**AMAX Chemical Corporation**
A SUBSIDIARY OF AMAX INC.
402 SOUTH KENTUCKY AVENUE • LAKELAND, FLORIDA 33801 • (813) 687-2561

May 11, 1984

DER
MAY 17 1984
BAQM

Mr. Willard Hanks
Florida Department of
Environmental Regulation
Central Air Permitting Section
2600 Blair Stone Road
Tallahassee, FL 32301

Dear Mr. Hanks:

Attached is the air point source test results for the AMAX Big Four Mine Dryer COWM (Coal-Oil-Water-Mixture) test results. These tests were run for AMAX on February 16 and 17 by Sholtes and Koogler Environmental Consultants.

The test results indicate that the dryer was well within the allowable standards established by your staff.

If you have any questions about this point source test, please let me know.

Sincerely,

Fred G. Mullins, III
Regulatory Compliance Manager

FGM/ds
Attachment

cc: G.P. Uebelhoer
R.F. Crabill

HILLSBOROUGH COUNTY

ENVIRONMENTAL PROTECTION COMMISSION

# CONVERSATION RECORD

Date May 2, 1984

Time

Subject Relief from EPC's 20% Rule

Permit No.

Department

M Fred Mullins

Telephone No. 687-2561

Representing AMAX

☐ Telephoned Me ☑ Was Called ☐ Scheduled Meeting ☐ Unscheduled Meeting

Other Individuals Involved in Conversation/Meeting

Summary of Conversation/Meeting

Told Fred that he needs to submit a letter summarizing the information presented at the meeting this AM. Once this is accomplished we will sit down with the Commissioners & discuss the mechanism which would allow EPC the right to relieve AMAX from the 20% rule. I made it clear we would not recommend such relief until the EPC is satisfied that AMAX has done everything possible to reduce opacity. AMAX is going to request a BACT or LAER determination from CAPS. Discussed all this with Bill Thomas this PM and he is in agreement.

(continue on another sheet, if necessary)

Signature Terry Campbell

Title

To: Files
FROM: Jerry Campbell
DATE: May 2, 1994
SUBJECT: FBRs #1 and #2 + Paragon Kiln / AMAX's Request for Relief from Cty's 20% Opacity Std

The following items were discussed at a meeting attended by the people listed on the attached sheet on this date:

1. The only other FBR in Florida is at Occidental Chemical with a crossflow scrubber for controls.
2. AMAX's 2 ambient stations have been set up for a 15µ cut + have not recorded any #s approaching the proposed 24 hour and annual standard over 3 years.
3. Fred has discussed this with his lawyers who have contacted Sara + they feel our rule allows for a modification of the Cty 20%.
4. AMAX is withdrawing their request for a variance, instead they will attempt to accomplish the same end through the lawyers.
5. A compliance schedule was discussed to keep AMAX out of enforcement.
6. AMAX offered to request a BACT or LAER determination from CAPS.

462

075 03

**AMAX Chemical Corporation**
A SUBSIDIARY OF AMAX INC.
402 SOUTH KENTUCKY AVENUE • LAKELAND, FLORIDA 33801 • (813) 687-2561

752-1161

April 3, 1984

Mr. Anthony Jones
Air Engineering Department
Hillsborough County
Environmental Protection Commission
1900 Ninth Avenue
Tampa, FL 33605

Dear Mr. Jones:

In accordance with the requirements of operating permit No. A029-66058, a compliance test was conducted at the No. 2 Feed Preparation wet scrubber, located at the Plant City Facility, on March 27, 1984. We are transmitting the results on the attached report.

Should you have any questions, please do not hesitate to contact me.

Sincerely,

Robert L. Harrison Jr.

Robert L. Harrison
Central Monitoring Supervisor

RH/ds
Attachment

cc: Bob Garrett, DER
N. W. Lowrey
F. G. Mullins
G. Townsend
J. J. Lewis (w/o attachment)

RECEIVED
APR 9 1984
H.C.E.P.C.

70

4h2 (AMAX)

# COUNTY OF HILLSBOROUGH

RECEIVED
JUL 11 1983
H.C.E.P.C.

TO

## MEMORANDUM

Date July 6, 1983

~~To Bill Thomas~~

From Jerry Campbell JC

Subject: NEDS Number for Amax R&D FBR Scrubber

The construction permit AC29-65451 issued for the above source lists the NEDS number as 231. Other sources at this same Plant City facility have a NEDS number of 75. Please explain why this difference exists or if this was simply an oversight just advise us of the correct number.

Thank you for your cooperation.

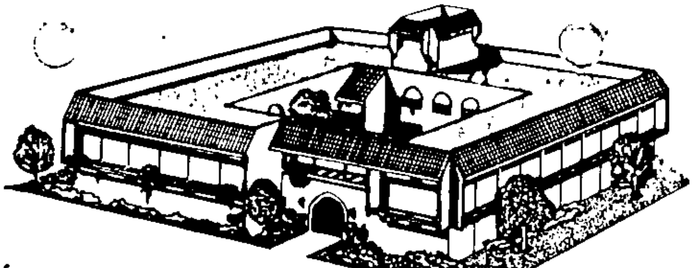
ck

When this permit was issued, it was to be operated by a separate agency - other than AMAX - hence it was given a separate plant no. to differentiate it from the AFI ~~plant~~ complex at Plant City.

Bob.

JUL [illegible] 1983
SOUTHWEST DISTRICT
TAMPA

HILLSBOROUGH COUNTY
ENVIRONMENTAL PROTECTION
COMMISSION
E. L. BING
RODNEY COLSON
MATT JETTON
JOHN R. PAULK
JAN KAMINIS PLATT



ROGER P. STEWART
DIRECTOR

1900 - 9th AVE
TAMPA, FLORIDA 33605

TELEPHONE (813) 272-5960

7h2 FBR - PARAGON KILNS

September 16, 1983

Mr. Dan Williams
Air Engineer
Florida Department of Environmental Regulation
Southwest District
7601 Highway 301 North
Tampa, Florida 33610

Re: AMAX Chemical Corporation

Dear Mr. Williams:

This is in response to AMAX Chemical Corporation's request to have Florida Department of Environmental Regulation establish a 40% opacity limit for the two fluid bed reactors at their Coronet Junction defluorination plant. While Chapter 17-2.610, FAC, provides the mechanism by which the Department may establish such a standard, doing so in this case would create a permit condition which conflicts with the Rules of the Hillsborough County Environmental Protection Commission.

Our rules are specific with respect to visible emissions. Please refer to Chapter 1-3.03I. This section states that no person shall emit pollutants in excess of 20% opacity. The general particulate emission limiting standard varies proportionally with the amount of material processed. Nothing in the VE rule can be construed as allowing the particulate mass emission rate limit to supercede the opacity limit. The two are measurements of different emission phenomena. Particulate limits are gravimetric efficiency measurements based on process weight rate. The VE is a volumetric estimation of the small particle content of the gas stream. Due to the relatively low mass of these small particles, large increases in their concentration may not substantially increase total particulate mass. However, it is these small particles that have the greater impact on public health, and visibility.

Granted, relationships between particulate concentrations and visible emissions can be established, but few conclusions can be made based on results from a single Method 5 test. More needs to be known about size distribution over a variety of operating conditions and product matrices.

The character and composition of the particles need to be determined. Many process and control equipment parameters must be measured under varied conditions too. Even then AMAX must show that compliance with our rule creates some insurmountable hardship. Under these circumstances the Director may request that the Commission establish an alternative emission plan for AMAX. Only then would an increase in the visible emission limit for this source be possible.

Perhaps it is important to note that AMAX recently requested, and was granted, an increase in the process rates and allowable particulate emissions for these two units. Until this increase became effective AMAX apparently had no difficulty in meeting the opacity limit. In any case no such problem was reported to our office. It appears, on the surface, that what we have is a control device that is unable to handle the increased load from the reactors. If this is the problem, AMAX's approach should be to upgrade the control equipment not to raise the emission limit. Maybe to comply with our VE rule AMAX may have to return to the lesser process rate.

We cannot support AMAX's request to circumvent our VE rule. In Hillsborough County the VE is not a surrogate standard. It is a separate, independently enforceable regulation. It is equally as important as the particulate and other emission limits, and ranks first among the prohibited acts listed in our rules. Since ours is a more stringent regulation than 17-2.610, the Department is compelled by the provisions of Chapter 403.186(6), F.S., to enforce this stricter rule.

We recently issued two Notices of Alleged Violation to AMAX requiring that they cease and desist the excess visible emissions. The Notices will be rescinded but Hillsborough County Environmental Protection Commission will initiate administrative enforcement should they continue to exceed the limits of Chapter 1-3.03.

Hopefully, this letter clarifies out position on this and any similar request that your office may receive concerning other sources located in Hillsborough County. If you have any questions or require further comments, please contact Anthony Jones of the Air Compliance Section.

Sincerely,

Iwan Choronenko

Iwan Choronenko
Air Pollution Control Programs Manager
Hillsborough County Environmental
Protection Commission

IC/lw

cc: Fred G. Mullins, AMAX Chemical Corp.

# LEGAL BRIEFS

by **H. Newcomb Morse**, J.D., LL.M., F.A.A.F.S.

**VISUAL OPACITY STANDARDS:** The Chemithon Corporation appealed a fine for violating a regional air pollution regulation.

The Puget Sound Air Pollution Control Agency (PSAPCA) is a regional air pollution control agency which adopted procedural and substantive rules, under the heading Regulation I, to implement its authority. Among the Regulation I rules is § 9.03, which pertains to visual opacity standards and states in part:

> (b) After July 1, 1975, it shall be unlawful for any person to use or allow the emission of any air contaminant . . . which is:
>
> (1) Darker in shade than that designated as No. 1 (20% density) . . .
>
> (e) This section shall not apply when the presence of uncombined water is the only reason for failure of the emission to meet the requirements of this section.

Section 9.09, which pertains to particulate emission standards, provides in relevant part:

> It shall be unlawful for any person to cause or allow the emission of particulate matter if the emission is in violation of Section 9.03 *or* if the particulate matter discharged into the atmosphere from any single source exceeds the following weights at the point of discharge: . . .

(Emphasis added.) The penalties for violating any of the standards are set forth in § 3.29 of Regulation I:

> In addition to or as an alternate to or any other penalty provided for herein or by law, any person who violates *any* of the provisions of this regulation shall incur a penalty in the form of a fine in an amount not to exceed two hundred fifty dollars per day for each violation.

(Emphasis added.)

On September 17, 1976, a PSAPCA enforcement officer made a *visual opacity* observation of a plume rising from a stack of a Chemithon plant and discovered the plume had a density of 50 to 80 percent. As a result of this observation, a $250 penalty was imposed on Chemithon for violating § 9.03. Chemithon appealed the penalty to the Pollution Control Hearings Board (Board), presenting evidence that the stack emission at the time of the alleged violation was within the *particulate* weight standards established by PSAPCA. The Board found that the particulate emissions were within the weight standards established by the PSAPCA, but affirmed the penalty notwithstanding such findings, reasoning that Chemithon violated a separate visual opacity standard. On review, the Superior Court of King County, Washington, rendered judgment holding the findings and conclusions of the Board were not clearly erroneous, nor arbitrary or capricious, and upheld the penalty.

Chemithon argued that it should not be fined for violation of the opacity standard, § 9.03, when the requirements as established by the particulate standard, § 9.09, are not also violated. According to Chemithon, the visual opacity test is a less reliable measure of pollution in a stack emission than actual particulate analysis of the emission. From this premise, Chemithon reasoned that the visual opacity test creates only a presumption of illegal pollution and is subject to rebuttal proof that actual emissions are within particulate standards; thus, superior particulate evidence should rebut opacity observations. Chemithon stated that Regulation I did not intend that a plant emitting dry (particulate) pollutants up to the amount allowed in § 9.09 complies with the Regulation, but a plant emitting the same pollutants mixed with water, a nonpollutant, is subject to a civil penalty because of the § 9.03 opaqueness standard, especially since § 9.03 is not a "cosmetic" regulation. Since PSAPCA requires Chemithon to demonstrate that all particulate emissions have been removed in order to be exempt from the visual opacity standards, Chemithon asserted it is being fined merely because it mixes harmless water vapor with an allowable amount of particulate pollution.

Chemithon's contention was rejected by the Court of Appeals of Washington, which affirmed the judgement of the Superior Court.

The Court of Appeals declared: "We are unpersuaded by Chemithon's argument and hold a visual opacity civil penalty legal even when the particulate standards are not violated. The language of § 3.29 makes it clear that a violation of *any* of the provisions of Regulation I will subject the violator to a civil penalty. Furthermore, the Pollution Control Hearings Board provided that a person shall violate § 9.09 if he violates the opacity standards in § 9.03, or if he exceeds the particulate standards in § 9.09. We believe that violations of § 9.03 may be determined independently of the particulate standard of § 9.09. It does not matter that water vapor might be the primary cause of the observed visual opacity. For the uncombined water exception of § 9.03 to apply, the effluent must be free of all particulate contaminants . . . We do not speculate here why the Board decided that lawful particulate effluents when mixed with nonpolluting water vapor create unlawful pollution. It is enough to say that there are possible rational bases for the Board's decision; for example, particulates uncombined with water may dissipate resulting in no harm, but when combined with water the particulates may quickly fall to earth and have a harmful effect."

*Citation: Chemithon Corporation v. Puget Sound Air Pollution Control Agency, 31 Wash. App. 276, 640 P.2d 1085 (1982).*

# VISIBLE EMISSION OBSERVATION FORM

SOURCE NAME: AMAX CHEMICAL

ADDRESS:

CITY: PLANT CITY

STATE:

ZIP:

PHONE:

SOURCE ID NUMBER: 0075 24

PROCESS EQUIPMENT: FBR #2

OPERATING MODE:

CONTROL EQUIPMENT: SCRUBBER & IWS

OPERATING MODE:

DESCRIBE EMISSION POINT: STACK FOR FBR#2

HEIGHT ABOVE GROUND LEVEL: 155'

HEIGHT RELATIVE TO OBSERVER: 150'

DISTANCE FROM OBSERVER: 150'

DIRECTION FROM OBSERVER: W

DESCRIBE EMISSIONS:

EMISSION COLOR: WHITE

PLUME TYPE: CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT: NO ☑ YES ☐

IS WATER DROPLET PLUME: ATTACHED ☐ DETACHED ☐

AT WHAT POINT IN THE PLUME WAS OPACITY DETERMINED: 2 STACK DIA. DOWNWIND

DESCRIBE BACKGROUND: SKY

BACKGROUND COLOR: BLUE

SKY CONDITIONS: 30% OVERCAST

WIND SPEED: 5-10 mph

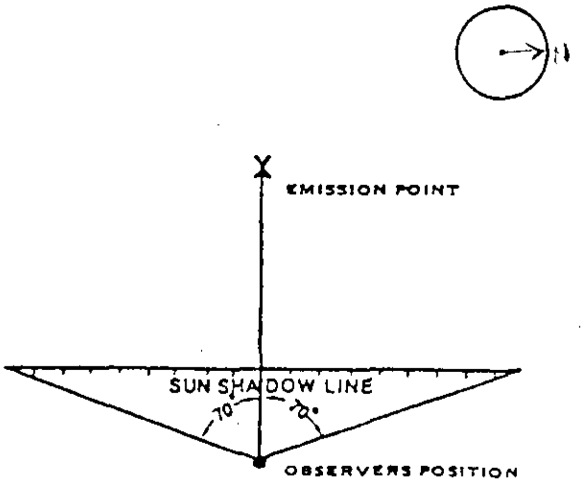
WIND DIRECTION: SSW

AMBIENT TEMPERATURE: 85°F

RELATIVE HUMIDITY:

SOURCE LAYOUT SKETCH

DRAW NORTH ARROW



COMMENTS: VE TAKEN DURING SECOND RUN OF COMPLIANCE TEST / OPERATING RATE UNKNOWN

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE:

TITLE:

DATE:

OBSERVATION DATE: 5-3-84

START TIME: 11.33

STOP TIME: 11:45

| M \ SEC | 0 | 15 | 30 | 45 | M \ SEC | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 30 | 35 | 30 | 25 | 31 | | | | |
| 2 | 20 | 25 | 25 | 25 | 32 | | | | |
| 3 | 25 | 25 | 25 | 25 | 33 | | | | |
| 4 | 25 | 30 | 30 | 30 | 34 | | | | |
| 5 | 30 | 30 | 30 | 30 | 35 | | | | |
| 6 | 30 | 30 | 30 | 30 | 36 | | | | |
| 7 | 35 | 35 | 30 | 30 | 37 | | | | |
| 8 | 30 | 30 | 30 | 30 | 38 | | | | |
| 9 | 20 | 30 | 30 | 30 | 39 | | | | |
| 10 | 35 | 35 | 35 | 30 | 40 | | | | |
| 11 | 30 | 30 | 30 | 30 | 41 | | | | |
| 12 | 30 | 30 | 30 | 30 | 42 | | | | |
| 13 | | | | | 43 | | | | |
| 14 | | | | | 44 | | | | |
| 15 | | | | | 45 | | | | |
| 16 | | | | | 46 | | | | |
| 17 | | | | | 47 | | | | |
| 18 | | | | | 48 | | | | |
| 19 | | | | | 49 | | | | |
| 20 | | | | | 50 | | | | |
| 21 | | | | | 51 | | | | |
| 22 | | | | | 52 | | | | |
| 23 | | | | | 53 | | | | |
| 24 | | | | | 54 | | | | |
| 25 | | | | | 55 | | | | |
| 26 | | | | | 56 | | | | |
| 27 | | | | | 57 | | | | |
| 28 | | | | | 58 | | | | |
| 29 | | | | | 59 | | | | |
| 30 | | | | | 60 | | | | |

AVERAGE OPACITY FOR HIGHEST PERIOD: 31%

NUMBER OF READINGS ABOVE 20 % WERE 47

RANGE OF OPACITY READINGS: 20% MINIMUM 35% MAXIMUM

OBSERVER'S NAME (PRINT): JERRY CAMPBELL

OBSERVER'S SIGNATURE: Jerry Campbell

DATE: 5/3/84

ORGANIZATION: HCEPC

CERTIFIED BY: ETA

DATE: 3/84

VERIFIED BY:

DATE:

Type III

HILLSBOROUGH COUNTY ENVIRONMENTAL
PROTECTION COMMISSION

## INSPECTION REPORT
## EXECUTIVE SUMMARY

PLANT NAME Amax Phosphate NEDS 075 DATE/TIME 3 May 84 11:00 AM

PLANT LOCATION Plant City, FL # OF NEDS POINTS 25

PROCESS DESCRIPTION Fluidized bed reactor #2, a packed bed scrubber and an electrostatic precipitator type scrubber, and a spray tower are used to defluorinate phosphate-based animal feed.

COMPLIANCE VERIFICATION (X) PERMIT REVIEW ( )
ENFORCEMENT ( ) OTHER ( )

PERSONS CONTACTED-TITLE George Townsend - Plant Engineer

NEDS POINTS HECKED 24 NEDS POINTS IN COMPLIANCE NEDS POINTS IN VIOLATION 24

SUMMARY OF FINDINGS A Visible Emissions test (EPA Method 9) was performed to measure the opacity of the plume arising from the process stack. This stack is the common emission point for Fluidized Bed Reactor #2 and Paragon Defluorinating Kiln #2; however, only Fluidized Bed Reactor #2 was on-line at the time of the inspection. The visible emission (opacity) was approximately 35%. The process controls and operations logs for the reactor and precipitator were inspected. Stack testing was in progress and was monitored briefly. Technique and equipment appeared to be in order. Operating rate at the time of inspection was not available. George ~~Townsend~~ Townsend was directed to perform a VE concurrent with the stack test.

SPECTION COMMENTS FOR APIS (LIMIT 50 SPACES) A 12 min. VE showed average 31% opacity

SPECTOR'S SIGNATURE Steve [illegible]

# AIR POLLUTION EMISSIONS COMPLIANCE TEST

## BIG FOUR MINE DRYER

## AMAX CHEMICAL CORPORATION

FEBRUARY 1984

SHOLTES & KOOGLER
ENVIRONMENTAL CONSULTANTS, INC.
1213 N.W. 6TH STREET
GAINESVILLE, FLORIDA 32601
(904) 377-5822

# TABLE OF CONTENTS

APPENDICES

To the best of my knowledge, all applicable field and analytical procedures comply with Florida Department of Environmental Regulation requirements and all test data and plant operating data are true and correct.

Robert S. Sholtes

ROBERT S. SHOLTES, PH.D., P.E.

3-9-84

DATE

SEAL

## 1.0 EXECUTIVE SUMMARY

On February 16 and 17, 1984, Sholtes & Koogler, Environmental Consultants, Inc. (SKEC) of Gainesville, Florida performed emission tests on the Big Four Mine Dryer for the pollutants sulfur dioxide, nitrogen oxides, particulate matter and visible emissions. The measured emissions proved to be in compliance with all limitations specified in Permit AC29-65834 for this installation. The specific limits and measured emissions are summarized on Page 11 of this report.

## 2.0 INTRODUCTION

AMAX Chemical Corporation operates a 300 tph fluid-bed phosphate rock dryer and associated dry rock storage and handling equipment at their Big Four Mine located near the intersection of State Road 674 and Bethlehem Road, Fort Lonesome, Hillsborough County, Florida.

