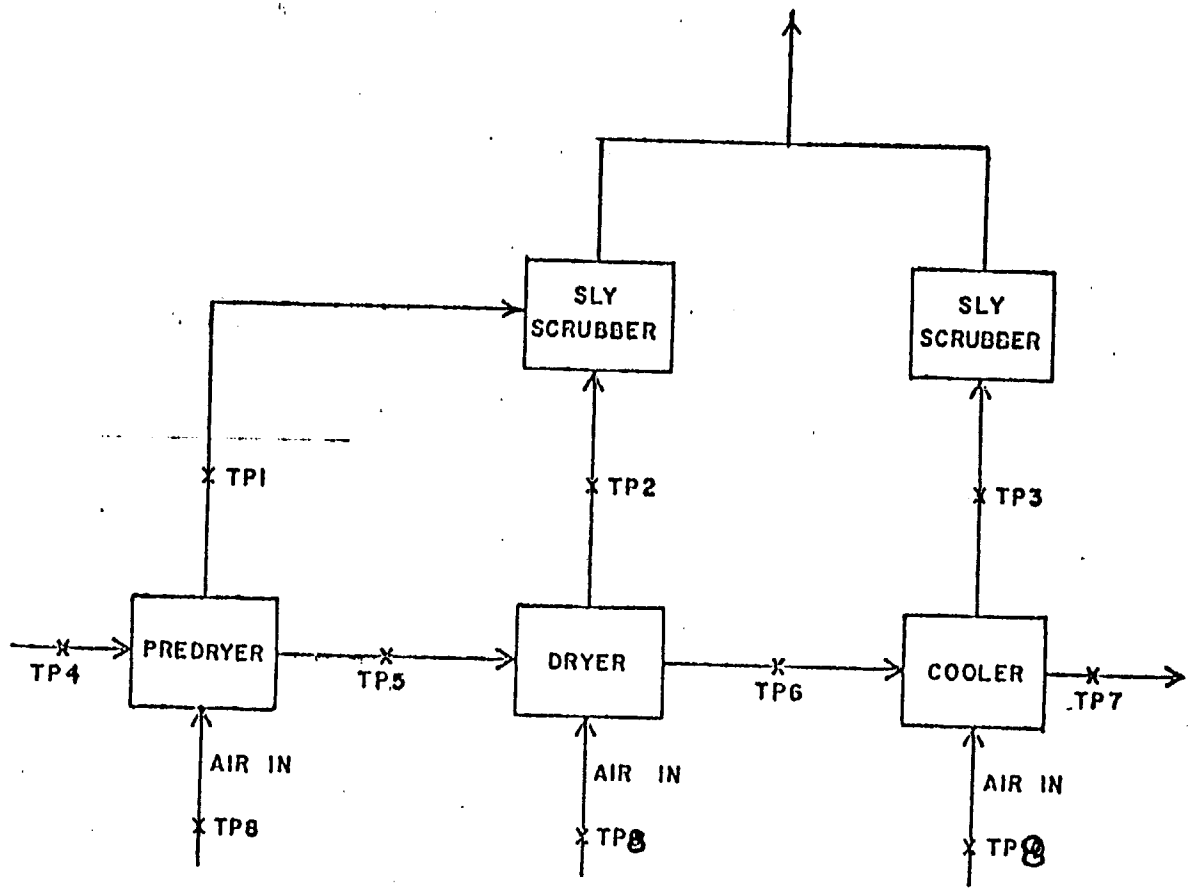


Figure 3. Predryer, Dryer, Cooler, Union Oil of California, Brea, California.

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

February 21, 1979

Mr. Dennis P. Becvar
Engineering Science, Inc.
150 North Santa Anita Avenue
Arcadia, California 91006

Reference: EPA Contract No. 68-02-2815, Assignment No. 26, Union Oil Company, Brea, California, EMB Report No. 78-NHF-7

Dear Dennis:

This correspondence is to document and clarify the details of the sampling and analytical procedures required for the above referenced work assignment.

Urea Test

The urea train configuration shall consist of a glass-lined probe connected by a flexible Teflon line to six(6) impingers. The first two impingers shall be prefilled with deionized, distilled water (100 mls each). The next two shall 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 second, fourth, 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 first and third impingers are of the Greenburg-Smith regular design which includes tips with orifice plates located within 1/2 inch of the bottom.

Each probe shall be heated to the temperature range of the stack plus 10°F; not to exceed 160°F. No filter will be required in the urea collector train.

Sample cleanup and recovery procedures include the following:

(1) The probe, flexible Teflon line, first two impingers, and their associated glassware shall be rinsed with deionized, distilled water into one container. The probe shall be brushed and rinsed.

(2) The third, fourth, fifth impingers, and their connecting glassware shall be rinsed with 1N H_2SO_4 solution and placed in a second container.