The company has recently been permitted (AC29-65834) for a coal-oil-water mix fuel (COWM) containing up to 2.5 percent sulfur by weight.

The moisture content of 300 tph wet phosphate rock from the beneficiation plant is reduced from approximately 14 percent to 2.5 percent in a Heyl Patterson fluid bed dryer. The pollution from the dryer is controlled by a Peabody emission control system consisting of a twin cyclone and a wet impingement scrubber with a demisting section. Sulfur dioxide, produced from burning fuel containing sulfur, is absorbed in the scrubber and the phosphate rock product.

Specific Condition 17 of the above referenced permit requires emission testing for particulate matter, sulfur dioxide, nitrogen oxides and opacity while firing with the two alternate fuels, No. 6 fuel oil and COWM. This report constitutes an evaluation of these emissions in fulfillment of this specific permit condition.

## 3.0 SAMPLING PROCEDURES

### A. Sampling Location

Sampling for particulates required traversing of the dryer discharge in accordance with EPA Reference Methods 1 and 5. Figure 1 illustrates the geometry of this sampling location and specifies the specific traverse points used in these testing efforts. The other emission monitoring methods do not require traversing, however, sampling for these methods with the exception of opacity, were taken at one of the described sampling ports and at a location approximately one-third to one-half of the stack diameter away from the inner wall.

### B. Particulate Matter

Particulate matter samples were collected by the particulate matter emission measurement method adopted by the FDER in October 1980. A schematic diagram of the sampling train used is shown in Figure 2. All particulate matter captured from the nozzle to, and including, the filter was included in the calculation of the emission rate of particulate matter.

### Preparation of Equipment

1. Filters - Gelman type "A" filters were placed in a drying oven for two hours at 105 degrees C, removed and placed in a standard glass desiccator containing indicating silica gel, allowed to cool for two hours, and weighed to the nearest 0.1 mg.

2. <u>Nozzle, Filter Holder and Sampling Probe</u> - The nozzle, filter holder and sampling probe were washed vigorously with soapy water and brushes, rinsed with acetone and distilled water and dried prior to the test program. All openings on the sampling equipment were sealed while in transit to the test site.

3. <u>Impingers</u> - The Greenburg-Smith impingers were cleaned with a warm soapy water solution and brushes, rinsed with distilled water and acetone and dried. The impingers were sealed tightly during transit.

## Test Procedure

Prior to performing the actual particulate matter sample runs, certain stack and stack gas parameters were measured. These preliminary measurements included the average gas temperature, the stack gas velocity head, the stack gas moisture content, and the stack dimensions at the point where the tests were being performed. The stack gas temperature was determined by using an iron-constantan thermocouple with a digital readout. Velocity head measurements were made with calibrated type "S" pitot tube and an inclined manometer.

The sampling traverse points were selected so that a representative sample could be extracted from the gas stream. The traverse points were located in the center of equal areas, which were dependent upon the distance upstream and downstream from flow disturbances.

Each particulate matter test run consisted of sampling for a specific time at each traverse point. The type "S" pitot tube was connected to the sampling probe so that an instantaneous velocity head measurement could be made at each traverse point while making the test run. The stack gas temperature was also measured at each traverse point. Nomographs were used to calculate the isokinetic sampling rate at each traverse point during each test run.

The gases sampled passed through the following components: a stainless steel nozzle and probe; a glass fiber filter; two impingers with 100 ml of distilled water; one impinger dry; one impinger with 180 grams of silica gel; a flexible sample line; an air-tight pump; a dry test meter; and a calibrated orifice. The second impinger had a standard tip, while the first, third and fourth impingers had modified tips with a 0.5 inch I.D. opening.

Sample recovery was accomplished by the following procedures:

1. The pretared filter was removed from its holder and placed in Container 1 and sealed.
2. All sample-exposed surfaces prior to the filter were washed with acetone and placed in Container 2.
3. The volume of water from the first three impingers was measured for the purpose of calculating the moisture in the stack gas and then discarded.
4. The used silica gel from the fourth impinger was transferred to the original tared container and sealed.

## Laboratory Analysis

The three sample containers from each sample run were analyzed according to the following procedures:

1. The contents of Container 1 were transferred to a tared glass weighing dish, dried, and desiccated to a constant weight.
2. The acetone from Container 2 was transferred to a tared beaker and evaporated to dryness at 212 degrees F. It was then desiccated to a constant weight.
3. The used silica gel in its tared container was weighed to the nearest gram.

The total sample weight included the weight of material collected on the filter plus the weight of material collected in the nozzle, sampling probe, and front half of the filter holder.

## Data

The field data sheets, calculation sheets, and nomenclature definitions are included in the Appendix of this report.

## C. Sulfur Dioxide Testing

As specified in the FDER permit, testing for sulfur dioxide was carried out in accordance with EPA Reference Method 6. The procedures used in this testing were those outlined in the Method, a copy of which is appended hereto, along with field data and computations.

## D. Nitrogen Oxides Testing

As specified in the FDER permit testing for nitrogen oxides was carried out in accordance with EPA Reference Method 7. The procedures used in this testing were those outlined in the Method, a copy of which is appended hereto, along with field data and computations.

## E. Opacity Determinations

Opacity observations were made on the discharge while burning oil and COWM for periods of one-half hour in accordance with the provisions of Chapter 17-2, Florida Administrative Code. The observation period was selected on the basis that this source constituted a minor source with respect to particulate emissions.

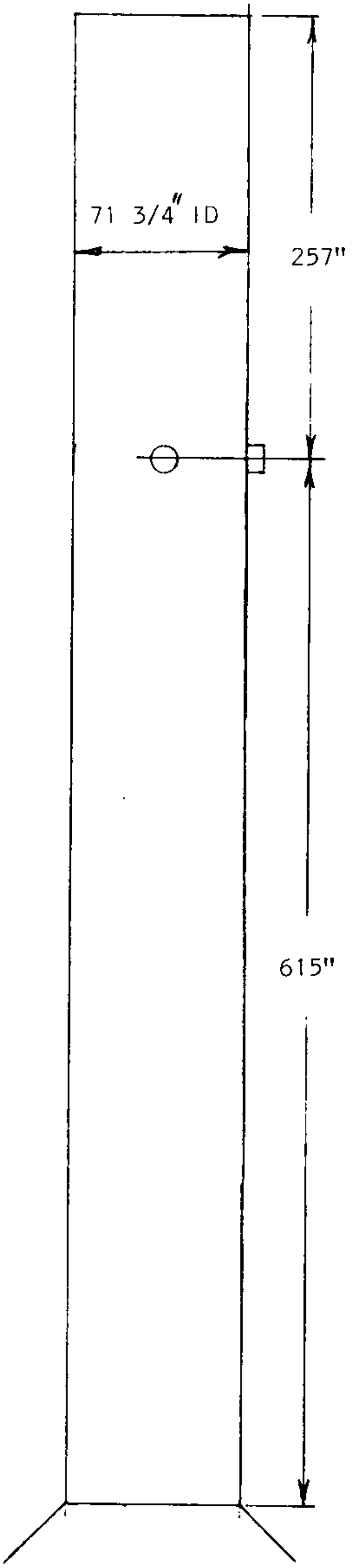


FIGURE 1

AMAX CHEMICAL CORPORATION
BIG FOUR MINE DRYER
STACK GEOMETRY

| Traverse Point | Distance From Inside Wall (inches) |
|---|---|
| 1 | 3.2 |
| 2 | 10.5 |
| 3 | 21.2 |
| 4 | 50.6 |
| 5 | 61.2 |
| 6 | 68.6 |

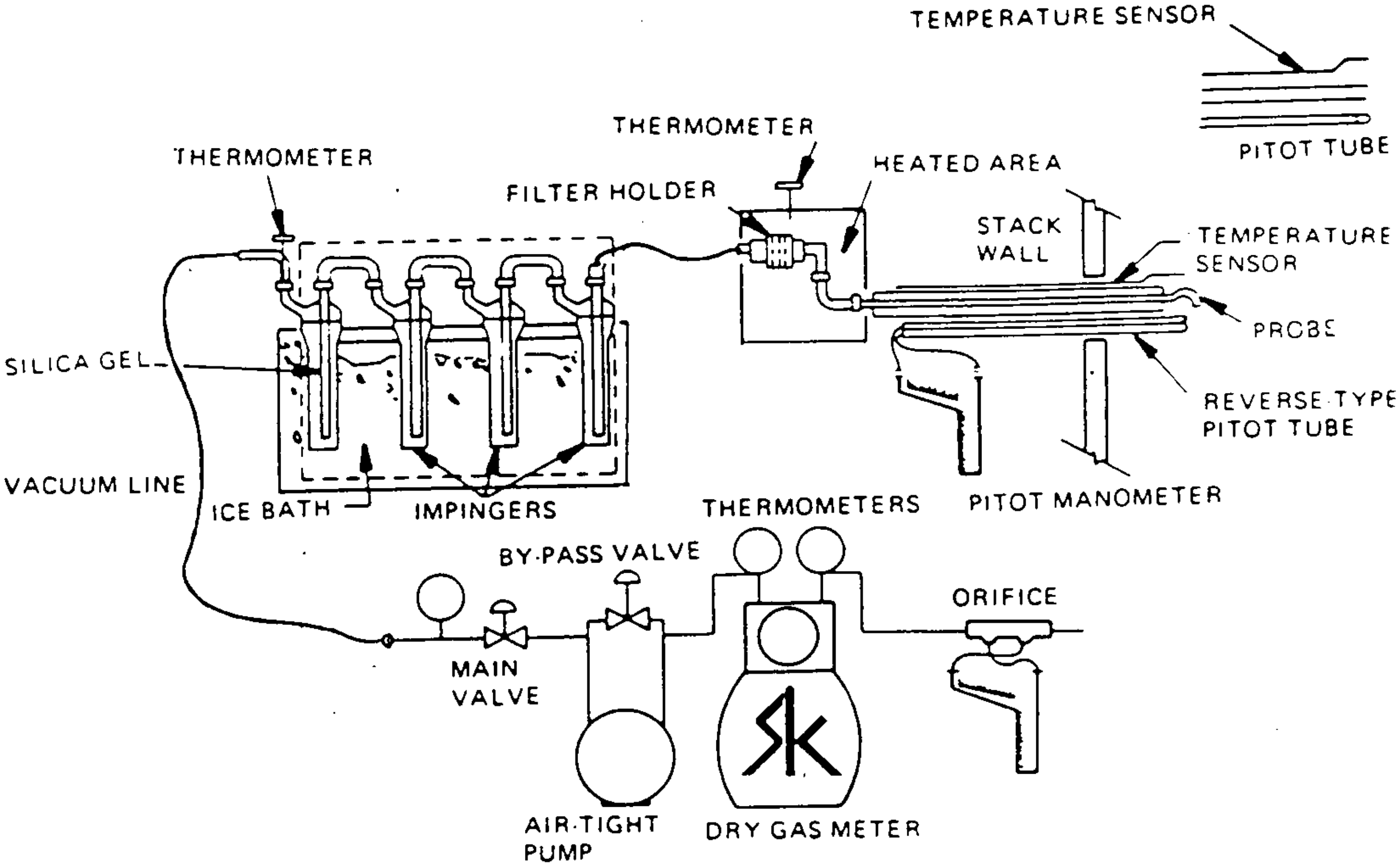


FIGURE 2

FDER PARTICULATE MATTER SAMPLING TRAIN

## 4.0 RESULTS

Table I summarizes the results of these test series. It will be observed that for both fuel regimes, all specified emission limits were attained during the testing period.

From the point of view of testing, there are no known limitations upon these data and it is purported that they represent a fair and representative evaluation of the emissions involved.

## TABLE I

## EMISSIONS TESTS
## BIG FOUR MINE DRYER

## AMAX CHEMICAL CORPORATION

| Date | Test No. | Feed Rate (tph) | Fuel | / Rate (gal/hr) | Heat Input* ($10^6$ btu/hr) | Opacity (%) | Particulate Matter (lb/hr) | Particulate Matter (lb/ton) | Sulfur Dioxide (lb/hr) | Sulfur Dioxide (lb/$10^6$ btu) | Nitric Oxides (lb/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 02-16-84 | 1 | 270 | COWM | 600 | 81.7 | 0 | 11.6 | 0.04 | 3.76 | 0.046 | |
| 02-16-84 | 2 | 270 | COWM | 600 | 81.7 | | 13.5 | 0.05 | 19.95 | 0.244 | 19.5 |
| 02-16-84 | 3 | 270 | COWM | 600 | 81.7 | | 13.4 | 0.05 | 38.39 | 0.470 | |
| Average | | | | | | | 12.6 | 0.043 | 20.7 | 0.253 | |
| 02-16-84 | 1 | 277 | Oil | 600 | 77.7 | | 12.5 | 0.05 | 64.02 | 0.824 | |
| 02-17-84 | 2 | 300 | Oil | 625 | 77.7 | 5 | 10.2 | 0.03 | 23.38 | 0.301 | 28.1 |
| 02-17-84 | 3 | 270 | Oil | 640 | 77.7 | | 10.4 | 0.04 | 63.69 | 0.820 | |
| Average | | | | | | | 11.0 | 0.040 | 50.36 | 0.648 | |

?

Allowable Emissions:

| | |
|---|---|
| Particulate Matter | 0.06 lb/ton |
| Sulfur Dioxide | 1.1 lb/$10^6$ btu |
| Nitrogen Oxide | 35.5 lb/hr |
| Opacity | 10 Percent |

*Heat Input Based on Duration of Method 6 ($SO_2$) Tests.

# APPENDICES

Appendix A - Field Data Sheets and Computations
  A1 - Particulate Sampling/Method 5
  A2 - Sulfur Dioxide Sampling/Method 6
  A3 - Nitrogen Oxide Sampling/Method 7
  A4 - Opacity/Method 9

Appendix B - Plant Operating Data

Appendix C - Calibrations and Project Participants

# APPENDIX A1

## Field Data Sheets and Computations
## Particulate Sampling/Method 5

# EQUATIONS FOR CALCULATING PARTICULATE EMISSIONS

$$\mathrm{VWV} = 0.0000893(\mathrm{TSTD})(\mathrm{VC})$$

$$\mathrm{VSTPD} = (\mathrm{VM})(\mathrm{PB} + \frac{\Delta H}{13.6})(\frac{\mathrm{TSTD}}{\mathrm{TM}})(\frac{1}{29.92})$$

$$\mathrm{VT} = (\mathrm{VWV}) + (\mathrm{VSTPD})$$

$$\mathrm{W} = (\mathrm{VWV}) \div (\mathrm{VT})$$

$$\mathrm{FDA} = (1.0) - (\mathrm{W})$$

$\mathrm{FMOIST}$ = Assumed moisture fraction

$$\mathrm{MD} = (0.44 \times \%\ \mathrm{CO_2}) + (0.32 \times \%\ \mathrm{O_2}) + (0.28 \times \%\ \mathrm{N_2}) + (0.28 \times \%\ \mathrm{CO})$$

$$\mathrm{MS} = (\mathrm{MD} \times \mathrm{FDA}) + (18 \times \mathrm{W})$$

$$\mathrm{GS} = (\mathrm{MS}) \div (28.99)$$

$$\mathrm{EA} = \left[(100) \times (\%\ \mathrm{O_2} - \frac{\%\ \mathrm{CO}}{2})\right] \div \left[(0.266 \times \%\ \mathrm{N_2}) - (\%\ \mathrm{O_2} - \frac{\%\ \mathrm{CO}}{2})\right]$$

$$\underline{\mathrm{U}} = 4{,}006(\mathrm{CP})\sqrt{\mathrm{H}}\ \sqrt{(\frac{\mathrm{TS}}{\mathrm{TSTD}})(\frac{29.92}{\mathrm{PS}})(\frac{1}{\mathrm{GS}})}$$

$$\mathrm{QS} = (\underline{\mathrm{U}}) \times (\mathrm{AS})$$

$$\mathrm{QD} = (\mathrm{QS}) \times (\mathrm{FDA})$$

$$\mathrm{QSTPD} = \mathrm{TSTD}(\mathrm{QD})(\mathrm{PS}) \div [\mathrm{TS}(29.92)]$$

$$\mathrm{PISO} = \left[(0.00267 \times \mathrm{VC} \times \mathrm{TS}) + (\mathrm{P_o} \times \mathrm{TS} \times \mathrm{VM} \div \mathrm{TM})\right] \div \left[(\mathrm{Time} \times \underline{\mathrm{U}} \times \mathrm{PS} \times \mathrm{AN})\right]$$

$$\mathrm{ESTP} = \frac{(\frac{15.43\ \mathrm{grains}}{\mathrm{gram}})\ (y)}{\mathrm{VSTPD}}$$

$$\mathrm{E_{12}} = \frac{(\mathrm{ESTP})\ (12)}{(\mathrm{CO_2}\ \%)}$$

$$\mathrm{E50} = \frac{(\mathrm{ESTP})\ (100 + \mathrm{EA})}{150}$$

$$\mathrm{EM} = (\mathrm{ESTP})\ (\mathrm{QSTPD})\ (60\ \frac{\mathrm{min}}{\mathrm{hr}})\ (\frac{\mathrm{lb}}{7000\ \mathrm{grains}})$$

# SOURCE SAMPLING NOMENCLATURE SHEET

PB - Barometric pressure, inches Hg
PS - Stack pressure, inches Hg
As - Stack area, sq. ft.
AS' - Effective area of positive stack gas flow, sq. ft.
NPTS - Number of traverse points where the pitot velocity head was greater than zero
TSTD - Standard temperature, °R
TS - Stack temperature, °R
TM - Meter temperature, °R
H - Average square root of velocity head, $\sqrt{\text{inches } H_2O}$
$\bar{H}$ - Average meter orifice pressure differential, inches $H_2O$
AN - Sampling nozzle area, square feet
CP - S-type pitot tube correction factor
VM - Recorded meter volume sample, cubic feet (meter conditions)
VC - Condensate and silica gel increase in impingers, milliliters
Po - Pressure at the dry test meter orifice, $\left[PB + \frac{\Delta \bar{H}}{13.6}\right]$ inches Hg
STP - Standard conditions

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VWV - Converstion of condensate in milliliters to water vapor in cubic feet (STP)
VSTPD - Volume sampled, cubic feet (STP)
VT - Total water vapor volume and dry gas volume sampled, cubic feet (STP)
W - Moisture fraction of stack gas
FDA - Dry gas fraction
MD - Molecular weight of stack gas, lbs/lb-mole (dry conditions)
MS - Molecular weight of stack gas, lbs/lb-mole (stack conditions)
GS - Specific gravity of stack gas, referred to air
EA - Excess air, %
$\sqrt{HxTS}$ - Average square root of velocity head times stack temperature
$\bar{U}$ - Stack gas velocity, feet per minute
QS - Stack gas flow rate, cubic feet per minute (stack conditions)
QD - Stack gas flow rate, cubic feet per minute (dry conditions)
QSTDP - Stack gas flow rate, cubic feet per minute (STP)
PISO - Percent isokinetic volume sampled (method described in Federal Register)
ESTP - Particulate concentration at standard and dry conditions, grains/scf
$E_{12}$ - ESTP corrected to 12% $CO_2$, grains/scf
$E_{50}$ - ESTP corrected to 50% excess Air, grains/scf
EM - Mass Emission Rate, lbs/hr

* - Stack Gas Saturated

## Table 1

## SUMMARY OF PARTICULATE MATTER EMISSIONS

AMAX
BIG 4 DRYER COAL/OIL
2/16/84

| | | | | | Particulate Matter | |
|---|---|---|---|---|---|---|
| Run No. | Process Weight Rate (Tons/Hr) | Stack Gas Flow Rate (SCFMD) | Stack Gas Temperature (Deg F) | Stack Gas Moisture (%) | Conc. (gr/SCF) | Emission Rate (Lbs/Hr) |
| 1 | 270.0 | 52612 | 131.5 | 14.1 | .0258 | 11.64 |
| 2 | 270.0 | 52099 | 134.2 | 14.3 | .0302 | 13.50 |
| 3 | 270.0 | 51949 | 131.2 | 14.0 | .0300 | 13.40 |
| Avg | 270.0 | 52220 | 132.3 | 14.1 | .0287 | 12.85 |

Allowable Particulate Matter Emission Rate = Lbs/Hr
(Chap. 17-2, Florida Administrative Code) --

# SHOLTES AND KOOGLER ENVIRONMENTAL CONSULTANTS

## Source Sampling Calculations

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   Plant: AMAX                                                  Date: 2/16/84
   Stack: BIG 4 DRYER COAL/OIL                           Run 1 From 1106 - 1210
 Weather: PARTLY CLOUDY                                      Total Time: 60 Min

         Stack Area       28.08 Sq Ft           Nozzle Area    .000539 Sq Ft
         Stack Temp       131.5 Deg F            Meter Temp       87.3 Deg F
     Stack Pressure       30.12 "Hg          Baro. Pressure      30.12 "Hg
     Stack Vel Head        .666 "H2O       Meter Press Diff       3.45 "H2O
                                               Meter Volume     58.372 cf
   Pitot Tube Factor        .84           Condensate Volume      198.7 ml

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  1.  Volume Water Vapor                                         9.359 SCF
  2.  Gas Volume Sampled - STPD                                 57.167 SCFD
  3.  Total Volume                                              66.526 SCF
  4.  Moisture in Stack Gas - Volume Fraction                     .141
  5.  Dry Stack Gas - Volume Fraction                             .859
  6.  Molecular Weight of Stack Gas - Dry Basis                  29.00
  7.  Molecular Weight of Stack Gas - Stack Conditions           27.45
  8.  Specific Gravity of Stack Gas Relative to Air               .95
  9.  Excess Air - Percent
 10.  Average Stack Velocity                                    2426.4 FPM
 11.  Average Stack Gas Flow Rate                                68133 ACFM
 12.  Actual Stack Gas Flow Rate Dry                             58548 CFMD
 13.  Stack Gas Flow Rate STPD                                   52612 SCFMD
 14.  Percent Isokinetic                                          94.3 %


 Probe Wash:      8.70 Mg      .0023 Gr/SCF       1.06 Lbs/Hr
     Filter:     86.90 Mg      .0234 Gr/SCF      10.58 Lbs/Hr
 ===Totals===    95.60 Mg      .0258 Gr/SCF      11.64 Lbs/Hr
```

## SHOLTES AND KOOGLER ENVIRONMENTAL CONSULTANTS

### Source Sampling Calculations

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------------------------------------------------------------------------------

                                                              Date: 2/16/84
   Plant: AMAX                                       Run 2 From 1237 - 1342
   Stack: BIG 4 DRYER COAL/OIL                           Total Time: 60 Min
 Weather: PARTLY CLOUDY

          Stack Area     28.08 Sq Ft          Nozzle Area   .000539 Sq Ft
          Stack Temp     134.2 Deg F           Meter Temp      94.2 Deg F
      Stack Pressure     30.12 "Hg         Baro. Pressure     30.12 "Hg
      Stack Vel Head      .663 "H20      Meter Press Diff      3.48 "H20
                                             Meter Volume    59.900 cf
   Pitot Tube Factor      .84           Condensate Volume     204.6 ml

------------------------------------------------------------------------------

  1.   Volume Water Vapor                                       9.637 SCF
  2.   Gas Volume Sampled - STPD                               57.937 SCFD
  3.   Total Volume                                            67.574 SCF
  4.   Moisture in Stack Gas - Volume Fraction                   .143
  5.   Dry Stack Gas - Volume Fraction                           .857
  6.   Molecular Weight of Stack Gas - Dry Basis                29.00
  7.   Molecular Weight of Stack Gas - Stack Conditions         27.43
  8.   Specific Gravity of Stack Gas Relative to Air              .95
  9.   Excess Air - Percent
 10.   Average Stack Velocity                                  2419.1 FPM
 11.   Average Stack Gas Flow Rate                              67929 ACFM
 12.   Actual Stack Gas Flow Rate Dry                           58241 CFMD
 13.   Stack Gas Flow Rate STPD                                 52099 SCFMD
 14.   Percent Isokinetic                                        96.5 %


 Probe Wash:       9.60 Mg       .0026 Gr/SCF        1.14 Lbs/Hr
     Filter:     103.90 Mg       .0276 Gr/SCF       12.36 Lbs/Hr
 ===Totals===    113.50 Mg       .0302 Gr/SCF       13.50 Lbs/Hr
```

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              SHOLTES AND KOOGLER ENVIRONMENTAL CONSULTANTS

                        Source Sampling Calculations

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    Plant: AMAX                                                Date: 2/16/84
    Stack: BIG 4 DRYER COAL/OIL                       Run 3 From 1405 - 1508
  Weather: PARTLY CLOUDY                                  Total Time: 60 Min

         Stack Area      28.08 Sq Ft            Nozzle Area    .000539 Sq Ft
         Stack Temp      131.2 Deg F             Meter Temp       92.9 Deg F
     Stack Pressure      30.12 "Hg           Baro. Pressure      30.12 "Hg
     Stack Vel Head       .657 "H20        Meter Press Diff       3.43 "H20
                                               Meter Volume     59.988 cf
    Pitot Tube Factor     .84             Condensate Volume      200.8 ml

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   1.   Volume Water Vapor                                       9.458 SCF
   2.   Gas Volume Sampled - STPD                               58.152 SCFD
   3.   Total Volume                                            67.610 SCF
   4.   Moisture in Stack Gas - Volume Fraction                   .140
   5.   Dry Stack Gas - Volume Fraction                           .860
   6.   Molecular Weight of Stack Gas - Dry Basis                29.00
   7.   Molecular Weight of Stack Gas - Stack Conditions         27.46
   8.   Specific Gravity of Stack Gas Relative to Air              .95
   9.   Excess Air - Percent
  10.   Average Stack Velocity                                  2392.4 FPM
  11.   Average Stack Gas Flow Rate                              67178 ACFM
  12.   Actual Stack Gas Flow Rate Dry                           57781 CFMD
  13.   Stack Gas Flow Rate STPD                                 51949 SCFMD
  14.   Percent Isokinetic                                        97.2 %


  Probe Wash:       5.60 Mg       .0015 Gr/SCF          .66 Lbs/Hr
      Filter:     107.80 Mg       .0285 Gr/SCF        12.74 Lbs/Hr
  ===Totals===    113.40 Mg       .0300 Gr/SCF        13.40 Lbs/Hr
```

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              Source Sampling Input Data      09:33 24-Feb-84


    Plant Name: AMAX                                    Pollutant: 3
Stack Location: BIG 4 DRYER COAL/OIL                     H2SO4=1
       Weather: PARTLY CLOUDY                             Part=2
      Run Date: 2/16/84                               Scrubber=3
         Run #: 1
    Time Start: 1106
      Time End: 1210                                  Source Type: 2
     Total Min: 60                                  Combustion=1
   Baro. Press: 30.12                                Non-Comb.=2
   Stack Press: 30.12      H2SO4 ---  Vt:               ORSAT=3
   Nozzle Diam: .3143                Vtb:
    Stack Area: 28.08                  N:                   %CO2:
   Final Meter: 332.872            Vsoln:           ORSAT -  % CO:
 Initial Meter: 274.5                 Va:                   % O2:
  Cond. Volume: 198.7        SO2 ---  Vt:
Stack Velocity: .444                 Vtb:         Weights for -
    Meter Diff: 3.45                   N:              Probe Wash: 8.70
Stack Gas Temp: 131.5              Vsoln:                  Filter: 86.9
    Meter Temp: 87.3                  Va:                        :
                          Prod Rate(TPD):                        :
                                    % O2:                        :
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              Source Sampling Input Data       09:36 24-Feb-84

    Plant Name: AMAX                                    Pollutant: 3
Stack Location: BIG 4 DRYER COAL/OIL                     H2SO4=1
       Weather: PARTLY CLOUDY                             Part=2
      Run Date: 2/16/84                                 Scrubber=3
         Run #: 2
    Time Start: 1237
      Time End: 1342                                    Source Type: 2
     Total Min: 60                                    Combustion=1
   Baro. Press: 30.12                                  Non-Comb.=2
   Stack Press: 30.12      H2SO4 ---  Vt:                ORSAT=3
   Nozzle Diam: .3143                Vtb:
    Stack Area: 28.08                  N:                    %CO2:
   Final Meter: 393.2              Vsoln:           ORSAT -  % CO:
 Initial Meter: 333.3                 Va:                    % O2:
  Cond. Volume: 204.6        SO2 ---  Vt:
Stack Velocity: .439                 Vtb:          Weights for -
    Meter Diff: 3.476                  N:              Probe Wash: 9.60
Stack Gas Temp: 134.2              Vsoln:                  Filter: 103.9
    Meter Temp: 94.2                  Va:                         :
                          Prod Rate(TPD):                         :
                                    % O2:                         :
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               Source Sampling Input Data        09:39 24-Feb-84


     Plant Name: AMAX                                               Pollutant: 3
 Stack Location: BIG 4 DRYER COAL/OIL                                 H2SO4=1
        Weather: PARTLY CLOUDY                                         Part=2
       Run Date: 2/16/84                                           Scrubber=3
          Run #: 3
     Time Start: 1405
       Time End: 1508                                           Source Type: 2
      Total Min: 60                                           Combustion=1
    Baro. Press: 30.12                                         Non-Comb.=2
   Stack Press: 30.12        H2SO4 ---   Vt:                        ORSAT=3
    Nozzle Diam: .3143                   Vtb:
     Stack Area: 28.08                    N:                             %CO2:
    Final Meter: 453.888              Vsoln:                ORSAT -    % CO:
  Initial Meter: 393.9                    Va:                           % O2:
   Cond. Volume: 200.8         SO2 ---   Vt:
 Stack Velocity: .432                    Vtb:               Weights for -
     Meter Diff: 3.43                     N:                    Probe Wash: 5.60
 Stack Gas Temp: 131.2                Vsoln:                        Filter: 107.8
     Meter Temp: 92.9                     Va:                              :
                              Prod Rate(TPD):                              :
                                       % O2:                               :
```

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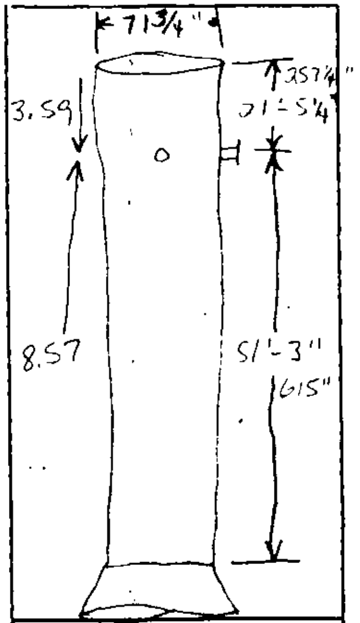
## SOURCE SAMPLING FIELD DATA SHEET

Plant Amax
Sampling Location Big 4
Type of Control Scrubber
Type of Samples Part
Date 2-16-84 Run No. 1 Coal out
Time Start 1106 Time End 1210
Sample Time 5 min/pt 60 Total min
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. 30.12 "Hg, Stack Press. 30.12 "Hg
Moisture 15 %, FDA ____, Gas Density Factor ____
Temp. 74 °F, W/D Vari, W/S 3-5
Weather Ptly Cloudy Thermocouple Readout Sb-1
Sample Box No. Sb-1 meter Box No. Sb-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. 5/16 in., Probe Length Sb-S1 ft
Probe Heater Setting 4 Nomograph $C_f$ 7.76
Stack Dimensions 71.75" in
Stack Area 28.08 $ft^2$
Effective Stack Area 28.08 $ft^2$
Stack Height ____ ft



Stack Dimensions

Umbilical Cord 100' [✓ 200']

Mat'l Processing Rate ____
Final Gas Meter Reading 332.872 $ft^3$
Initial Gas Meter Reading 274.500 $ft^3$ 58.372
Condensate Increase in Impingers 188 ml
Moisture in Silica Gel 10.7 gm 198.7
Silica Gel Container No. 27 Filter No. 4-045

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R Paul
D Watel

Stack Test Observers: ____

Leak Check Meter Box
Initial 0.00 cfm @ 15 In $H_2$
Final 0.015 cfm @ 12 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec, [✓ Stable], Leak
Static 3 In $H_2O$ for 15 sec, [✓ Stable], Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| 1 | 3.2 | | 74.5 | .43 | 3.34 | 3.34 | 143 | 81 | 248 | 57 | 8 |
| 2 | 10.5 | | 79.2 | .49 | 3.8 | 3.8 | 142 | 81 | 254 | 46 | 10 |
| 3 | 21.2 | | 84.3 | .46 | 3.57 | 3.57 | 137 | 82 | 262 | 48 | 10 |
| 4 | 50.6 | | 89.5 | .40 | 3.11 | 3.11 | 131 | 84 | 260 | 48 | 9 |
| 5 | 61.2 | | 94.1 | .2541 | 3.98 | 3.98 | 126 | 85 | 266 | 48 | 9 |
| 6 | 68.6 | | 98.5 | .36 | 2.79 | 2.79 | 122 | 88 | 239 | 49 | 8 |
| 1 | | | 02.8 | .47 | 3.65 | 3.65 | 134 | 89 | 257 | 54 | 10 |
| 2 | | | 7.8 | .47 | 3.65 | 3.65 | 132 | 90 | 250 | 50 | 10 |

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) |  | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Calc. | Actual |  |  |  |  |  |
| 3 |  |  | 12.8 | .45 | 3.49 | 3.49 | 128 | 90 | 247 | 49 | 10 |
| 4 |  |  | 17.8 | .45 | 3.49 | 3.49 | 128 | 92 | 243 | 49 | 10 |
| 5 |  |  | 22.8 | .47 | 3.65 | 3.65 | 127 | 92 | 242 | 50 | 11 |
| 6 |  |  | 27.9 | .48 | 3.72 | 3.72 | 128 | 93 | 242 | 50 | 12 |
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## SOURCE SAMPLING FIELD DATA SHEET

Plant Amax
Sampling Location Blg 4 Dryer
Type of Control Scrubber
Type of Samples Part
Date 2-16-84 Run No. 2 Coal Oil
Time Start 1237 Time End 1342
Sample Time 5 min/pt 60 Total min
DB ____ °F, WB ____ °F, VP @ DP ________ "Hg
Bar. Press. 30.12 "Hg, Stack Press. 30.12 "Hg
Moisture 15 %, FDA ____, Gas Density Factor ____
Temp. 77 °F, W/D Vari, W/S 3-5
Weather Ptly Cloudy Thermocouple Readout Sb-1
Sample Box No. Sb-1 meter Box No. Sb-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. 5/16 in., Probe Length Sb-8' ft
Probe Heater Setting 4 Nomograph $C_f$ 7.905
Stack Dimensions 71.75" in
Stack Area 28.08 $ft^2$
Effective Stack Area 28.08 $ft^2$
Stack Height ________ ft

Stack Dimensions

Umbilical Cord 100' [✓ 200']

Mat'l Processing Rate ________
Final Gas Meter Reading 393.200 $ft^3$
Initial Gas Meter Reading 333.300 $ft^3$
Condensate Increase in Impingers 196 ml 204.6
Moisture in Silica Gel 8.6 gm
Silica Gel Container No. 31 Filter No. 5-046

Orsat: %$CO_2$
%$O_2$
%CO
%$N_2$

Test Conducted By: R Paul
D Fabel

Stack Test Observers: ________

Leak Check Meter Box
Initial 0.00 cfm @ 15 In Hg
Final 0.00 cfm @ 13 In Hg

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Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. [✓ Stable], Leak
Static 3 In $H_2O$ for 15 sec. [✓ Stable], Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) Calc. | Meter Orifice Press. Diff. ("$H_2O$) Actual | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 33.3 | .40 | 3.16 | 3.16 | 139 | 93 | 232 | 63 | 9 |
| 2 | | | 38.1 | .47 | 3.72 | 3.72 | 134 | 93 | 241 | 46 | 11 |
| 3 | | | 43.1 | .47 | 3.72 | 3.72 | 135 | 93 | 257 | 46 | 11 |
| 4 | | | 48.3 | .47 | 3.72 | 3.72 | 133 | 93 | 259 | 47 | 11 |
| 5 | | | 53.6 | .47 | 3.72 | 3.72 | 131 | 94 | 250 | 45 | 11 |
| 6 | | | 58.6 | .42 | 3.3 | 3.3 | 129 | 94 | 247 | 45 | 11 |
| 1 | | | 63.6 | .42 | 3.3 | 3.3 | 142 | 95 | 263 | 47 | 11 |
| 2 | | | 68.5 | .49 | 3.87 | 3.87 | 135 | 95 | 242 | 47 | 13 |

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) |  | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Calc. | Actual |  |  |  |  |  |
| 3 |  |  | 73.9 | .47 | 3.72 | 3.72 | 136 | 95 | 255 | 48 | 13 |
| 4 |  |  | 78.8 | .44 | 3.48 | 3.48 | 133 | 95 | 264 | 49 | 13 |
| 5 |  |  | 83.9 | .39 | 3.08 | 3.08 | 132 | 95 | 265 | 48 | 12 |
| 6 |  |  | 88.8 | .37 | 2.92 | 2.92 | 131 | 95 | 260 | 48 | 12 |
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SH[redacted] & K[redacted]R
ENVIRONMENTAL CONSULTANTS, INC.
GAINESVILLE, FLORIDA 32601
(904) 377-5822

## SOURCE SAMPLING FIELD DATA SHEET

Plant Amax
Sampling Location Big 4 Dryer
Type of Control Scrubber
Type of Samples Part
Date 2-16-84 Run No. 3 Coolant
Time Start 1405 Time End 1508
Sample Time 5 min/pt 60 Total min
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. 30.12 "Hg, Stack Press. 30.12 "Hg
Moisture 15 %, FDA ____, Gas Density Factor ____
Temp. 75 °F, W/D Vari, W/S 3-8
Weather Ptly Cloudy Thermocouple Readout Sk-4
Sample Box No. Sk1 meter Box No. Sk-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. 5/16 in., Probe Length Sk-81 ft
Probe Heater Setting 4 Nomograph $C_f$ .7905
Stack Dimensions 71.75 in
Stack Area 28.08 $ft^2$
Effective Stack Area 28.08 $ft^2$
Stack Height ____ ft

Stack Dimensions

Umbilical Cord 100' [✓ 200']

Mat'l Processing Rate ____
Final Gas Meter Reading 453.888 $ft^3$
Initial Gas Meter Reading 393.900 $ft^3$
Condensate Increase in Impingers 192 ml 200.8
Moisture in Silica Gel 8.8 gm
Silica Gel Container No. 3 Filter No. 6-047

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R Paul
G Gabel

Stack Test Observers: ____

Leak Check Meter Box
Initial 0.00 cfm @ 15 In Hg
Final 0.006 cfm @ 11 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. [✓ Stable], Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| 1 | | | 93.9 | .42 | 3.32 | 3.32 | 143 | 92 | 266 | 60 | 10 |
| 2 | | | 99.1 | .47 | 3.72 | 3.72 | 137 | 92 | 264 | 54 | 11 |
| 3 | | | 4.0 | .47 | 3.72 | 3.72 | 132 | 91 | 259 | 55 | 11 |
| 4 | | | 9.2 | .42 | 3.32 | 3.32 | 123 | 91 | 260 | 55 | 11 |
| 5 | | | 14.3 | .39 | 3.08 | 3.08 | 122 | 92 | 267 | 56 | 10 |
| 6 | | | 19.0 | .36 | 2.85 | 2.85 | 124 | 93 | 254 | 56 | 10 |
| 1 | | | 23.5 | .41 | 3.24 | 3.24 | 134 | 94 | 250 | 61 | 11 |
| 2 | | | 28.5 | .41 | 3.24 | 3.24 | 133 | 94 | 256 | 52 | 9 |

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) |  | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Calc. | Actual |  |  |  |  |  |
| 3 |  |  | 33.3 | .47 | 3.72 | 3.72 | 132 | 94 | 242 | 51 | 10 |
| 4 |  |  | 38.5 | .47 | 3.72 | 3.72 | 132 | 94 | 243 | 50 | 11 |
| 5 |  |  | 43.6 | .47 | 3.72 | 3.72 | 130 | 94 | 260 | 49 | 11 |
| 6 |  |  | 49.0 | .44 | 3.48 | 3.48 | 132 | 94 | 264 | 48 | 11 |
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# SAMPLING RATE CALCULATIONS

## S¢K NOMOGRAPH

CO. NAME: Amax
DATE: 2-16-84
STACK: Bcg 4
LOCATION:

$\Delta H$ = ORIFICE READING (INCHES $H_2O$)
$D_N$ = NOZZLE DIA. (INCHES)
$\Delta H@$ = METER BOX CONSTANT
$B_w$ = MOISTURE FRACTION
$T_m$ = METER TEMP (°F)
$T_s$ = STACK TEMP (°F)
$M_s$ = WET MOLECULAR WEIGHT OF STACK GAS (FROM TABLE)
$\Delta P$ = PITOT READING (INCHES $H_2O$

$$\left[\frac{T_m+460}{M_s(T_s+460)}\,(1-B_w)^2\,\Delta H@\,(D_n)^4\,17741\right]\Delta P=\Delta H$$

130

.45 - .30

| MOISTURE FRACTION | Ms |
|---|---|
| 0.0 | 29.0 |
| 0.05 | 28.5 |
| 0.10 | 27.9 |
| 0.15 | 27.4 |
| 0.20 | 26.8 |
| 0.25 | 26.2 |
| 0.30 | 25.7 |
| 0.35 | 25.2 |
| 0.40 | 24.6 |

$$\frac{548}{27.4(590)}\quad 16164$$

$$\underline{558}$$

| | RUN 1 | | RUN 2 | | RUN 3 |
|---|---|---|---|---|---|
| $\frac{T_m+460}{M_s(T_s+460)}$ = | 0.033898 | | 0.03452 | | |
| × $(1-B_w)^2$ = | 0.7225 | | | | |
| × $\Delta H@$ = | 1.83 | | | | |
| × $(D_n)^4$ = | 0.009763 | | | | |
| × 17741 = | 17741 | 17741 | 17741 | 17741 | 17741 |
| × $\Delta P$ = | 776 | | 7904 | | |

# METER ORIFICE CHECK

Meter Box No. Ab-1

Δ Ha of Box 1.83

Date 2-16-84

Time for 10 $ft^3$ = 13 min. 24 sec.

264.1

10 ÷ 13.4 total minutes = 0.7463 $\Delta Ha_2$

$\frac{0.75}{\Delta Ha_2}$ = 1.005 x 100 = 100.5%

RC Paul

Signature

Procedure: Set flow rate of meter box at ΔHa of meter box--measure the amount of time required to sample 10.00 $ft^3$.