The urea samples shall be analyzed within 24 hours of collection as follows:

1. Analyze the water samples for urea content by two separate methods, Kjeldahl and Colormetric. Determine the ammonia content by Nesslerization. Remove an aliquot for formaldehyde analysis.

2. Analyze the 1N H_2SO_4 samples for urea content by two separate methods, Kjeldahl and Colormetric. Determine ammonia content by Nesslerization.

3. Formaldehyde aliquot samples shall be analyzed later at contractor's convenience by chromotropic acid procedure.

For the scrubber solution samples, aliquots shall be collected approximately every 30 minutes during the test periods (five aliquots for two 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) for each run.

Before analyzing the scrubber samples they shall first be filtered using a tared glass fiber filter to determine the percent solids. Afterwards the samples shall be anlayzed for urea and ammonia within 24 hours of their collection times.

Place the filtrate in a 1 liter volumetric flask and dilute to exactly 1 liter with deionized, distilled water. Analyze the sample for urea, ammonia, and formaldehyde using the same procedures as for the emission samples. 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 anlayzed as specified in the actual test program.

Particle sizing shall be conducted using an Anderson cascade impactor with preseparator. Glass fiber substrates shall be used for the filter media. The particle sizing device shall be inserted into the stack stream for a minimum of 15 minutes to allow the device to come

to an equilibrium temperature. Each test shall cover approximately 15 minutes and be performed using isokinetic conditions at a predetermined average sampling point. The unit shall be cleaned up in a secluded, clean area and the filters weighed on an electrobalance.

For the visible emissions, 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 prill tower melt sample, unscreened product samples, and cooler product in and out samples it will not be necessary to perform the percent urea, formaldehyde, and ammonia analyses within a 24 hour period. These samples can be returned to the ES lab for analyses at your convenience. It will be necessary however to perform the sieve and bulk density determinations at the plant site.

Pressure drop measurements across the four prill tower scrubbers shall be recorded every 15 minutes during the testing periods. The pressure drop measurements shall be recorded for both the fertilizer and feed grade emission test. However, it is believed that the feed grade air flows will be negligible, consequently the pressure drops will be approximately 0.

In order to determine a total volumetric flow for the prill tower it will be necessary to monitor a single velocity point at each of the remaining three outlet stacks. These individual average points shall be selected from data generated from the preliminary velocity traverse profiles. These velocity measurements shall be recorded every 15 minutes during the fertilizer grade test periods only.

Ammonium Nitrate Test

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 sample 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 analyzed as is.

The emission samples shall be analyzed within 48 hours after collection 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 ion specific electrode and Nessler.
4. Dry the funnel filter, desiccate, and weigh to determine undissolved particulate.

Three particle size test shall be conducted on each of the outlet stacks from the predryer, dryer, and cooler (TP1, TP2, TP3). The same operating procedures as described in the urea testing section shall be used during these test.

For the process samples (predryer product, etc.) it will not be necessary to perform the percent ammonium nitrate and ammonia analysis within a 48 hour period. These samples can be returned to the ES lab for analysis at your convenience. It will be necessary however to perform the sieve and bulk density determinations at the plant site.

EMISSION MEASUREMENT BRANCH

TECHNICAL DIRECTIVE NO. 1

Project Number 78-NHF-7 Date 2/21/79

Contractor Engineering Science, Inc.

Contract Number 68-02-2815 Work Assignment Number 26

Technical Manager Clyde E. Riley

Verbal Directions Given To Mr. Dennis Becvar

Directive:

1. Contractor shall perform 9 particle size test at the following outlet locations (See attached "Source Sampling and Analysis Schedule").

Clyde E. Riley
Technical Manager, EMB

A. T. McCarley
Section Chief, EMB

McCallister
X-2237

SOURCE S LING AND ALYSIS SCHEDULE
Fertilizer Grade
See Figure 1

C t No. 68-02-2615

Design Numb 26

Company Name: Union Oil of California

Company Location: Brea, California

Industry: Ammonium Fertilizer

Process: Ammonium Nitrate Predryer, Dryer, and 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	3	Particle Size	Anderson w/ preseparator	CTR	15 min	N.A	Particle Size Distribution	Gravimeteric Weighing	CTR			
TP2	3	"	"	CTR	15 min	N.A	"	"	CTR			
TP3	3	"	"	CTR	15 min	N.A	"	"	CTR			

REMARKS:

1. Sampling shall be performed with ± 10% isokinetic conditions.
2. Meth are EPA unless indicated otherwise.
3. Imp and analysis of impinger catch will be per the Federal Register, Volume 36, No. 1[illegible], Part II, Tuesday, Aug. 17, 1971, unless specifically changed by the Project [illegible]
4. Sampling time and [illegible]

* Simultaneous Sampling Requir

**CTR-Contractor, EPA-Environmental Protection Agency

EMISSION MEASUREMENT BRANCH

TECHNICAL DIRECTIVE NO. 2

Project Number 78-NHF-7 Date 4-17-79

Contractor Engineering Science, Inc.