<u>Note:</u> If answer is within 5 percent meter is o.k. If not, recalibrate meter.

# NOZZLE CALIBRATION

Nozzle 5/16

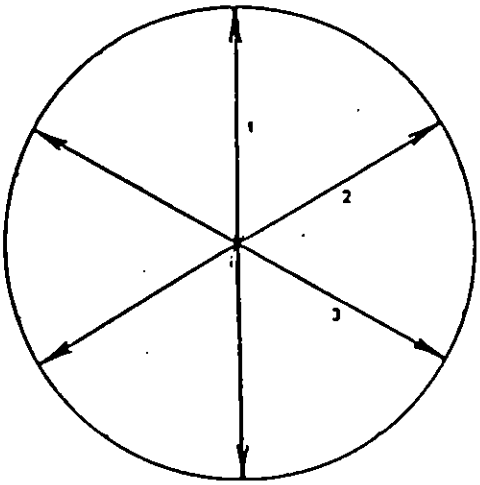
Date 2-16-84

| Measurement No. | Inside Diameter (inches) |
|---|---|
| 1 | .314 |
| 2 | .314 |
| 3 | .315 |

Average .3143

Area of Nozzle ______ Ft$^2$

Calibrated by: Rodney Paul



Nozzle X-section

## SAMPLE CHAIN OF CUSTODY

PLANT NAME: Amax

SOURCE NAME: Big 4 Dryer Coal Oil

DATE: 2-16-84 TYPE OF SAMPLE: Part

## SAMPLE RECOVERY

| CONTAINER NO. | DESCRIPTION |
|---|---|
| 1-ACO-P | Probe Wash Run 1 |
| 2-ACO-P | " " " 2 |
| 3-ACO-P | " " " 3 |
| 4 | Filter Holder Run 1 |
| 5 | " " " 2 |
| 6 | " " " 3 |
| 27 | Silica Gel Run 1 |
| 31 | " " " 2 |
| 3 | " " " 3 |

Sample Recovered By: RS & GG

Particulate Analysis By: R. Paul

SHOLTES & KOOGLER, ENVIRONMENTAL CONSULTANTS, INC.

## PARTICULATE LAB DATA SHEET

Project No. AMAX - COAL/OIL
2-16-84

| | Run 1 | Run 2 | Run 3 | Blank |
|---|---|---|---|---|
| Container No. | sb-29 | sb-47 | sb-31 | sb-3 |
| Total Volume (ml) | 253 | 247 | 236 | 100 |
| Aliquot Evaporated (ml) | 253 | 247 | 236 | 100 |
| Final Weight (g) | 108.8817 | 97.3080 | 88.0466 | 90.4763 |
| Tare Weight (g) | -108.8730 | -97.2984 | -88.0410 | -90.4763 |
| Gross Weight Gained (g) | 0.0087 | 0.0096 | 0.0056 | 0.0000 |
| Average Blank (g) | - — | - — | - — | - — |
| Net Weight (g) | 0.0087 | 0.0096 | 0.0056 | — |
| Aliquot Factor | x 1.0 | x 1.0 | x 1.0 | x 1.0 |
| Total Net Weight (mg) | 8.7 | 9.6 | 5.6 | |

| | | | | |
|---|---|---|---|---|
| Container No. | 1F | 2F | 3F | |
| Filter No. | 045 | 046 | 047 | |
| Final Weight (g) | 0.5444 | 0.5609 | 0.5638 | |
| Tare Weight (g) | -0.4575 | -0.4570 | -0.4560 | - |
| Gross Weight Gained (g) | 0.0869 | 0.1039 | 0.1078 | |
| Average Blank | - — | - — | - — | - |
| Total Net Weight (mg) | 86.9 | 103.9 | 107.8 | |

**Tare Balance Check**

0 0.0 50g 50.0000
10g 10.0000 100g 100.0000
0.5g .5000
By RC Paul
Date 2-22-84

**Final Balance Check**

0 0.0000 50g 50.0000
10g 10.0000 100g 100.0000
0.5g 0.5000
By R Paul
Date 2-23-84

Table 1

## SUMMARY OF PARTICULATE MATTER EMISSIONS

AMAX
BIG 4 DRYER
2/17/84

| Run No. | Process Weight Rate (Tons/Hr) | Stack Gas Flow Rate (SCFMD) | Stack Gas Temperature (Deg F) | Stack Gas Moisture (%) | Particulate Matter Conc. (gr/SCF) | Particulate Matter Emission Rate (Lbs/Hr) |
|---|---|---|---|---|---|---|
| 1 | 276.7 | 54051 | 130.7 | 14.2 | .0268 | 12.45 |
| 2 | 270.0 | 53472 | 141.9 | 14.4 | .0223 | 10.24 |
| 3 | 270.0 | 53324 | 144.8 | 14.2 | .0228 | 10.43 |
| Avg | 272.2 | 53616 | 139.1 | 14.2 | .0240 | 11.04 |

Allowable Particulate Matter Emission Rate = Lbs/Hr
(Chap. 17-2, Florida Administrative Code)

# SHOLTES AND KOOGLER ENVIRONMENTAL CONSULTANTS

## Source Sampling Calculations

---

```
   Plant: AMAX                                                  Date: 2/16/84
   Stack: BIG 4 DRYER - OIL                          Run 1 From 1617 - 1719
 Weather: PARTLY CLOUDY                                  Total Time: 60 Min

          Stack Area       28.08 Sq Ft          Nozzle Area    .000539 Sq Ft
          Stack Temp       130.7 Deg F           Meter Temp       91.3 Deg F
      Stack Pressure       30.12 "Hg         Baro. Pressure      30.12 "Hg
      Stack Vel Head        .685 "H2O      Meter Press Diff       3.72 "H2O
                                               Meter Volume     61.972 cf
   Pitot Tube Factor      .84            Condensate Volume       211.5 ml
```

---

```
  1.  Volume Water Vapor                                        9.962 SCF
  2.  Gas Volume Sampled - STPD                                60.292 SCFD
  3.  Total Volume                                             70.253 SCF
  4.  Moisture in Stack Gas - Volume Fraction                    .142
  5.  Dry Stack Gas - Volume Fraction                            .858
  6.  Molecular Weight of Stack Gas - Dry Basis                 29.00
  7.  Molecular Weight of Stack Gas - Stack Conditions          27.44
  8.  Specific Gravity of Stack Gas Relative to Air               .95
  9.  Excess Air - Percent
 10.  Average Stack Velocity                                   2492.6 FPM
 11.  Average Stack Gas Flow Rate                               69993 ACFM
 12.  Actual Stack Gas Flow Rate Dry                            60068 CFMD
 13.  Stack Gas Flow Rate STPD                                  54051 SCFMD
 14.  Percent Isokinetic                                         96.8 %


 Probe Wash:     13.00 Mg      .0033 Gr/SCF      1.54 Lbs/Hr
     Filter:     92.00 Mg      .0235 Gr/SCF     10.91 Lbs/Hr
 ===Totals===   105.00 Mg      .0268 Gr/SCF     12.45 Lbs/Hr
```

```
              SHOLTES AND KOOGLER ENVIRONMENTAL CONSULTANTS

                       Source Sampling Calculations

--------------------------------------------------------------------------


     Plant: AMAX                                          Date: 2/17/84
     Stack: BIG 4 DRYER - OIL                     Run 2 From 0841 - 0943
   Weather: CLEAR                                      Total Time: 60 Min

         Stack Area      28.08 Sq Ft            Nozzle Area   .000539 Sq Ft
         Stack Temp      141.9 Deg F             Meter Temp      75.8 Deg F
     Stack Pressure      30.14 "Hg           Baro. Pressure     30.14 "Hg
     Stack Vel Head       .685 "H2O        Meter Press Diff      3.51 "H2O
                                               Meter Volume    59.830 cf
     Pitot Tube Factor    .84             Condensate Volume     213.2 ml

--------------------------------------------------------------------------


   1.   Volume Water Vapor                                   10.042 SCF
   2.   Gas Volume Sampled - STPD                            59.902 SCFD
   3.   Total Volume                                         69.943 SCF
   4.   Moisture in Stack Gas - Volume Fraction                .144
   5.   Dry Stack Gas - Volume Fraction                        .856
   6.   Molecular Weight of Stack Gas - Dry Basis             29.00
   7.   Molecular Weight of Stack Gas - Stack Conditions      27.42
   8.   Specific Gravity of Stack Gas Relative to Air          .95
   9.   Excess Air - Percent
  10.   Average Stack Velocity                               2516.2 FPM
  11.   Average Stack Gas Flow Rate                           70655 ACFM
  12.   Actual Stack Gas Flow Rate Dry                        60511 CFMD
  13.   Stack Gas Flow Rate STPD                              53472 SCFMD
  14.   Percent Isokinetic                                     97.2 %



  Probe Wash:     15.00 Mg     .0039 Gr/SCF      1.77 Lbs/Hr
      Filter:     71.70 Mg     .0184 Gr/SCF      8.47 Lbs/Hr
  ===Totals===    86.70 Mg     .0223 Gr/SCF     10.24 Lbs/Hr
```

# SHOLTES AND KOOGLER ENVIRONMENTAL CONSULTANTS

## Source Sampling Calculations

---

Plant: AMAX
Stack: BIG 4 DRYER - OIL
Weather: CLEAR

Date: 2/17/84
Run 3 From 1003 - 1107
Total Time: 60 Min

| | | | |
|---|---|---|---|
| Stack Area | 28.08 Sq Ft | Nozzle Area | .000539 Sq Ft |
| Stack Temp | 144.8 Deg F | Meter Temp | 90 Deg F |
| Stack Pressure | 30.14 "Hg | Baro. Pressure | 30.14 "Hg |
| Stack Vel Head | .683 "H2O | Meter Press Diff | 3.65 "H2O |
| | | Meter Volume | 61.300 cf |
| Pitot Tube Factor | .84 | Condensate Volume | 209.7 ml |

---

| | | |
|---|---|---|
| 1. | Volume Water Vapor | 9.877 SCF |
| 2. | Gas Volume Sampled - STPD | 59.808 SCFD |
| 3. | Total Volume | 69.685 SCF |
| 4. | Moisture in Stack Gas - Volume Fraction | .142 |
| 5. | Dry Stack Gas - Volume Fraction | .858 |
| 6. | Molecular Weight of Stack Gas - Dry Basis | 29.00 |
| 7. | Molecular Weight of Stack Gas - Stack Conditions | 27.44 |
| 8. | Specific Gravity of Stack Gas Relative to Air | .95 |
| 9. | Excess Air - Percent | |
| 10. | Average Stack Velocity | 2515.9 FPM |
| 11. | Average Stack Gas Flow Rate | 70648 ACFM |
| 12. | Actual Stack Gas Flow Rate Dry | 60635 CFMD |
| 13. | Stack Gas Flow Rate STPD | 53324 SCFMD |
| 14. | Percent Isokinetic | 97.3 % |

| | | | |
|---|---|---|---|
| Probe Wash: | 9.60 Mg | .0025 Gr/SCF | 1.13 Lbs/Hr |
| Filter: | 78.80 Mg | .0203 Gr/SCF | 9.29 Lbs/Hr |
| ===Totals=== | 88.40 Mg | .0228 Gr/SCF | 10.43 Lbs/Hr |

```
              Source Sampling Input Data        09:08 24-Feb-84

    Plant Name: AMAX                                          Pollutant: 3
Stack Location: BIG 4 DRYER - OIL                             H2SO4=1
       Weather: PARTLY CLOUDY                                   Part=2
      Run Date: 2/16/84                                       Scrubber=3
         Run #: 1
    Time Start: 1617
      Time End: 1719                                          Source Type: 2
     Total Min: 60                                          Combustion=1
   Baro. Press: 30.12                                        Non-Comb.=2
   Stack Press: 30.12      H2SO4 ---   Vt:                      ORSAT=3
   Nozzle Diam: .3143                 Vtb:
    Stack Area: 28.08                   N:                         %CO2:
   Final Meter: 516.172             Vsoln:                 ORSAT -  % CO:
 Initial Meter: 454.2                  Va:                          % O2:
  Cond. Volume: 211.5        SO2 ---   Vt:
Stack Velocity: .469                  Vtb:                Weights for -
    Meter Diff: 3.716                   N:                    Probe Wash: 13.0
Stack Gas Temp: 130.7               Vsoln:                        Filter: 92.0
    Meter Temp: 91.3                   Va:                              :
                        Prod Rate(TPD):                                 :
                                   % O2:                                :
```

```
              Source Sampling Input Data      09:13 24-Feb-84


    Plant Name: AMAX                                     Pollutant: 3
Stack Location: BIG 4 DRYER - OIL                         H2SO4=1
       Weather: CLEAR                                      Part=2
      Run Date: 2/17/84                                Scrubber=3
         Run #: 2
    Time Start: 0841
      Time End: 0943                                   Source Type: 2
     Total Min: 60                                   Combustion=1
   Baro. Press: 30.14                                 Non-Comb.=2
   Stack Press: 30.14      H2SO4 ---  Vt:                 ORSAT=3
   Nozzle Diam: .3143                Vtb:
    Stack Area: 28.08                  N:                    %CO2:
   Final Meter: 576.630            Vsoln:           ORSAT -  % CO:
 Initial Meter: 516.8                 Va:                    % O2:
  Cond. Volume: 213.2        SO2 ---  Vt:
Stack Velocity: .469                 Vtb:           Weights for -
    Meter Diff: 3.513                  N:               Probe Wash: 15.0
Stack Gas Temp: 141.9              Vsoln:                   Filter: 71.7
    Meter Temp: 75.8                  Va:                         :
                          Prod Rate(TPD):                         :
                                    % O2:                         :
```

```
                    Source Sampling Input Data        09:16 24-Feb-84


    Plant Name: AMAX                                                   Pollutant: 3
Stack Location: BIG 4 DRYER - OIL                                        H2SO4=1
       Weather: CLEAR                                                     Part=2
      Run Date: 2/17/84                                               Scrubber=3
         Run #: 3
    Time Start: 1003
      Time End: 1107                                                 Source Type: 2
     Total Min: 60                                                  Combustion=1
   Baro. Press: 30.14                                                Non-Comb.=2
   Stack Press: 30.14               H2SO4 ---  Vt:                       ORSAT=3
   Nozzle Diam: .3143                         Vtb:
    Stack Area: 28.08                           N:                          %CO2:
   Final Meter: 648.6                       Vsoln:     ORSAT -             % CO:
 Initial Meter: 587.3                          Va:                         % O2:
  Cond. Volume: 209.7                 SO2 ---  Vt:
Stack Velocity: .467                          Vtb:     Weights for -
    Meter Diff: 3.649                           N:          Probe Wash: 9.60
Stack Gas Temp: 144.8                       Vsoln:              Filter: 78.8
    Meter Temp: 90                             Va:                    :
                                   Prod Rate(TPD):                    :
                                             % O2:                    :
```

SH[redacted]S & [redacted]ER
ENVIRONMENTAL CONSULTANTS, INC.
GAINESVILLE, FLORIDA 32601
(904) 377-5822

# SOURCE SAMPLING FIELD DATA SHEET

Plant Amad
Sampling Location Bag 4 Dryer
Type of Control scrubber
Type of Samples Part
Date 2-16-84 Run No. 1 /Oil
Time Start 1617 Time End 1719
Sample Time 5 min/pt 60 Total min
DB ___ °F, WB ___ °F, VP @ DP ___ "Hg
Bar. Press. 30.12 "Hg, Stack Press. 30.12 "Hg
Moisture 15 %, FDA ___, Gas Density Factor ___
Temp. 72 °F, W/D Var, W/S 3-8
Weather Partly Cloudy Thermocouple Readout Sb-1
Sample Box No. Sb-1 meter Box No. Sb-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. 5/16 in., Probe Length Sb-8' ft
Probe Heater Setting 4 Nomograph $C_f$ 7905
Stack Dimensions 71.75 in
Stack Area 28.08 $ft^2$
Effective Stack Area 28.08 $ft^2$
Stack Height ___ ft

0.12

Stack Dimensions

Umbilical Cord 100' [✓ 200]

Mat'l Processing Rate ___
Final Gas Meter Reading 516.172 $ft^3$
Initial Gas Meter Reading 454.200 $ft^3$
Condensate Increase in Impingers 200 ml 211.5
Moisture in Silica Gel 11.5 gm
Silica Gel Container No. 10 Filter No. 1-1252

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R Paul
G Gabel

Stack Test Observers: ___

Leak Check Meter Box
Initial 0.00 cfm @ 15 In Hg
Final 0.00 cfm @ 12 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. [✓ Stable], Leak
Static 3 In $H_2O$ for 15 sec. [✓ Stable], Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| 1 | | | 54.2 | .47 | 3.72 | 3.72 | 133 | ~~260~~ 90 | 260 | 49 | 10 |
| 2 | | | 59.4 | .52 | 4.11 | 4.11 | 137 | 90 | 251 | 48 | 11 |
| 3 | | | 64.7 | .52 | 4.11 | 4.11 | 139 | 90 | 263 | 51 | 11 |
| 4 | | | 70.2 | .47 | 3.72 | 3.72 | 128 | 90 | 270 | 52 | 11 |
| 5 | | | 75.4 | .49 | 3.87 | 3.87 | 129 | 91 | 261 | 51 | 11 |
| 6 | | | 80.7 | .50 | 3.95 | 3.95 | 131 | 91 | 266 | 51 | 12 |
| 1 | | | 86.0 | .45 | 3.55 | 3.55 | 138 | 91 | 269 | 52 | 11 |
| 2 | | | 90.9 | .47 | 3.72 | 3.72 | 131 | 92 | 256 | 52 | 12 |

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) |  | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Calc. | Actual |  |  |  |  |  |
| 3 |  |  | 96.0 | .49 | 3.87 | 3.87 | 133 | 92 | 262 | 53 | 12 |
| 4 |  |  | 501.5 | .45 | 3.56 | 3.56 | 126 | 92 | 262 | 53 | 12 |
| 5 |  |  | 505.9 | .45 | 3.56 | 3.56 | 123 | 93 | 255 | 53 | 12 |
| 6 |  |  | 11.5 | .36 | 2.85 | 2.85 | 120 | 93 | 253 | 54 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |
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## SOURCE SAMPLING FIELD DATA SHEET

Plant A-mad
Sampling Location Big 4 Dryer
Type of Control Scrubber
Type of Samples Part
Date 2-17-84 Run No. 2 oil
Time Start 0841 Time End 0943
Sample Time 5 min/pt 60 Total min
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. 30.14 "Hg, Stack Press. 30.14 "Hg
Moisture 15 %, FDA ____, Gas Density Factor ____
Temp. 55 °F, W/D Vari, W/S 2-3
Weather Clear Thermocouple Readout Sb-1
Sample Box No. Sb-1 meter Box No. Sb-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. 5/16 in., Probe Length Sb-8' ft
Probe Heater Setting ____ Nomograph $C_f$ 7.512
Stack Dimensions 71.75 in
Stack Area 28.08 $ft^2$
Effective Stack Area 28.08 $ft^2$
Stack Height ____ ft

Stack Dimensions

Umbilical Cord 100' [✓ 200']

Mat'l Processing Rate ____
Final Gas Meter Reading 576.630 $ft^3$
Initial Gas Meter Reading 516.800 $ft^3$
Condensate Increase in Impingers 203 ml 213.2
Moisture in Silica Gel 10.2 gm
Silica Gel Container No. 22 Filter No. 2-1253

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R Paul
G Gabel

Stack Test Observers: ____

Leak Check Meter Box
Initial 0.00 cfm @ 15 In Hg
Final 0.00 cfm @ 13 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec, [✓ Stable], Leak
Static 3 In $H_2O$ for 15 sec, [✓ Stable], Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| 1 | | | 16.8 | .45 | 3.38 | 3.38 | 143 | 66 | 266 | 62 | 10 |
| 2 | | | 21.6 | .45 | 3.38 | 3.38 | 146 | 66 | 268 | 55 | 10 |
| 3 | | | 26.5 | .50 | 3.76 | 3.76 | 146 | 69 | 270 | 53 | 11 |
| 4 | | | 31.7 | .48 | 3.61 | 3.61 | 145 | 71 | 267 | 51 | 11 |
| 5 | | | 37.2 | .50 | 3.76 | 3.76 | 146 | 74 | 261 | 51 | 12 |
| 6 | | | 41.7 | .47 | 3.53 | 3.52 | 145 | 76 | 257 | 51 | 11 |
| 1 | | | 46.7 | .44 | 3.31 | 3.31 | 152 | 78 | 259 | 53 | 11 |
| 2 | | | 51.7 | .51 | 3.83 | 3.83 | 148 | 80 | 266 | 51 | 13 |

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| 3 | | | 56.9 | .49 | 368 | 3.68 | 144 | 81 | 251 | 51 | 13 |
| 4 | | | 61.9 | .47 | 3.53 | 3.53 | 134 | 82 | 252 | 51 | 13 |
| 5 | | | 66.9 | .44 | 331 | 3.31 | 127 | 83 | 250 | 51 | 12 |
| 6 | | | 72.0 | .41 | 308 | 3.08 | 127 | 84 | 248 | 51 | 12 |
| | | | | | | | | | | | |
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## SOURCE SAMPLING FIELD DATA SHEET

Plant Amad
Sampling Location Big 4 Dryer
Type of Control Scrubber
Type of Samples Part
Date 2-17-84 Run No. 3 oil
Time Start 1003 Time End 1107
Sample Time 5 min/pt 60 Total min
DB ___ °F, WB ___ °F, VP @ DP ___ "Hg
Bar. Press. 30.14 "Hg, Stack Press. 30.14 "Hg
Moisture 15 %, FDA ___, Gas Density Factor ___
Temp. 63 °F, W/D Var., W/S 3-5
Weather Clear Thermocouple Readout Sh-1
Sample Box No. Sh-1 meter Box No. Sh-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. 5/16 in., Probe Length Sh-8' ft
Probe Heater Setting 4 Nomograph $C_f$ 1.808
Stack Dimensions 71.75 in
Stack Area 28.08 $ft^2$
Effective Stack Area 28.08 $ft^2$
Stack Height ___ ft

Stack Dimensions

Umbilical Cord 100' [✓ 200]

Mat'l Processing Rate ___
Final Gas Meter Reading 648.600 $ft^3$
Initial Gas Meter Reading 587.300 $ft^3$
Condensate Increase in Impingers 198 ml 209.7
Moisture in Silica Gel 11.7 gm
Silica Gel Container No. 37 Filter No. 3-1254

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| %CO | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R Paul
D Gabel

Stack Test Observers: ___

Leak Check Meter Box
Initial 0.00 cfm @ 15 In Hg
Final 0.00 cfm @ 12 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. [✓ Stable], Leak
Static 3 In $H_2O$ for 15 sec. [✓ Stable], Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) Calc. | Meter Orifice Press. Diff. ("$H_2O$) Actual | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 87.3 | .47 | 3.67 | 3.67 | 156 | 87 | 235 | 61 | 9 |
| 2 | | | 92.4 | .52 | 4.06 | 4.06 | 154 | 87 | 241 | 53 | 10 |
| 3 | | | 97.7 | .46 | 3.59 | 3.59 | 153 | 88 | 259 | 55 | 10 |
| 4 | | | 2.8 | .46 | 3.59 | 3.59 | 151 | 89 | 257 | 54 | 10 |
| 5 | | | 7.8 | .41 | 3.2 | 3.2 | 145 | 90 | 251 | 55 | 9 |
| 6 | | | 12.7 | .41 | 3.2 | 3.2 | 145 | 91 | 260 | 54 | 9 |
| 1 | | | 17.3 | .45 | 3.51 | 3.51 | 146 | 91 | 266 | 57 | 10 |
| 2 | | | 22.5 | .50 | 3.9 | 3.9 | 139 | 91 | 247 | 54 | 12 |

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| 3 | | | 27.7 | .48 | 3.75 | 3.75 | 139 | 91 | 257 | 55 | 12 |
| 4 | | | 33.0 | .48 | 3.75 | 3.75 | 133 | 91 | 239 | 54 | 12 |
| 5 | | | 38.2 | .51 | 3.98 | 3.98 | 133 | 92 | 245 | 55 | 12 |
| 6 | | | 63.7 | .46 | 3.59 | 3.59 | 143 | 92 | 256 | 56 | 12 |
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# SAMPLING RATE CALCULATIONS

## S&K NOMOGRAPH

CO. NAME: ____
DATE: ____
STACK: ____
LOCATION: ____

$\Delta H$ = ORIFICE READING (INCHES $H_2O$)
$D_N$ = NOZZLE DIA. (INCHES)
$\Delta H@$ = METER BOX CONSTANT
$B_W$ = MOISTURE FRACTION
$T_M$ = METER TEMP (°F)
$T_S$ = STACK TEMP (°F)
$M_S$ = WET MOLECULAR WEIGHT OF STACK GAS (FROM TABLE)
$\Delta P$ = PITOT READING (INCHES $H_2O$

$$\left[\frac{T_m + 460}{M_s(T_s + 460)} (1 - B_w)^2 \, \Delta H@ \, (D_n)^4 \, 17741\right] \Delta P = \Delta H$$

| MOISTURE FRACTION | Ms |
|---|---|
| 0.0 | 29.0 |
| 0.05 | 28.5 |
| 0.10 | 27.9 |
| 0.15 | 27.4 |
| 0.20 | 26.8 |
| 0.25 | 26.2 |
| 0.30 | 25.7 |
| 0.35 | 25.2 |
| 0.40 | 24.6 |

$$\frac{533}{27.4 \quad (593) \, 16248.2}$$

|  | RUN 1 |  | RUN 2 |  | RUN 3 |
|---|---|---|---|---|---|
| $\frac{T_M + 460}{M_S(T_S + 460)}$ = | 0.032803 |  | 0.034094 |  |  |
| × $(1 - B_W)^2$ = | 0.7225 |  |  |  |  |
| × $\Delta H@$ = | 1.83 |  |  |  |  |
| × $(D_n)^4$ = | 0.009763 |  |  |  |  |
| × 17741 = | 17741 | 17741 | 17741 | 17741 | 17741 |
| × $\Delta P$ = | 7.512 |  |  |  |  |

# METER ORIFICE CHECK

Meter Box No. ______ $\Delta$ Ha of Box ____________

Date ______________

Time for 10 ft$^3$ = 13 min. 20 sec.

576.900

10 ÷ 13.33 total minutes = 0.75 $\Delta$ Ha$_2$

$\frac{0.75}{\Delta Ha_2}$ = 1.00 x 100 = 100%

R C Paul

Signature

Procedure: Set flow rate of meter box at $\Delta$Ha of meter box--measure the amount of time required to sample 10.00 ft$^3$.

**Note:** If answer is within 5 percent meter is o.k. If not, recalibrate meter.

# NOZZLE CALIBRATION

Nozzle 5/16

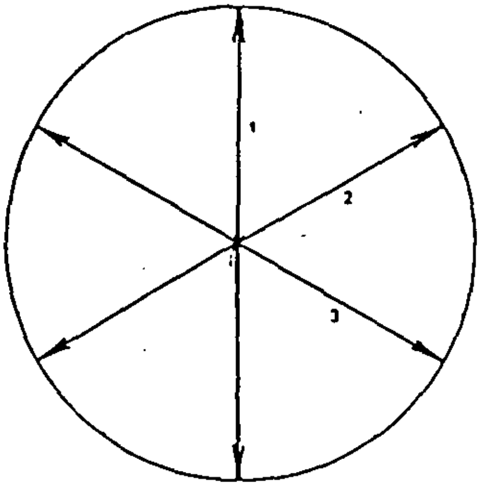
Date 2-16+17-84

| Measurement No. | Inside Diameter (inches) |
|---|---|
| 1 | .314 |
| 2 | .310 |
| 3 | .315 |

Average .3143

Area of Nozzle ______ Ft$^2$

Calibrated by: RC Paul



Nozzle X-section

# SAMPLE CHAIN OF CUSTODY

PLANT NAME: Amax Chemical Corp.

SOURCE NAME: Big Bend Dryer

DATE: 2-17-84 TYPE OF SAMPLE: Particulate

## SAMPLE RECOVERY

| CONTAINER NO. | DESCRIPTION |
|---|---|
| SK-41 | Run 1 Oil Probe Wash |
| SK-33 | Run 2 " " " |
| SK-301 | Run 3 " " " |
| SK-45 | Acetone Blank Oil |
| 15 | Run 1 Filter Oil |
| 25 | Run 2 " " |
| 35 | Run 3 " " |

Sample Recovered By: R. Paul - R.S. Sholtes

Particulate Analysis By: R. Paul

SHOLTES & KOOGLER, ENVIRONMENTAL CONSULTANTS, INC.

PARTICULATE LAB DATA SHEET

Project No. AMAX - OIL
2-17-84

| | Run 1 | Run 2 | Run 3 | Blank |
|---|---|---|---|---|
| Container No. | Sb-41 | Sb-33 | Sb-301 | Sb-45 |
| Total Volume (ml) | 203 | 183 | 226 | 100 |
| Aliquot Evaporated (ml) | 203 | 183 | 226 | 100 |
| Final Weight (g) | 93.8620 | 91.8932 | 101.1009 | 99.2636 |
| Tare Weight (g) | -93.8490 | -91.8782 | -101.0913 | -99.2634 |
| Gross Weight Gained (g) | 0.0130 | 0.0150 | 0.0096 | 0.0002 |
| Average Blank (g) | - — | - — | - — | - — |
| Net Weight (g) | 0.0130 | 0.0150 | 0.0096 | 0.0002 |
| Aliquot Factor | x 1.0 | x 1.0 | x 1.0 | x 1.0 |
| Total Net Weight (mg) | 13.0 | 15.0 | 9.6 | 0.2 |

| | | | | |
|---|---|---|---|---|
| Container No. | 1 J | 2 J | 3 J | |
| Filter No. | 1252 | 1253 | 1254 | |
| Final Weight (g) | 0.5455 | 0.5235 | 0.5312 | |
| Tare Weight (g) | -0.4535 | -0.4518 | -0.4524 | - |
| Gross Weight Gained (g) | 0.0920 | 0.0717 | 0.0788 | |
| Average Blank | - — | - — | - — | - |
| Total Net Weight (mg) | 92.0 | 71.7 | 78.8 | |

Tare Balance Check

0 0.0000 50g 50.0000
10g 10.0000 100g 100.0000
0.5g 0.5000

By R Paul
Date 2-22-84

Final Balance Check

0 0.0000 50g 50.0000
10g 10.0000 100g 100.0000
0.5g 0.5000

By R Paul
Date 2-23-84

# APPENDIX A2

## Field Data Sheets and Computations
## Sulfur Dioxide Sampling/Method 6

2-16-84 Coal/Oil

From Run 1 of Method 5
1106-1210 hr.
Flow = 52612 SCFMD

Run 1 1045 hr.

$$V_{m(std)} = 17.4 \frac{0.700 \times 30.12}{(86+460)} = 0.673 \text{ ft}^3$$

$$C_{SO_2} = \frac{0.3989 \times 10^{-5} (0.5-0.3)}{0.673} = 0.119 \times 10^{-5} \text{ lb/dscf}$$

Mass Emission = $0.119 \times 10^{-5} \times 52{,}612 \times 60$ = 3.76 lb/hr.

Run 2 1140 hr.

$$V_{m(std)} = 17.4 \frac{0.849 \times 30.12}{(460+104)} = 0.789 \text{ ft}^3$$

$$C_{SO_2} = 0.3989 \times 10^{-5} \frac{(1.55-0.3)}{0.789} = 0.632 \times 10^{-5} \text{ lb/dscf}$$

Mass Emission = $0.632 \times 10^{-5} \times 52{,}612 \times 60$ = 19.95 lb/hr.

Run 3 1230 hr.

$$V_{m(std)} = 17.4 \frac{1.065 \times 30.12}{(460+107)} = 0.984 \text{ ft}^3$$

$$C_{SO_2} = 0.3989 \times 10^{-5} \frac{(3.3-0.3)}{0.984} = 1.216 \times 10^{-5} \text{ lb/dscf}$$

Mass Emission = $1.216 \times 10^{5} \times 52{,}612 \times 60$ = 38.39 lb/hr.

Avg Mass Emission = 20.7 lb/hr $SO_2$

From Run 1 of Method 5
1617 - 1719
Flow = 54051 SCFMD

2-16-84 Oil

Run 1 1610 hr

$$V_{m(std)} = 17.4 \frac{0.705 \times 30.12}{(460 + 94)} = 0.667 \text{ ft}^3$$

$$C_{SO_2} = \frac{0.3989 \times 10^{-5} (3.6 - .3)}{0.667} = 1.974 \times 10^{-5} \text{ lb/SCFD}$$

Mass Emission = $1.974 \times 10^{-5} \times 54051 \times 60$ = 64.02 lb/hr. $SO_2$

Run 2 1645 hr

$$V_{m(std)} = 17.4 \frac{0.777 \times 30.12}{(460 + 106)} = 0.719 \text{ ft}^3$$

$$C_{SO_2} = \frac{0.3989 \times 10^{-5} (1.6 - .3)}{0.719} = 0.721 \times 10^{-5} \text{ lb/SCFD}$$

Mass Emission = $0.721 \times 10^{-5} \times 54,051 \times 60$ = 23.38 lb/hr $SO_2$

~1760 hr.

Run 3

$$V_{m(std)} = 17.4 \frac{0.935 \times 30.12}{(460 + 108)} = 0.863 \text{ ft}^3$$

$$C_{SO_2} = \frac{0.3989 \times 10^{-5} (4.55 - .3)}{0.863} = 1.964 \times 10^{-5} \text{ lb/SCFt}$$

Mass Emission = $1.964 \times 10^{-5} \times 54051 \times 60$ = 63.69 lb/hr $SO_2$

Average Mass Emission = 50.36 lb/hr. $SO_2$

Method 6 Computations

$SO_2$ in Stack Gases

From Method 6

$$C_{SO_2} = K_2 \frac{(V_t - V_{tb}) N \left(\frac{V_{sol}}{V_a}\right)}{V_{m(std)}}$$

where $K_2 = 7.061 \times 10^{-5}$ for English Units

$V_a = 20$ ml

$V_{soln} = 100$ ml.

$V_{tb} = 0.3$

$N = .0113$ all constant

$$C_{SO_2} = \frac{7.061 \times 10^{-5} (V_t - 0.3)(.0113)\left(\frac{100}{20}\right)}{V_{m(std)}}$$

$$C_{SO_2} = \frac{0.3989 \times 10^{-5} (V_t - 0.3)}{V_{m(std)}}$$ in ~~ppm~~ lb/dscf

$$V_{m(std)} = K_1 Y \frac{V_m P_{bar}}{T_m}$$

where $K_1 = 17.64$ for English Units.

$Y = 1.000$

$$V_{m(std)} = 17.64 \frac{V_m P_{bar}}{T_m}$$ in std $ft^3$

# Fuel Consumption / Heat Release

Coal/Oil Mix

14,660 Btu/lb heat value

9.29 lb/gal @ 72F    8.61 lb/gal @ 122F

~~assume 8.5 lb/gal @ metered temp.~~ not metered

given 600 gal/hr. @ 72F

Heat input = 600 x ~~8.5~~ 9.3 x 14,660 = $81.7 \times 10^6$ Btu/hr.

#6 Oil    Heat Value given to be

~~18,357 Btu/lb.~~    148,000 Btu/gal

~~8.28 lb/gal~~

Oil Meter @ 1600 = 1391160
@ 1700 = 1391760
600 gal/hr.

2/16/84

@ 1700 = 1391760
@ 1800 = 1392210
450 gal/hr.

$SO_2$ Tests started 1610 & Run thru 1730

Avg = 525 gal/hr.

Heat Release = $77.7 \times 10^6$ Btu/hr.

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2

## SOURCE SAMPLING FIELD DATA SHEET

Plant AMAX
Sampling Location Fluid Bed Dryer
Type of Control Scrubber
Type of Samples SO2
Date 2-16 Run No. 1 Com
Time Start 1045 Time End
Sample Time min/pt Total min
DB °F, WB °F, VP @ DP "Hg
Bar. Press. 30.12 "Hg, Stack Press. "Hg
Moisture %, FDA , Gas Density Factor
Temp. °F, W/D , W/S
Weather Thermocouple Readout
Sample Box No. meter Box No.
Meter ΔH@ Pitot Corr. Factor
Nozzle Dia. in., Probe Length ft
Probe Heater Setting Nomograph $C_f$
Stack Dimensions in
Stack Area $ft^2$
Effective Stack Area $ft^2$
Stack Height ft

Method 6

Begin Purge 1122

End 1137

Stack Dimensions

Umbilical Cord 100' 200'

Mat'l Processing Rate
Final Gas Meter Reading 723.292 $ft^3$ 0.7
Initial Gas Meter Reading 722.592 $ft^3$
Condensate Increase in Impingers ml
Moisture in Silica Gel gm
Silica Gel Container No. Filter No.

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| %CO | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R. Sholtes

*Stack Test Observers:

Leak Check Meter Box
Initial 0.00 cfm @ NA In $H_2$
Final 0.00 cfm @ X In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. Stable, Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | 130 | 86 | | | |
| | | 1045 | 722.592 | | | | | 80 | | | 1.8 |
| | | 1050 | 22.695 | | | | 130 | 80 | | | 1.8 |
| | | 1055 | 22.782 | | | | 130 | 82 | | | 2.2 |
| | | 1100 | 22.880 | | | | | 83 | | | 2.0 |
| | | 1105 | 22.992 | | | | 130 | 87 | | | 2.2 |
| | | 1110 | 23.078 | | | | | 90 | | | 2.2 |
| | | 1115 | 23.182 | | | | | 92 | | | 2.2 |
| | | 1120 | 23.292 | | | | | 94 | | | 2.2 |

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## SOURCE SAMPLING FIELD DATA SHEET

Plant AMAX
Sampling Location Fluid Bed Dryer
Type of Control
Type of Samples Coal/Oil Mix
Date 2-16 Run No. 2
Time Start 1140 Time End
Sample Time ____ min/pt ____ Total min
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. ____ "Hg, Stack Press. ____ "Hg
Moisture ____ %, FDA ____, Gas Density Factor ____
Temp. ____ °F, W/D ____, W/S ____
Weather ____ Thermocouple Readout ____
Sample Box No. ____ meter Box No. ____
Meter ΔH@ ____ Pitot Corr. Factor ____
Nozzle Dia. ____ in., Probe Length ____ ft
Probe Heater Setting ____ Nomograph $C_f$ ____
Stack Dimensions ____ in
Stack Area ____ $ft^2$
Effective Stack Area ____ $ft^2$
Stack Height ____ ft

Method 6

Begin Purge
1206

Stack Dimensions

Umbilical Cord 100' 200'

Mat'l Processing Rate ____
Final Gas Meter Reading 724.617 $ft^3$
Initial Gas Meter Reading 723.768 $ft^3$ 0.849
Condensate Increase in Impingers ____ ml
Moisture in Silica Gel ____ gm
Silica Gel Container No. ____ Filter No. ____

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| %CO | | | | |
| $\%N_2$ | | | | |

Test Conducted By: K. Sholtes

Stack Test Observers: Anthony

Leak Check Meter Box
Initial 0.00 cfm @ 10 In $H_2$
Final ____ cfm @ ____ In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. Stable, Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | 103.5 | | | |
| | | 1140 | 23.768 | | | | | 102 | | | 2.8 |
| | | 1145 | 23.900 | | | | | 102 | | | 2.4 |
| | | 1150 | 24.100 | | | | | 104 | | | 2.5 |
| | | 1155 | 24.270 | | | | | 104 | | | [illegible] |
| | | 1200 | 24.422 | | | | | 104 | | | 2.6 |
| | | 1205 | 724.617 | | | | | 105 | | | 2.7 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

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## SOURCE SAMPLING FIELD DATA SHEET

Plant AMAX
Sampling Location Fluid Bed Dryer
Type of Control
Type of Samples Coal/Oil
Date Run No. 3
Time Start 1230 Time End
Sample Time min/pt Total min
DB °F, WB °F, VP @ DP "Hg
Bar. Press. "Hg, Stack Press. "Hg
Moisture %, FDA , Gas Density Factor
Temp. °F, W/D , W/S
Weather Thermocouple Readout
Sample Box No. meter Box No.
Meter ΔH@ Pitot Corr. Factor
Nozzle Dia. in., Probe Length ft
Probe Heater Setting Nomograph $C_f$
Stack Dimensions in
Stack Area $ft^2$
Effective Stack Area $ft^2$
Stack Height ft

Method 6

Purg 1252 Start
End

Stack Dimensions

Umbilical Cord 100' 200'

Mat'l Processing Rate
Final Gas Meter Reading 726.400 $ft^3$
Initial Gas Meter Reading 725.335 $ft^3$ 1,065
Condensate Increase in Impingers ml
Moisture in Silica Gel gm
Silica Gel Container No. Filter No.