Contract Number 68-02-2815 Work Assignment Number 26

Technical Manager Clyde E. Riely

Verbal Directions Given To Mr. Dennis Becvar

Directive: Union Oil Company

Contractor shall cancel or amend the following Source Sampling and Analysis Schedule items.

Urea Prill Tower (Fertilizer Grade)

1. Cancel collection and analysis of 3 scrubber solution-out samples at SW2.
2. Cancel collection and analysis of 1 melt to prill tower sample at TP11.
3. Cancel analysis for 1 prill tower product sample to be collected at TP12. Union Oil lab personnel shall perform specified analyses.
4. Contractor shall record scrubber flow pressures (2) during each test run. Data shall be delivered to GCA's Mr. Steve Harvey via EPA's Technical Manager, Clyde E. Riley.

Urea Prill Tower (Feed Grade)

1. Cancel collection and analysis of 3 scrubber solution-out samples at SW2.
2. Cancel collection and analysis of 1 melt to prill tower sample at TP11.
3. Cancel analysis for 1 prill tower product sample to be collected at TP12. Union Oil lab personnel shall perform specified analysis.
4. Contractor shall record scrubber flow pressures (2) during each test run. Data shall be delieverd to GCA's Mr. Steve Harvey via EPA's Technical Manager, Clyde E. Riley.

Clyde E. Riley
Technical Manager, EMB

Section Chief, EMB

Urea Cooler (Fertilizer Grade)

1. Cancel collection and analysis for 1 Cooler Product In sample to be collected at TP6.

2. Cancel analysis for 1 Cooler Product Out sample to be collected at TP7. Union Oil lab personnel shall perform specified analyses.

3. Cancel sieve and bulk density analyses on 3 Cooler Product In samples to be collected at TP6.

Urea Cooler (Feed Grade)

1. Cancel entire Source Sampling and Analysis Schedule for feed grade testing. (Feed grade material is not processed by the cooler unit).

Ammonium Nitrate Predryer, Dryer, and Cooler

1. Cancel following analyses requested on Predryer Product In sample at TP4, Dryer Product In sample at TP5, Cooler Product In sample at TP6, and Cooler Product Out sample at TP7. Union Oil lab personnel shall perform specified analyses.

    a. Tempt, pH
    b. Moisture
    c. Percent AN
    d. Percent NH_3

4-2-79

SOURCE SAMPLING AND ANALYSIS SCHEDULE

Thea Cooler
Product Sampler

Contract No.: 68-02-.815 | Assignment Number: 26 | 78-A F-7

Company Name: Union Chemical | Company Location: Brea, Calif

Industry: Thea Cooler | Process: 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
T06	1	Cooler Product in	void								
T07	1	Cooler product out	Composite of 3 runs	CTR	N.A.	N.A.	% Moisture		plant		
							% NH_3		"		
							% Thea		"		
							% Formaldehyde		"		

Contractor shall collect samples for each of the three runs and combine to a composite which shall be split, half being transfered to the technical mgr. the other half being retained by E.S for possible future analysis.

All cooler instructions dealing with the feed grade sampling are to be disregarded — Cooler feed grade test canceled! 4-2-79 C.E.R.

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 specifically changed by the Project Officer.
4. Sampling time and volume for each sample

* Simultaneous Sampling Required
**CTR=Contractor EPA=Environmental Protection Agency

4-3-79

SOURCE SAMPLING AND ANALYSIS SCHEDULE

Urea Prill Tower Product Sample

Contract No.: 68-02-[illegible]15

Assignment Number: 26

78-N[illegible]-7

Company Name: Union Chemical

Company Location: Brea, Calif

Industry: Urea

Process: Urea Prill Tower

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
SW 2	3	Scrubber Solution Out	Composite	CTR	(void)						
TB11	1	melt to concentrator	Grab	Plant	(Plant will collect)		(void)				
TB12	1	Prill tower Product	(3 Run) Composite	CTR	N.A	N.A.	Moisture Tangt NH_3 % Urea % Formaldehyde		 plant plant " "	E S to retain equal portion for possible future analysis	

✓ Contractor shall collect a composite scrubber water solution sample at the inlet for each of the particulate runs. Outlet scrubber solutions samples have been canceled.

✓ Melt sample has been canceled!

Contractor shall make a composite prill tower product sample for the 3 part test. Sample analysis shall be conducted by the plant personnel. These instructions are applicable for the urea fertilizer and feed grade test.

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 specifically changed by the Project Officer.
4. Sampling time and gas volumes are for each sample.

* Simultaneous Sampling Required

**CTR=Contractor, EPA=Environmental Protection Agency