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: K. Sholtes

Stack Test Observers:

Leak Check Meter Box
Initial [illegible] cfm @ 15 In $H_2$
Final cfm @ In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. Stable, Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) 106.8. | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| | | 1230 | 25.335 | | | | | 125 | | | 2.7 |
| | | 1235 | 25.620 | | | | | 106 | | | 2.6 |
| | | 1240 | 25.940 | | | | | 107 | | | 2.6 |
| | | 1245 | 26.250 | | | | | 108 | | | 2.7 |
| | | 1250 | 26.400 | | | | | 108 | | | 2.4 |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

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## SOURCE SAMPLING FIELD DATA SHEET

Plant AMAX
Sampling Location Fluid Bed ~~S~~ Dryer
Type of Control Scrubber
Type of Samples SO2
Date ______ Run No. 1 Oil
Time Start 1610 Time End ______
Sample Time ______ min/pt ______ Total min
DB ______ °F, WB ______ °F, VR @ DP ______ "Hg
Bar. Press. ______ "Hg, Stack Press. ______ "Hg
Moisture ______ %, FDA ______, Gas Density Factor ______
Temp. ______ °F, W/D ______, W/S ______
Weather ______ Thermocouple Readout ______
Sample Box No. ______ meter Box No. ______
Meter ΔH@ ______ Pitot Corr. Factor ______
Nozzle Dia. ______ in., Probe Length ______ ft
Probe Heater Setting ______ Nomograph $C_f$ ______
Stack Dimensions ______ in
Stack Area ______ $ft^2$
Effective Stack Area ______ $ft^2$
Stack Height ______ ft

Method 6
Oil

St' Purge @ 1631

Stack Dimensions

Umbilical Cord 100' 200'

Mat'l Processing Rate ______
Final Gas Meter Reading 727.915 $ft^3$ 0.705
Initial Gas Meter Reading 727.210 $ft^3$
Condensate Increase in Impingers ______ ml
Moisture in Silica Gel ______ gm
Silica Gel Container No. ______ Filter No. ______

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: K. Sholtes

Stack Test Observers: ______

Leak Check
Meter Box
Initial 0.00 cfm @ 10 In H2
Final 0.00 cfm @ 15 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. Stable, Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | 94 | | | |
| | | 1610 | 27.210 | | | | | 92 | | | 2.7 |
| | | 1615 | 27.340 | | | | | 93 | | | 2.8 |
| | | 1620 | 27.470 | | | | | 94 | | | ↑ 4.5 |
| | | 1625 | 27.730 | | | | | 95 | | | 4.0 |
| | | 1630 | 27.915 | | | | | 96 | | | 4.0 |
| | | | | | | | | | | | |
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## SOURCE SAMPLING FIELD DATA SHEET

Plant AMAX
Sampling Location Fluid Bed Dryer
Type of Control Scrubber
Type of Samples $SO_2$ - Method 6
Date ______ Run No. 2 Oil
Time Start 1645 Time End ______
Sample Time ______ min/pt ______ Total min
DB ______ °F, WB ______ °F, VP @ DP ______ "Hg
Bar. Press. ______ "Hg, Stack Press. ______ "Hg
Moisture ______ %, FDA ______, Gas Density Factor ______
Temp. ______ °F, W/D ______, W/S ______
Weather ______ Thermocouple Readout ______
Sample Box No. ______ meter Box No. ______
Meter ΔH@ ______ Pitot Corr. Factor ______
Nozzle Dia. ______ in., Probe Length ______ ft
Probe Heater Setting ______ Nomograph $C_f$ ______
Stack Dimensions ______ in
Stack Area ______ $ft^2$
Effective Stack Area ______ $ft^2$
Stack Height ______ ft

Method 6
Oil

Stack Dimensions

Umbilical Cord 100' 200'

Mat'l Processing Rate ______
Final Gas Meter Reading 729.188 $ft^3$
Initial Gas Meter Reading 728.411 $ft^3$ 0.777
Condensate Increase in Impingers ______ ml
Moisture in Silica Gel ______ gm
Silica Gel Container No. ______ Filter No. ______

| | | | | |
|---|---|---|---|---|
| Orsat: $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| $\%CO$ | | | | |
| $\%N_2$ | | | | |

Test Conducted By: R Sholtes

Stack Test Observers: ______

Leak Check Meter Box
Initial 0.00 cfm @ 10 In Hg
Final 0.00 cfm @ 10 In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. Stable, Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) 105.6 | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | | | | |
| | | 1645 | 728.411 | | | | | 104 | | | 2.9 |
| | | 1650 | 728.605 | | | | | 105 | | | 2.8 |
| | | 1655 | 28.800 | | | | | 106 | | | 2.8 |
| | | 1700 | 28.940 | | | | | 106 | | | 2.8 |
| | | 1705 | 729.188 | | | | | 107 | | | 2.8 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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## SOURCE SAMPLING FIELD DATA SHEET

Plant AMAX
Sampling Location Fluid Bed Dryer
Type of Control Scrubber
Type of Samples $SO_2$ Oil
Date ______ Run No. 2 Oil
Time Start ______ Time End ______
Sample Time ______ min/pt ______ Total min
DB ____ °F, WB ____ °F, VP @ DP ______ "Hg
Bar. Press. ______ "Hg, Stack Press. ______ "Hg
Moisture ____ %, FDA ____, Gas Density Factor ____
Temp. ______ °F, W/D ______, W/S ______
Weather ______ Thermocouple Readout ______
Sample Box No. ______ Meter Box No. ______
Meter ΔH@ ______ Pitot Corr. Factor ______
Nozzle Dia. ______ in., Probe Length ______ ft
Probe Heater Setting ______ Nomograph $C_f$ ______
Stack Dimensions ______ in
Stack Area ______ $ft^2$
Effective Stack Area ______ $ft^2$
Stack Height ______ ft

Method 6
Oil

Purge [illegible] 1745

Stack Dimensions

Umbilical Cord 100' 200'

Mat'l Processing Rate ______
Final Gas Meter Reading 730.558 $ft^3$
Initial Gas Meter Reading 729.623 $ft^3$ 0.935
Condensate Increase in Impingers ______ ml
Moisture in Silica Gel ______ gm
Silica Gel Container No. ______ Filter No. ______

| Orsat: | | | | |
|---|---|---|---|---|
| $\%CO_2$ | | | | |
| $\%O_2$ | | | | |
| %CO | | | | |
| $\%N_2$ | | | | |

Test Conducted By: C. Sholtes

Stack Test Observers: ______

Leak Check Meter Box
Initial ______ cfm @ ______ In $H_2$
Final ______ cfm @ ______ In Hg

Pitot Tubes
Impact 3 In $H_2O$ for 15 sec. Stable, Leak
Static 3 In $H_2O$ for 15 sec. Stable, Leak

| Port and Traverse Point No. | Distance From Inside Stack Wall (in.) | Clock Time | Gas Meter Reading ($ft^3$) | Stack Velocity Head ("$H_2O$) | Meter Orifice Press. Diff. ("$H_2O$) | | Stack Gas Temp. (°F) | Meter Temp. (°F) | Sample Box Temp. (°F) | Last Impinger Temp. (°F) | Vacuum on Sample Train ("Hg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Calc. | Actual | | 108.4 | | | |
| | | 1710 | 729.623 | | | | | 110 | | | 4.0 |
| | | 1715 | 29.765 | | | | | 109 | | | 5.0 |
| | | 1720 | — | | | | | 108 | | | 4.8 |
| | | 1725 | 730.400 | | | | | 108 | | | 5.0 |
| | | 1730 | 730.558 | | | | | 107 | | | 5.0 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

## SAMPLE CHAIN OF CUSTODY

PLANT NAME: Amax Chemical Corp.

SOURCE NAME: Big Bend Dryer.

DATE: 2-17-84 TYPE OF SAMPLE: $SO_2$ on Oil

## SAMPLE RECOVERY

| CONTAINER NO. | DESCRIPTION |
|---|---|
| Run 1 | Method 6 on Oil |
| Run 2 | " " " |
| Run 3 | " " " |

Sample Recovered By: R. Sholtes

~~Particulate~~ $SO_2$ Analysis By: George Gable

# $SO_2$
# LAB DATA

Plant Name AMAX OIL Date Analyzed 2-17-84

Analyzed By Geo. Sibel

| Stack | Sample No. | V.T. | V.T.B. | N. | V.Soln. | V.A. |
|---|---|---|---|---|---|---|
| DRYER | Run 1 | 3.6 | 0.3 | .0113 | 100 | 20 |
| OIL | " | 3.6 | ↓ | ↓ | | |
| | Run 2 | 1.6 | ↓ | ↓ | | |
| | " | 1.6 | ↓ | ↓ | | |
| | Run 3 | 4.5 | ↓ | ↓ | | |
| | | 4.6 | ↓ | ↓ | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

V.T. = Volume of Barium perchlorate titrant used for sample (ml)
V.T.B. = Volume of Barium perchlorate titrant used for blank (ml)
N. = Normality of Barium perchlorate
V.Soln. = Total solution volume
V.A. = Volume of sample aliquot titrated (ml)

# SAMPLE CHAIN OF CUSTODY

PLANT NAME: Amax Chemical Corp.

SOURCE NAME: Big Bend Dryer.

DATE: 2-16-84 TYPE OF SAMPLE: $SO_2$ on Coal/Oil

## SAMPLE RECOVERY

| CONTAINER NO. | DESCRIPTION |
|---|---|
| Run 1 | Method 6 on coal/oil |
| Run 2 | " " " |
| Run 3 | " " " |

Sample Recovered By: R. Sholtes

~~Particulate~~ $SO_2$ Analysis By: George Gabel

## $SO_2$
## LAB DATA

Plant Name AMAX COAL/OIL Date Analyzed 2-17-84

Analyzed By Geo. Gobel

| Stack | Sample No. | V.T. | V.T.B. | N. | V.Soln. | V.A. |
|---|---|---|---|---|---|---|
| DRYER | Run 1 | 0.5 | 0.3 | .0113 | 100 | 20 |
| COAL/OIL | " | 0.5 | | | | |
| | Run 2 | 1.6 | | | | |
| | " | 1.5 | | | | |
| | Run 3 | 3.3 | | | | |
| | | 3.3 | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

V.T. = Volume of Barium perchlorate titrant used for sample (ml)
V.T.B. = Volume of Barium perchlorate titrant used for blank (ml)
N. = Normality of Barium perchlorate
V.Soln. = Total solution volume
V.A. = Volume of sample aliquot titrated (ml)

where:
$K_1$ = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE.—Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds $L_a$. If $L_p$ or $L_i$ exceeds $L_a$, Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace $V_m$ in Equation 5-1 with the expression;

$$V_m-(L_p-L_a)\theta]$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace $V_m$ in Equation 5-1 by the expression:

$$\left[V_m-(L_1-L_a)\theta_1-\sum_{i=2}^{n}(L_i-L_a)\theta_i-(L_p-L_a)\theta_p\right]$$

and substitute only for those leakage rates ($L_i$ or $L_p$) which exceed $L_a$.

6.4 Volume of water vapor.

$$V_{w(std)}=V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right)=K_2V_{lc}$$

Equation 5-2

where:
$K_2$ = 0.001333 m³/ml for metric units
= 0.04707 ft³/ml for English units.

6.5 Moisture Content.

$$B_{ws}=\frac{V_{w(std)}}{V_{m(std)}+V_{w(std)}}$$

Equation 5-3

NOTE.—In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of $B_{ws}$ shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ± 1° C (2° F).

6.6 Acetone Blank Concentration.

$$C_a=\frac{m_a}{V_a\rho_a}$$

Equation 5-4

6.7 Acetone Wash Blank.

$$W_a=C_aV_{aw}\rho_a$$

Equation 5-5

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 5-3). NOTE.—Refer to Section 4.1.5 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

6.9 Particulate Concentration.

$$c_s=(0.001\ g/mg)\ (m_n/V_{m(std)})$$

Equation 5-6

6.10 Conversion Factors:

| From | To | Multiply by |
|---|---|---|
| scf | m³ | 0.02832 |
| g/ft³ | gr/ft³ | 15.43 |
| g/ft³ | lb/ft³ | $2.205\times10^{-3}$ |
| g/ft³ | g/m³ | 35.31 |

6.11 Isokinetic Variation.

6.11.1 Calculation From Raw Data.

$$I=\frac{100\,T_s[K_3V_{lc}+(V_m/T_m)\,(P_{bar}+\Delta H/13.6)]}{60\,\theta v_s P_s A_n}$$

Equation 5-7

where:
$K_3$ = 0.003454 mm Hg-m³/ml-°K for metric units.
= 0.002669 in. Hg-ft³/ml-°R for English units.

6.11.2 Calculation From Intermediate Values.

$$I=\frac{T_sV_{m(std)}P_{std}\,100}{T_{std}v_s\theta A_nP_s\,60(1-B_{ws})}$$

$$=K_4\frac{T_sV_{m(std)}}{P_sV_sA_n\theta(1-B_{ws})}$$

Equation 5-8

where:
$K_4$ = 4.320 for metric units
= 0.09450 for English units.

6.12 Acceptable Results. If 90 percent $\leq I \leq$ 110 percent, the results are acceptable. If the results are low in comparison to the standard and $I$ is beyond the acceptable range, or, if $I$ is less than 90 percent, the Administrator may opt to accept the results. Use Citation 4 to make judgments. Otherwise, reject the results and repeat the test.

### 7. *Bibliography*

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9. Annual Book of ASTM Standards. Part 26. Gaseous Fuels; Coal and Coke; Atmospheric Analysis. American Society for Testing and Materials. Philadelphia, Pa. 1974. pp. 617-622.

## METHOD 6—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

### 1. *Principle and Applicability*

1.1 Principle. A gas sample is extracted from the sampling point in the stack. The sulfuric acid mist (including sulfur trioxide) and the sulfur dioxide are separated. The sulfur dioxide fraction is measured by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfur dioxide emissions from stationary sources. The minimum detectable limit of the method has been determined to be 3.4 milligrams (mg) of $SO_2$/m³ ($2.12\times10^{-7}$ lb/ft³). Although no upper limit has been established, tests have shown that concentrations as high as 80,000 mg/m³ of $SO_2$ can be collected efficiently in two midget impingers, each containing 15 milliliters of 3 percent hydrogen peroxide, at a rate of 1.0 lpm for 20 minutes. Based on theoretical calculations, the upper concentration limit in a 20-liter sample is about 93,300 mg/m³.

Possible interferents are free ammonia, water-soluble cations, and fluorides. The cations and fluorides are removed by glass wool filters and an isopropanol bubbler, and hence do not affect the $SO_2$ analysis. When samples are being taken from a gas stream with high concentrations of very fine metallic fumes (such as in inlets to control devices), a high-efficiency glass fiber filter must be used in place of the glass wool plug (i.e., the one in the probe) to remove the cation interferents.

Free ammonia interferes by reacting with $SO_2$ to form particulate sulfite and by reacting with the indicator. If free ammonia is present (this can be determined by knowledge of the process and noticing white particulate matter in the probe and isopropanol bubbler), alternative methods, subject to the approval of the Administrator, U.S. Environmental Protection Agency, are required.

### 2. *Apparatus*

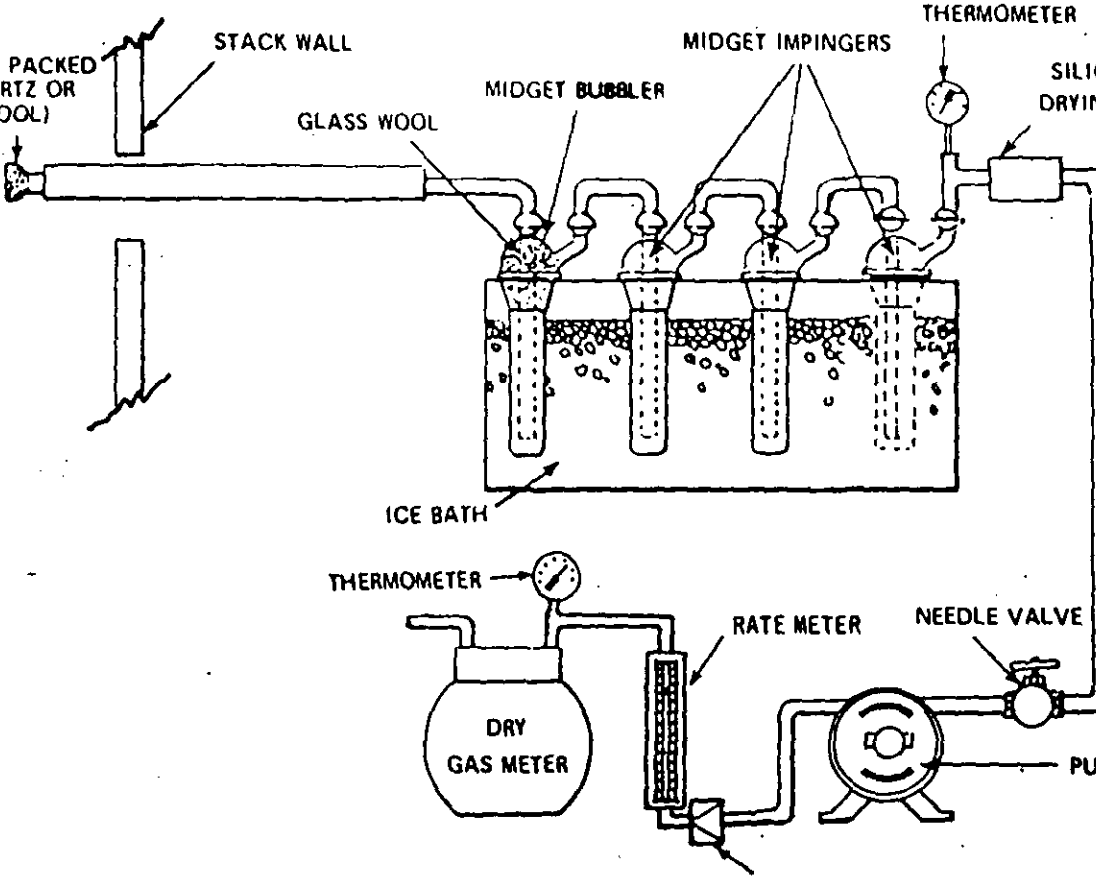

Figure 6-1. $SO_2$ sampling train.

2.1 Sampling. The sampling train is shown in Figure 6-1, and component parts are discussed below. The tester has the option of substituting sampling equipment described in Method 8 in place of the midget impinger equipment of Method 6. However, the Method 8 train must be modified to include a heated filter between the probe and isopropanol impinger, and the operation of the sampling train and sample analysis must be at the flow rates and solution volumes defined in Method 8.

The tester also has the option of determining $SO_2$ simultaneously with particulate matter and moisture determinations by (1) replacing the water in a Method 5 impinger system with 3 percent perioxide solution, or (2) by replacing the Method 5 water impinger system with a Method 8 isopropanol-filter-peroxide system. The analysis for $SO_2$ must be consistent with the procedure in Method 8.

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 plug of glass wool is a satisfactory filter.

2.1.2 Bubbler and Impingers. One midget bubbler, with medium-coarse glass frit and borosilicate or quartz glass wool packed in top (see Figure 6-1) to prevent sulfuric acid mist carryover, and three 30-ml midget impingers. The bubbler and midget impingers must be connected in series with leak-free glass connectors. Silicone grease may be used, if necessary, to prevent leakage.

At the option of the tester, a midget impinger may be used in place of the midget bubbler.

Other collection absorbers and flow rates may be used, but are subject to the approval of the Administrator. Also, collection efficiency 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 and analyzed separately. This extra absorber must not contain more than 1 percent of the total $SO_2$.

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 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. At least 760 mm Hg (30 in. Hg) gauge, 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, 5-ml, 20-ml (one per sample), and 25-ml sizes.

2.3.2 Volumetric Flasks. 100-ml size (one per sample) and 100-ml size.

2.3.3 Burettes. 5- and 50-ml sizes.

2.3.4 Erlenmeyer Flasks. 250 ml-size (one for each sample, blank, and standard).

2.3.5 Dropping Bottle. 125-ml size, to add indicator.

2.3.6 Graduated Cylinder. 100-ml size.

2.3.7 Spectrophotometer. To measure absorbance at 352 nanometers.

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 Isopropanol, 80 percent. Mix 80 ml of isopropanol with 20 ml of deionized, distilled water. Check each lot of isopropanol for peroxide impurities as follows: shake 10 ml of isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance at 352 nanometers on a spectrophotometer. If absorbance exceeds 0.1, reject alcohol for use.

Peroxides may be removed from isopropanol by redistilling or by passage through a column of activated alumina; however, reagent grade isopropanol with suitably low peroxide levels may be obtained from commercial sources. Rejection of contaminated lots may, therefore, be a more efficient procedure.

3.1.3 *Hydrogen Peroxide, 3 Percent. Dilute 30 percent* hydrogen peroxide 1:9 (v/v) with deionized, distilled water (30 ml is needed per sample). Prepare fresh daily.

3.1.4 Potassium Iodide Solution, 10 Percent. Dissolve *10.0 grams KI in deionized, distilled water and dilute to 100 ml. Prepare when needed.*

3.2 Sample Recovery.

3.2.1 Water. *Deionized*, distilled, as in 3.1.1.

3.2.2 *Isopropanol, 80 Percent.* Mix 80 ml of isopropanol with 20 ml of deionized, distilled water.

3.3 Analysis.

3.3.1 Water. *Deionized, distilled*, as in 3.1.1.

3.3.2 Isopropanol, 100 percent.

3.3.3 Thorin Indicator. 1-(o-arsonophenylazo)-2-naphthol-3,6-disulfonic acid, disodium salt, or equivalent. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate Solution, 0.0100 N. Dissolve 1.95 g of barium perchlorate trihydrate $[Ba(ClO_4)_2 \cdot 3H_2O]$ in 200 ml distilled water and dilute to 1 liter with isopropanol. Alternatively, 1.22 g of $[BaCl_2 \cdot 2H_2O]$ may be used instead of the perchlorate. Standardize as in Section 5.5.

3.3.5 Sulfuric Acid Standard, 0.0100 N. Purchase or standardize to ±0.0002 N against 0.0100 N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

## 4. *Procedure.*

4.1 Sampling.

4.1.1 Preparation of collection train. Measure 15 ml of 80 percent isopropanol into the midget bubbler and 15 ml of 3 percent hydrogen peroxide into each of the first two midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 6-1. Adjust 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:

With the probe disconnected, place a vacuum gauge at the inlet to the bubbler 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 to prevent back flow of the impinger fluid.

Other leak-check procedures may be used, subject to the approval of the Administrator, U.S. Environmental Protection Agency. The procedure used in Method 5 is not suitable for diaphragm pumps.

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, void the test run. Drain the ice bath, and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes at the sampling rate.

Clean ambient air can be provided by passing air through a charcoal filter or through an extra midget impinger with 15 ml of 3 percent $H_2O_2$. The tester may opt to simply use ambient air, without purification.

4.2 Sample Recovery. Disconnect the impingers after purging. Discard the contents of the midget bubbler. Pour the contents of the midget impingers into a leak-free polyethylene bottle for shipment. Rinse the three midget impingers and the connecting tubes 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 level of liquid in container, and confirm whether any sample was lost during shipment; note this on 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.

Transfer the contents of the storage container to a 100-ml volumetric flask and dilute to exactly 100 ml with deionized, distilled water. Pipette a 20-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 80 ml of 100 percent isopropanol and two to four drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat and average the titration volumes. Run a blank with each series of samples. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is larger.

(NOTE.—Protect the 0.0100 N barium perchlorate solution from evaporation at all times.)

## 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 or 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 Barium Perchlorate Solution. Standardize the barium perchlorate solution against 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol has been added.

## 6. *Calculations*

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.

$C_{SO_2}$ = Concentration of sulfur dioxide, dry basis corrected to standard conditions, mg/dscm (lb/dscf).

$N$ = Normality of barium perchlorate titrant, milliequivalents/ml.

$P_{bar}$ = 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 titrated, 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 sulfur dioxide sample is contained, 100 ml.

$V_t$ = Volume of barium perchlorate titrant used for the sample, ml (average of replicate titrations).

$V_{tb}$ = Volume of barium perchlorate titrant used for the blank, ml.

$Y$ = Dry gas meter calibration factor.

32.03 = Equivalent weight of sulfur dioxide.

6.2 Dry sample gas volume, corrected to standard conditions.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}}{P_{std}}\right) = K_1 Y \frac{V_m P_{bar}}{T_m}$$

Equation 6-1

where:

$K_1$ = 0.3858 °K/mm Hg for metric units.
= 17.64 °R/in. Hg for English units.

6.3 Sulfur dioxide concentration.

$$C_{SO_2} = K_2 \frac{(V_t - V_{tb})\, N \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 6-2

where:

$K_2$ = 32.03 mg/meq. for metric units.
= 7.061×10⁻⁵ lb/meq. for English units.

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# METHOD 7—DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES

## 1. *Principle and Applicability*

1.1 Principle. A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except nitrous oxide, are measured colorimetrically using the phenoldisulfonic acid (PDS) procedure.

1.2 Applicability. This method is applicable to the measurement of nitrogen oxides emitted from stationary sources. The range of the method has been determined to be 2 to 400 milligrams $NO_x$ (as $NO_2$) per dry standard cubic meter, without having to dilute the sample.

## 2. *Apparatus*

2.1 Sampling (see Figure 7-1). Other grab sampling systems or equipment, capable of measuring sample volume to within ±2.0 percent and collecting a sufficient sample volume to allow analytical reproducibility to within ±5 percent, will be considered acceptable alternatives, subject to approval of the Administrator, U.S. Environmental Protection Agency. The following equipment is used in sampling:

2.1.1 Probe. Borosilicate glass tubing, sufficiently heated to prevent water condensation and equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Stainless steel or Teflon[1] tubing may also be used for the probe. Heating is not necessary if the probe remains dry during the purging period.

---

[1] Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

# APPENDIX A3

## Field Data Sheets and Computations
## Nitrogen Oxide Sampling/Method 7

# $NO_x$ Mass Emissions

Coal/Oil Sample time 1315 thru 1600 on 2/16/84

Average Concen = $8.968 \times 10^{-6}$ lb/scf.

Particulate Runs 1, 2 & 3 span this time period.

Avg Flow = 52220 SCFMD.

$NO_x$ Mass Emission = $8.968 \times 10^{-6} \times 52{,}220 \times 60$

= 28.1 lb/hr.

Oil Sample time 0830 thru 1115 on 2/17/84

Average Concen = $6.080 \times 10^{-6}$ lb/scf.

Particulate Runs 2 & 3 span this time period

Average Flow = 53398 SCFMD

$NO_x$ Mass Emission = $6.080 \times 10^{-6} \times 53398 \times 60$

= 19.5 lb/hr.

P.O. Box 52718 Jacksonville, Florida 32201

PLANTS: 925 N. Lane Avenue Jacksonville, Florida 32201 904-786-0750
Stephens Drive Nicholasville, Kentucky 40356 606-885-6011

Coal/Oil

$8.968 \times 10^{-6}$ lb/scf 75.4 ppm

= 28.1 Lb/h

Oil

$6.080 \times 10^{-6}$ lb/scf. 51.1

= 19.5 Lb/hr.

as $NO_2$

Lb/SCF × $\frac{SCF}{h}$

James G. Nolan
(502) 451-6737

P. O. Box 20283
Louisville, Ky. 40220

# TABLE

# $NO_x$

# EMISSION DATA

PLANT AMAX Fluid Bed Dryer

STACK Coal/Oil

Bar 30.12

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Date | 2-16-84 | 2-16 | 2-16 | 2-16 |
| Time | 1315 | 1330 | 1345 | 1400 |
| Flask No. | 28 | 38 | 39 | 44 |
| $V_f$ = Flask + Valve Volume, ml | 2090 | 2026 | 2039 | 2017 |
| $V_a$ = Absorbing Soln. Volume, vl | 25 | 25 | 25 | 25 |
| $T_i$ = Initial Flask Temp., °F | 78 | 77 | 79 | 79 |
| $T_f$ = Final Flask Temp., °F | 63 | 63 | 63 | 63 |
| $P_i$ = Initial Flask Vacuum, "Hg | 28.3" | 28.3 | 28.2 | 28.0 |
| $P_f$ = Final Flask Vacuum, "Hg | -.2 | 0 | 0 | 0 |
| $V_{stpd}$ = Gas Sample Volume, ml* | 1939.5 | 1892.7 | 1898.8 | 1865.0 |
| m = Mass of NO2 in Gas Sample, µg | 285.0 | 285.0 | 349.1 | 270.8 |
| $NO_2$ Concentration, lbs/scf | 9.174 E-6 | 9.401 E-6 | 11.478 E-6 | 9.065 E-6 |
| $NO_2$ Concentration, ppm | 77.12 | 79.02 | 96.48 | 76.20 |

*Dry, 70°F, 29.92"Hg

$V_{stpd} = 17.64 \times (V_f - V_a) \times [\frac{Pbf - Pf}{Tf} - \frac{Pbi-Pi}{Ti}]$, when $P_{bf}$ & $P_{bi}$ = the final and initial barometric pressures.

$NO_2 \text{ (lbs/scf)} = 6.243 \times (\frac{m}{V_{stpd}}) \times 10^{-5}$

$NO_2 \text{ (ppm)} = 8.406 \times 10^6 \times \frac{lbs}{ft^3} \; NO_2$

TABLE

$NO_x$

EMISSION DATA

PLANT AMAX

STACK

~~Barometer 30.18~~ 30.12

| | | | | |
|---|---|---|---|---|
| Run No. | 9 | 10 | 11 | 12 |
| Date | 2/16/84 | 2/16/84 | 2/16/84 | 2/[illegible]/84 |
| Time | 1515 | 1530 | 1545 | 1600 |
| Flask No. | 32 | 31 | 40 | 36 |
| $V_f$ = Flask + Valve Volume, ml | 2079 | 2080 | 2017 | 2117 |
| $V_a$ = Absorbing Soln. Volume, vl | 25 | 25 | 25 | 25 |
| Ti = Initial Flask Temp., °F | 80 | 84 | 89 | 83 |
| Tf = Final Flask Temp., °F | 62 | 62 | 62 | 62 |
| $P_i$ = Initial Flask Vacuum, "Hg | 28.2 | 27.0 | 28.1 | 27.7 |
| $P_f$ = Final Flask Vacuum, "Hg | -.1 | -.4 | -.7 | -.2 |
| $V_{stpd}$ = Gas Sample Volume, ml* | 1933.8 | 1834.8 | 1830.6 | 1929.2 |
| m = Mass of $NO_2$ in Gas Sample, μg | 256.5 | 277.9 | 257.9 | 327.8 |
| $NO_2$ Concentration, lbs/scf | 8.281 E-6 | 9.456 E-6 | 8.795 E-6 | 10.607 E-6 |
| $NO_2$ Concentration, ppm | 69.61 | 79.48 | 73.93 | 89.17 |

FINAL-PB-29.80

*Dry, 70°F, 29.92"Hg

$V_{stpd} = 17.64 \times (V_f - V_a) \times \left[\frac{Pbf - Pf}{Tf} - \frac{Pbi - Pi}{Ti}\right]$, when $P_{bf}$ & $P_{bi}$ = the final and initial barometric pressures.

$NO_2$ (lbs/scf) $= 6.243 \times \left(\frac{m}{V_{stpd}}\right) \times 10^{-5}$

$NO_2$ (ppm) $= 8.406 \times 10^6 \times \frac{lbs}{ft^3}$ $NO_2$

# TABLE

# $NO_x$

# EMISSION DATA

Baromet 2/16/84
30.12

PLANT AMAX

STACK Scrubber Oil

2/17/84 Bar = 30.10

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Date | 2/17/84 | 2/17 | 2/17 | 2/17 |
| Time > | 0830 | 0845 | 0900 | 0915 |
| Flask No. > | 10 | 5 | 21 | 24 |
| $V_f$ = Flask + Valve Volume, ml | 2047 | 2024 | 2078 | 2083 |
| $V_a$ = Absorbing Soln. Volume, vl | 25 | 25 | 25 | 25 |
| $T_i$ = Initial Flask Temp., °F > | 65 | 61 | 60 | 60 |
| $T_f$ = Final Flask Temp., °F | 63 | 63 | 63 | 63 |
| $P_i$ = Initial Flask Vacuum, "Hg > | 28.5 | 27.8 | 28.0 | 28.5 |
| $P_f$ = Final Flask Vacuum, "Hg | -.1 | 0 | -.2 | 0 |
| $V_{stpd}$ = Gas Sample Volume, ml* | 1917.9 | 1854.6 | 1904.5 | 1957.9 |
| m = Mass of $NO_2$ in Gas Sample, µg | 185.3 | 175.3 | 153.9 | 213.8 |
| $NO_2$ Concentration, lbs/scf | 6.032 E-6 | 5.901 E-6 | 5.045 E-6 | 6.817 E-6 |
| $NO_2$ Concentration, ppm | 50.70 | 49.60 | 42.41 | 57.31 |

*Dry, 70°F, 29.92"Hg

$V_{stpd} = 17.64 \times (V_f - V_a) \times \left[\frac{P_{bf} - P_f}{T_f} - \frac{P_{bi} - P_i}{T_i}\right]$, when $P_{bf}$ & $P_{bi}$ = the final and initial barometric pressures.

$NO_2 \text{ (lbs/scf)} = 6.243 \times \left(\frac{m}{V_{stpd}}\right) \times 10^{-5}$

$NO_2 \text{ (ppm)} = 8.406 \times 10^6 \times \frac{\text{lbs}}{\text{ft}^3} \; NO_2$

TABLE

$NO_x$

EMISSION DATA

PLANT AMAX

STACK Scrubber Oil

Bar 30.10

| Run No. | 5 | 6 | 7 | 8 |
|---|---|---|---|---|
| Date | 2/17/80 | 2/17 | 2/17 | 2/17 |
| Time | 0930 | 0945 | 1000 | 1015 |
| Flask No. | 43 | 42 | 25 | 27 |
| $V_f$ = Flask + Valve Volume, ml | 2051 | 2026 | 2076 | 2107 |
| $V_a$ = Absorbing Soln. Volume, vl | 25 | 25 | 25 | 25 |
| $T_i$ = Initial Flask Temp., °F > | 67 | 69 | 73 | 74 |
| $T_f$ = Final Flask Temp., °F | 63 | 64 | 64 | 64 |
| $P_i$ = Initial Flask Vacuum, "Hg > | 28.3 | 28.4 | 28.3 | 28.3 |
| $P_f$ = Final Flask Vacuum, "Hg | -.5 | -1.1 | -1.1 | -.4 |
| $V_{stpd}$ = Gas Sample Volume, ml* | 1881.2 | 1820.9 | 1860.5 | 1937.9 |
| m = Mass of NO2 in Gas Sample, μg | 188.1 | 186.7 | 216.6 | 183.8 |
| $NO_2$ Concentration, lbs/scf | 6.242 E-6 | 6.401 E-6 | 7.268 E-6 | 5.921 E-6 |
| $NO_2$ Concentration, ppm | 52.47 | 53.81 | 61.10 | 49.77 |

*Dry, 70°F, 29.92"Hg

$V_{stpd} = 17.64 \times (V_f - V_a) \times \left[\frac{Pbf - Pf}{Tf} - \frac{Pbi - Pi}{Ti}\right]$, when $P_{bf}$ & $P_{bi}$ = the final and initial barometric pressures.

$NO_2 \text{ (lbs/scf)} = 6.243 \times \left(\frac{m}{V_{stpd}}\right) \times 10^{-5}$

$NO_2 \text{ (ppm)} = 8.406 \times 10^6 \times \frac{\text{lbs}}{\text{ft}^3} \; NO_2$

TABLE

$NO_x$

EMISSION DATA

PLANT AMAX

STACK Scrubber Oil

Bar 30.10

| | | | | |
|---|---|---|---|---|
| Run No. | 9 | 10 | 11 | 12 |
| Date | 2/17/84 | 2/17 | 2/[illegible] | 2/[illegible] |
| Time | 1030 | 1045 | 1100 | 1115 |
| Flask No. | 3 | 13 | 4 | 15 |
| $V_f$ = Flask + Valve Volume, ml | 2013 | 2076 | 2051 | 2075 |
| $V_a$ = Absorbing Soln. Volume, vl | 25 | 25 | 25 | 25 |
| $T_i$ = Initial Flask Temp., °F | 69 | 76 | 76 | 76 |
| $T_f$ = Final Flask Temp., °F | 64 | 64 | 63 | 62 |
| $P_i$ = Initial Flask Vacuum, "Hg | 28.2 | 28.4 | 28.2 | 28.2 |
| $P_f$ = Final Flask Vacuum, "Hg | -.4 | -.7 | -.6 | -.5 |
| $V_{stpd}$ = Gas Sample Volume, ml* | 1842.7 | 1895.5 | 1869.7 | 1902.7 |
| m = Mass of $NO_2$ in Gas Sample, µg | 142.5 | 185.3 | 175.3 | 199.5 |
| $NO_2$ Concentration, lbs/scf | 4.828 E-6 | 6.103 E-6 | 5.853 E-6 | 6.546 E-6 |
| $NO_2$ Concentration, ppm | 40.58 | 51.30 | 49.20 | 55.03 |

*Dry, 70°F, 29.92"Hg

$V_{stpd} = 17.64 \times (V_f - V_a) \times \left[\frac{Pbf - Pf}{Tf} - \frac{Pbi-Pi}{Ti}\right]$, when $P_{bf}$ & $P_{bi}$ = the final and initial barometric pressures.

$NO_2$ (lbs/scf) $= 6.243 \times \left(\frac{m}{V_{stpd}}\right) \times 10^{-5}$

$NO_2$ (ppm) $= 8.406 \times 10^6 \times \frac{lbs}{ft^3}$ $NO_2$

## $NO_X$ LABORATORY DATA

LAB. NO. 5

DATE 2-22-84

SAMPLE SOURCE

| SAMPLE NUMBER | ABSORBANCE 410 mu | VOLUME ml | ALIQUOT - DILUTION ml ml | DILUTION FACTOR | TOTAL ug |
|---|---|---|---|---|---|
| 3 | 0.100 | 100 | 50 - - | 2 | 142.5 |
| 4 | 0.123 | | | | 175.3 |
| 5 | 0.123 | | | | 175.3 |
| 10 | 0.130 | | | | 185.3 |
| 15 | 0.140 | | | | 199.5 |
| 21 | 0.108 | | | | 153.9 |
| 24 | 0.150 | | | | 213.8 |
| 25 | 0.152 | | | | 216.6 |
| 27 | 0.129 | | | | 183.8 |
| 28 | 0.200 | | | | 285.0 |
| 30 | 0.172 | | | | 245.1 |
| 32 | 0.180 | | | | 256.5 |
| 31 | 0.195 | | | | 277.9 |
| 33 | 0.155 | | | | 220.9 |
| 36 | 0.230 | | | | 327.8 |
| 38 | 0.200 | | | | 285.0 |
| 39 | 0.245 | | | | 349.1 |
| 40 | 0.181 | | | | 257.9 |
| 41 | 0.170 | | | | 242.3 |
| STANDARDS | | | | | |
| 1 | .135 | | | | 100 |
| 2 | .275 | | | | 200 |
| 3 | .420 | | | | 300 |
| 4 | .565 | | | | 400 |

$$K_C = \frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2}(100)$$

$K_C$ = 712.5

ANALYST M. Eisman

## NO$_X$ LABORATORY DATA

LAB. NO.

DATE 2-22-84

SAMPLE SOURCE

| SAMPLE NUMBER | ABSORBANCE 410 mu | VOLUME ml | ALIQUOT ml | DILUTION ml | DILUTION FACTOR | TOTAL ug |
|---|---|---|---|---|---|---|
| 35 | 0.165 | 100 | 50 | - - | 2 | 235.1 |
| 42 | 0.131 | | | | | 186.7 |
| 43 | 0.132 | | | | | 188.1 |
| 44 | 0.190 | | | | | 270.8 |
| 13 | 0.130 | | | | | 185.3 |
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| STANDARDS | | | | | | |

| | | |
|---|---|---|
| 1 | .135 | 100 |
| 2 | .275 | 200 |
| 3 | .420 | 300 |
| 4 | .565 | 400 |

$$K_C = \frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2}(100)$$

$K_C$ = 712.5

ANALYST M. Eisman

# $NO_x$ FLASK CALIBRATION

| FLASK NO. | VOLUME (ml) | FLASK NO. | VOLUME (ml) |
|---|---|---|---|
| 1 | 2016 | 29 | 2070 |
| 2 | 2063 | 30 | 2055 |
| 3 | 2013 | 31 | 2080 |
| 4 | 2051 | 32 | 2079 |
| 5 | 2024 | 33 | 2075 |
| 6 | 2045 | 34 | 2104 |
| 7 | 2064 | 35 | 2067 |
| 8 | 2069 | 36 | 2117 |
| 9 | 2065 | 37 | 2058 |
| 10 | 2047 | 38 | 2026 |
| 11 | 2071 | 39 | 2039 |
| 12 | 2055 | 40 | 2017 |
| 13 | 2076 | 41 | 2050 |
| 14 | 2043 | 42 | 2026 |
| 15 | 2075 | 43 | 2051 |
| 16 | 2010 | 44 | 2017 |
| 17 | 2099 | 45 | 2047 |
| 18 | 2086 | 46 | 2063 |
| 19 | 2096 | | |
| 20 | 2086 | | |
| 21 | 2078 | | |
| 22 | 2011 | | |
| 23 | 2061 | | |
| 24 | 2083 | | |
| 25 | 2076 | | |
| 26 | 2085 | | |
| 27 | 2107 | | |
| 28 | 2090 | | |

CALIBRATED BY: Scott McKee
9/23/83

# SAMPLE CHAIN OF CUSTODY

PLANT NAME: Amax Chemical Corp.

SOURCE NAME: Big Bend Dryer.

DATE: 2-16/17/84 TYPE OF SAMPLE: $NO_x$

## SAMPLE RECOVERY

| CONTAINER NO. | DESCRIPTION | | |
|---|---|---|---|
| 28 | $NO_x$ Flask | Coal/Oil | 1315 |
| 38 | " | " | 1330 |
| 39 | " | " | 1345 |
| 44 | " | " | 1400 |
| 33 | " | " | 1415 |
| 35 | " | " | 1430 |
| 41 | " | " | 1445 |
| 30 | " | " | 1500 |
| 32 | " | " | 1515 |
| 31 | " | " | 1530 |
| 40 | " | " | 1545 |
| 36 | " | " | 1600 |

Sample Recovered By: M. Eisman

~~Particulate~~ $NO_x$ Analysis By: M. Eisman

Sample Collection By R. Sholtes

# SAMPLE CHAIN OF CUSTODY

PLANT NAME: Amax Chemical Corp.

SOURCE NAME: Big Bend Dryer

DATE: 2-17-84 TYPE OF SAMPLE: NOx

## SAMPLE RECOVERY

| CONTAINER NO. | DESCRIPTION | | |
|---|---|---|---|
| 10 | NOx Flask | Oil Firing | 0830 |
| 5 | " | " | 0845 |
| 21 | " | " | 0900 |
| 24 | " | " | 0915 |
| 43 | " | " | 0930 |
| 42 | " | " | 0945 |
| 25 | " | " | 1000 |
| 27 | " | " | 1015 |
| 3 | " | " | 1030 |
| 13 | " | " | 1045 |
| 4 | " | " | 1100 |
| 15 | " | " | 1115 |

Sample Recovered By: M. Eisman

NOx ~~Particulate~~ Analysis By: M. Eisman

Sample Collection By R. Sholtes

## *4. Procedure*

4.1 Sampling.

4.1.1 Preparation of Collection Train. Preparation of the sample train is the same as described in Method 6A, Section 4.1.4, with the addition of the following:

The sampling train is assembled as shown in Figure 6A–1, except the isopropanol bubbler is not included. The probe must be heated to a temperature sufficient to prevent water condensation and must include a filter (either in-stack, out-of-stack, or both) to prevent particulate entrainment in the peroxide impingers. The electric supply for the probe heat should be continuous and separate from the timed operation of the sample pump.

Adjust the timer-switch to operate in the "on" position from 2 to 4 minutes on a 2-hour repeating cycle or other cycle specified in the applicable regulation. Other timer sequences may be used with the restriction that the total sample volume collected is between 25 and 60 liters for the amounts of sampling reagents prescribed in this method.

Add cold water to the tank until the impingers and bubblers are covered at least two-thirds of their length. The impingers and bubbler tank must be covered and protected from intense heat and direct sunlight. If freezing conditions exist, the impinger solution and the water bath must be protected.

Note.—Sampling may be conducted continuously if a low flow-rate sample pump (20 to 40 ml/min for the reagent volumes described in this method) is used. Then the timer-switch is not necessary. In addition, if the sample pump is designed for constant rate sampling, the rate meter may be deleted. The total gas volume collected should be between 25 and 60 liters for the amounts of sampling reagents prescribed in this method.

4.1.2 Leak-Check Procedure. The leak-check procedure is the same as described in Method 6, Section 4.1.2.

4.1.3 Sample Collection. Record the initial dry gas meter reading. To begin sampling, position the tip of the probe at the sampling point, connect the probe to the first impinger (or filter), and start the timer and the sample pump. Adjust the sample flow to a constant rate of approximately 1.0 liter/min as indicated by the rotameter. Assure that the timer is operating as intended, i.e., in the "on" position for the desired period and the cycle repeats as required.

During the 24-hour sampling period, record the dry gas meter temperature one time between 9:00 a.m. and 11:00 a.m., and the barometric pressure.

At the conclusion of the run, turn off the timer and the sample pump, remove the probe from the stack, and record the final gas meter volume reading. Conduct a leak check as described in Section 4.1.2. If a leak is found, void the test run or use procedures acceptable to the Administrator to adjust the sample volume for leakage. Repeat the steps in this section (4.1.3) for successive runs.

4.2 Sample Recovery. The procedures for sample recovery (moisture measurement, peroxide solution, and ascarite bubbler) are the same as in Method 6A, Section 4.2.

4.3 Sample Analysis. Analysis of the peroxide impinger solutions is the same as in Method 6, Section 4.3.

## *5. Calibration*

5.1 Metering System.

5.1.1 Initial Calibration. The initial calibration for the volume metering system is the same as for Method 6, Section 5.1.1.

5.1.2 Periodic Calibration Check. After 30 days of operation of the test train, conduct a calibration check as in Section 5.1.1 above, except for the following variations: (1) The leak check is not to be conducted, (2) three or more revolutions of the dry gas meter must be used, and (3) 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 and use of the train can continue. If the calibration factor deviates by more than 5 percent, recalibrate the metering system as in Section 5.1.1; and for the calculations for the preceding 30 days of data, use the calibration factor (initial or recalibration) that yields the lower gas volume for each test run. Use the latest calibration factor for succeeding tests.

5.2 Thermometers. Calibrate against mercury-in-glass thermometers initially and at 30-day intervals.

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 initially and at 30-day intervals.

5.5 Barium Perchlorate Solution. Standarize the barium perchlorate solution against 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol has been added.

## *6. Calculations*

The nomenclature and calculation procedures are the same as in Method 6A with the following exceptions:

$P_{bar}$ = Initial barometric pressure for the test period, mm Hg.

$T_m$ = Absolute meter temperature for the test period, °K.

## *7. Emission Rate Procedure*

The emission rate procedure is the same as described in Method 6A, section 7, except that the timer is needed and is operated as described in this method.

## *8. Bibliography*

The bibliography is the same as described in Method 6A, Section 8.

# METHOD 7—DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES

## *1. Principle and Applicability*

1.1 Principle. A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except nitrous oxide, are measured colorimetrically using the phenoldisulfonic acid (PDS) procedure.

1.2 Applicability. This method is applicable to the measurement of nitrogen oxides emitted from stationary sources. The range of the method has been determined to be 2 to 400 milligrams $NO_x$ (as $NO_2$) per dry standard cubic meter, without having to dilute the sample.

## *2. Apparatus*

2.1 Sampling (see Figure 7-1). Other grab sampling systems or equipment, capable of measuring sample volume to within ±2.0 percent and collecting a sufficient sample volume to allow analytical reproducibility to within ±5 percent, will be considered acceptable alternatives, subject to approval of the Administrator, U.S. Environmental Protection Agency. The following equipment is used in sampling:

2.1.1 Probe. Borosilicate glass tubing, sufficiently heated to prevent water condensation and equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Stainless steel or Teflon[1] tubing may also be used for the probe. Heating is not necessary if the probe remains dry during the purging period.

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[1] Mention of trade names or specific products does not constitue endorsement by the Environmental Protection Agency.

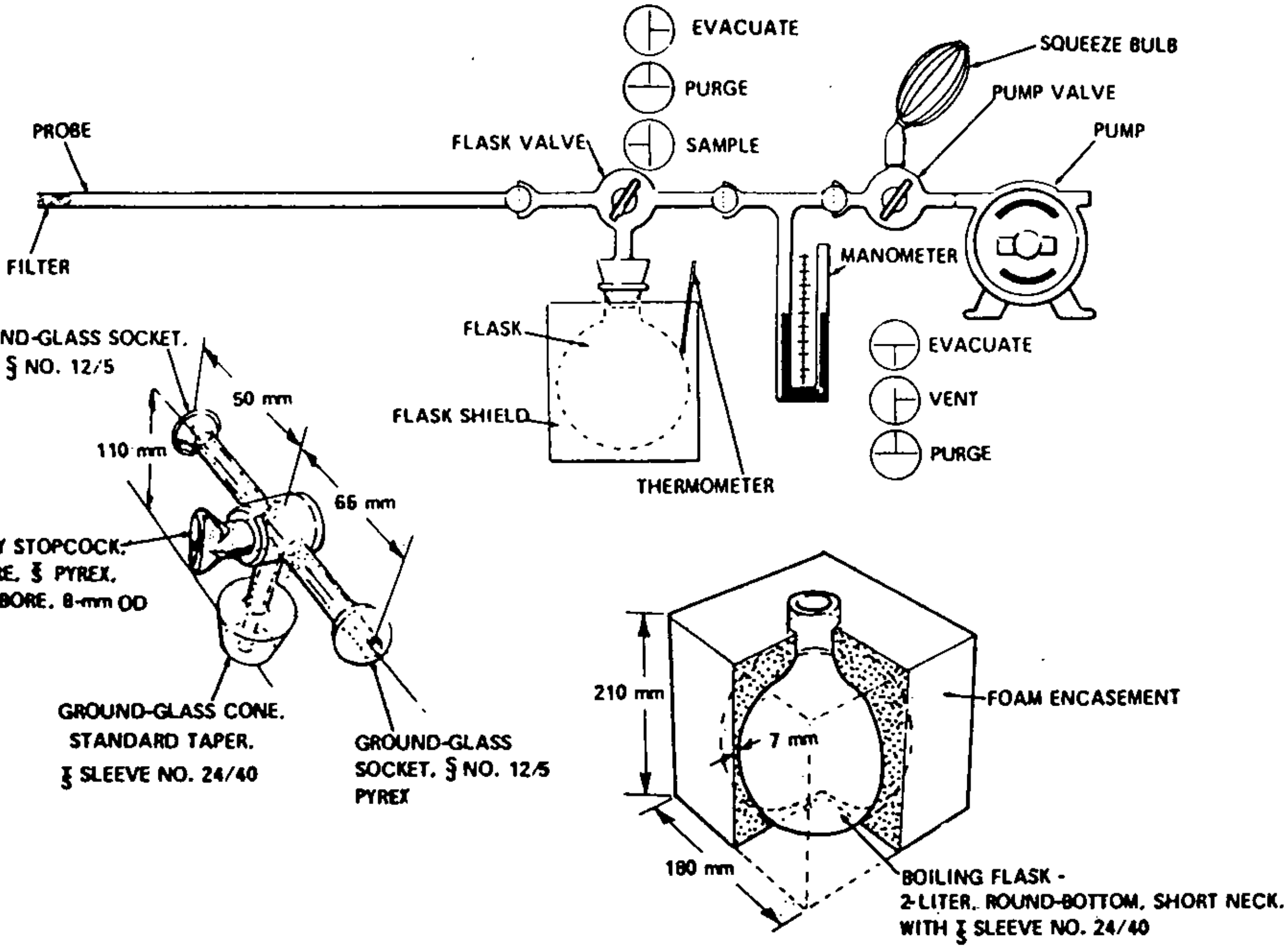


Figure 7-1. Sampling train, flask valve, and flask.

2.1.2 Collection Flask. Two-liter borosilicate, round bottom flask, with short neck and 24/40 standard taper opening, protected against implosion or breakage.

2.1.3 Flask Valve. T-bore stopcock connected to a 24/40 standard taper joint.

2.1.4 Temperature Gauge. Dial-type thermometer, or other temperature gauge, capable of measuring 1° C (2° F) intervals from −5 to 50° C (25 to 125° F).

2.1.5 Vacuum Line. Tubing capable of withstanding a vacuum of 75 mm Hg (3 in. Hg) absolute pressure, with "T" connection and T-bore stopcock.

2.1.6 Vacuum Gauge. U-tube manometer, 1 meter (36 in.), with 1-mm (0.1-in.) divisions, or other gauge capable of measuring pressure to within ±2.5 mm Hg (0.10 in. Hg).

2.1.7 Pump. Capable of evacuating the collection flask to a pressure equal to or less than 75 mm Hg (3 in. Hg) absolute.

2.1.8 Squeeze Bulb. One-way.

2.1.9 Volumetric Pipette. 25 ml.

2.1.10 Stopcock and Ground Joint Grease. A high-vacuum, high-temperature chlorofluorocarbon grease is required. Halocarbon 25-5S has been found to be effective.

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.

2.2 Sample Recovery. The following equipment is required for sample recovery:

2.2.1 Graduated Cylinder. 50 ml with 1-ml divisions.

2.2.2 Storage Containers. Leak-free polyethylene bottles.

2.2.3 Wash Bottle. Polyethylene or glass.

2.2.4 Glass Stirring Rod.

2.2.5 Test Paper for Indicating pH. To cover the pH range of 7 to 14.

2.3 Analysis. For the analysis, the following equipment is needed:

2.3.1 Volumetric Pipettes. Two 1 ml, two 2 ml, one 3 ml, one 4 ml, two 10 ml, and one 25 ml for each sample and standard.

2.3.2 Porcelain Evaporating Dishes. 175- to 250-ml capacity with lip for pouring, one for each sample and each standard. The Coors No. 45006 (shallow-form, 195 ml) has been found to be satisfactory. Alternatively, polymethyl pentene beakers (Nalge No. 1203, 150 ml), or glass beakers (150 ml) may be used. When glass beakers are used, etching of the beakers may cause solid matter to be present in the analytical step; the solids should be removed by filtration (see Section 4.3).

2.3.3 Steam Bath. Low-temperature ovens or thermostatically controlled hot plates kept below 70° C (160° F) are acceptable alternatives.

2.3.4 Dropping Pipette or Dropper. Three required.

2.3.5 Polyethylene Policeman. One for each sample and each standard.

2.3.6 Graduated Cylinder. 100 ml with 1-ml divisions.

2.3.7 Volumetric Flasks. 50 ml (one for each sample and each standard), 100 ml (one for each sample and each standard, and one for the working standard KNO$_3$ solution), and 1000 ml (one).

2.3.8 Spectrophotometer. To measure absorbance at 410 nm.

2.3.9 Graduated Pipette. 10 ml with 0.1-ml divisions.

2.3.10 Test Paper for Indicating pH. To cover the pH range of 7 to 14.

2.3.11 Analytical Balance. To measure to within 0.1 mg.

3. *Reagents*

Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

3.1 Sampling. To prepare the absorbing solution, cautiously add 2.8 ml concentrated H$_2$SO$_4$ to 1 liter of deionized, distilled water. Mix well and add 6 ml of 3 percent hydrogen peroxide, freshly prepared from 30 percent hydrogen peroxide solution. The absorbing solution should be used within 1 week of its preparation. Do not expose to extreme heat or direct sunlight.

3.2 Sample Recovery. Two reagents are required for sample recovery:

3.2.1 Sodium Hydroxide (1*N*). Dissolve 40 g NaOH in deionized, distilled water and dilute to 1 liter.

3.2.2 Water. Deionized, distilled to conform to ASTM specification D1193–77 Type 3 (incorporated by reference—see § 60.17). 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.

[3.2.2 amended by 48 FR 3735, January 27, 1983]

3.3 Analysis. For the analysis, the following reagents are required:

3.3.1 Fuming Sulfuric Acid. 15 to 18 percent by weight free sulfur trioxide. HANDLE WITH CAUTION.

3.3.2 Phenol. White solid.

3.3.3 Sulfuric Acid. Concentrated, 95 percent minimum assay. HANDLE WITH CAUTION.

3.3.4 Potassium Nitrate. Dried at 105 to 110° C (220 to 230° F) for a minimum of 2 hours just prior to preparation of standard solution.

3.3.5 Standard KNO$_3$ Solution. Dissolve exactly 2.198 g of dried potassium nitrate (KNO$_3$) in deionized, distilled water and dilute to 1 liter with deionized, distilled water in a 1,000-ml volumetric flask.

3.3.6 Working Standard KNO$_3$ Solution. Dilute 10 ml of the standard solution to 100 ml with deionized distilled water. One milliliter of the working standard solution is equivalent to 100 μg nitrogen dioxide (NO$_2$).

3.3.7 Water. Deionized, distilled as in Section 3.2.2.

3.3.8 Phenoldisulfonic Acid Solution. Dissolve 25 g of pure white phenol in 150 ml concentrated sulfuric acid on a steam bath. Cool, add 75 ml fuming sulfuric acid, and heat at 100° C (212° F) for 2 hours. Store in a dark, stoppered bottle.

4. *Procedures*

4.1 Sampling.

4.1.1 Pipette 25 ml of absorbing solution into a sample flask, retaining a sufficient quantity for use in preparing the calibration standards. Insert the flask valve stopper into the flask with the valve in the "purge" position. Assemble the sampling train as shown in Figure 7-1 and place the probe at the sampling point. Make sure that all fittings are tight and leak-free, and that all ground glass joints have been properly greased with a high-vacuum, high-temperature chlorofluorocarbon-based stopcock grease. Turn the flask valve and the pump valve to their "evacuate" positions. Evacuate the flask to 75 mm Hg (3 in. Hg) absolute pressure, or less. Evacuation to a pressure approaching the vapor pressure of water at the existing temperature is desirable. Turn the pump valve to its "vent" position and turn the off the pump. Check for leakage by observing the manometer for any pressure fluctuation. (Any variation greater than 10 mm Hg (0.4 in. Hg) over a period of 1 minute is not acceptable, and the flask is not to be used until the leakage problem is corrected. Pressure in the flask is not to exceed 75 mm Hg (3 in. Hg) absolute at the time sampling is commenced.) Record the volume of the flask and valve ($V_f$), the flask temperature ($T_i$), and the barometric pressure. Turn the flask valve counterclockwise to its "purge" position and do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and the flask valve area, heat the probe and purge until the condensation disappears. Next, turn the pump valve to its "vent" position. Turn the flask valve clockwise to its "evacuate" position and record the difference in the mercury levels in the manometer. The absolute internal pressure in the flask ($P_i$) is equal to the barometric pressure less the manometer reading. Immediately turn the flask valve to the "sample" position and permit the gas to enter the flask until pressures in the flask and sample line (i.e., duct, stack) are equal. This will usually require about 15 seconds; a longer period indicates a "plug" in the probe, which must be corrected before sampling is continued. After collecting the sample, turn the flask valve to its "purge" position and disconnect the flask from the sampling train. Shake the flask for at least 5 minutes.

4.1.2 If the gas being sampled contains insufficient oxygen for the conversion of NO to NO$_2$ (e.g., an applicable subpart of the standard may require taking a sample of a calibration gas mixture of NO in N$_2$), then oxygen shall be introduced into the flask to permit this conversion. Oxygen may be introduced into the flask by one of three methods; (1) Before evacuating the sampling flask, flush with pure cylinder oxygen, then evacuate flask to 75 mm Hg (3 in. Hg) absolute pressure or less; or (2) inject oxygen into the flask after sampling; or (3) terminate sampling with a minimum of 50 mm Hg (2 in. Hg) vacuum remaining in the flask, record this final pressure, and then vent the flask to the atmosphere until the flask pressure is almost equal to atmospheric pressure.

4.2 Sample Recovery. Let the flask set for a minimum of 16 hours and then shake the contents for 2 minutes. Connect the flask to a mercury filled U-tube manometer. Open the valve from the flask to the manometer and record the flask temperature ($T_f$), the barometric pressure, and the difference between the mercury levels in the manometer. The absolute internal pressure in the flask ($P_f$) is the barometric pressure less the manometer reading. Transfer the contents of the flask to a leak-free polyethylene bottle. Rinse the flask twice with 5-ml portions of deionized, distilled water and add the rinse water to the bottle. Adjust the pH to between 9 and 12 by adding sodium hydroxide (1 N), dropwise (about 25 to 35 drops). Check the pH by dipping a stirring rod into the solution and then touching the rod to the pH test paper. Remove as little material as possible during this step. Mark the height of the liquid level so that the container can be checked for leakage after transport. Label the container to clearly identify its contents. Seal the container for shipping.

4.3 Analysis. Note the level of the liquid in 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. Immediately prior to analysis, transfer the contents of the shipping container to a 50-ml volumetric flask, and rinse the container twice with 5-ml portions of deionized, distilled water. Add the rinse water to the flask and dilute to the mark with deionized, distilled water; mix thoroughly. Pipette a 25-ml aliquot into the procelain evaporating dish. Return any unused portion of the sample to the polyethylene storage bottle. Evaporate the 25-

[illegible]l aliquot to dryness on a steam bath and [illegible]ow to cool. Add 2 ml phenoldisulfonic [illegible]id solution to the dried residue and triturate thoroughly with a polyethylene policeman. Make sure the solution contacts all [illegible]e residue. Add 1 ml deionized, distilled [illegible]ter and four drops of concentrated sulfu[illegible] acid. Heat the solution on a steam bath for 3 minutes with occasional stirring. Allow the solution to cool, add 20 ml deionized, [illegible]stilled water, mix well by stirring, and add [illegible]ncentrated ammonium hydroxide, drop[illegible]se, with constant stirring, until the pH is 10 (as determined by pH paper). If the sample contains solids, these must be re[illegible]oved by filtration (centrifugation is an ac[illegible]ptable alternative, subject to the approval [illegible] the Administrator), as follows: filter through Whatman No. 41 filter paper into a 100-ml volumetric flask; rinse the evaporating dish with three 5-ml portions of deion[illegible]d, distilled water; filter these three rinses. [illegible]ash the filter with at least three 15-ml portions of deionized, distilled water. Add the filter washings to the contents of the volumetric flask and dilute to the mark with [illegible]ionized, distilled water. If solids are [illegible]sent, the solution can be transferred directly to the 100-ml volumetric flask and diluted to the mark with deionized, distilled water. Mix the contents of the flask thor[illegible]ghly, and measure the absorbance at the [illegible]timum wavelength used for the standards (Section 5.2.1), using the blank solution as a zero reference. Dilute the sample and the blank with equal volumes of deionized, dis[illegible]ed water if the absorbance exceeds $A_4$, [illegible]e absorbance of the 400 μg $NO_2$ standard (see Section 5.2.2).

5. *Calibration*

[illegible].1 Flask Volume. The volume of the col[illegible]tion flask-flask valve combination must be known prior to sampling. Assemble the flask and flask valve and fill with water, to the stopcock. Measure the volume of water [illegible] ± 10 ml. Record this volume on the flask.

[illegible].2 Spectrophotometer Calibration.

5.2.1 Optimum Wavelength Determination. Calibrate the wavelength scale of the spectrophotometer every 6 months. The c[illegible]ibration may be accomplished by using a[illegible] energy source with an intense line emission such as a mercury lamp, or by using a series of glass filters spanning the measuring range of the spectrophotometer. Calib[illegible]tion materials are available commercially a[illegible] from the National Bureau of Standards. Specific details on the use of such materials should be supplied by the vendor; general information about calibration techniques c[illegible] be obtained from general reference b[illegible]ks on analytical chemistry. The wavelength scale of the spectrophotometer must read correctly within ± 5 nm al all calibration points; otherwise, the specrophoto[illegible]er shall be repaired and recalibrated. O[illegible]ce the wavelength scale of the spectrophotometer is in proper calibration, use 410 nm as the optimum wavelength for the measurement of the absorbance of the standards and samples.

Alternatively, a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 400 and 415 nm using a 200 μg $NO_2$ standard solution in the sample cell and a blank solution in the reference cell. If a peak does not occur, the spectrophotometer is probably malfunctioning and should be repaired. When a peak is obtained within the 400 to 415 nm range, the wavelength at which this peak occurs shall be the optimum wavelength for the measurement of absorbance of both the standards and the samples. For a single-beam spectrophotometer, follow the scanning procedure described above, except that the blank and standard solutions shall be scanned separately. The optimum wavelength shall be the wavelength at which the maximum difference in absorbance between the standard and the blank occurs

5.2.2 Determination of Spectrophotometer Calibration Factor $K_c$. Add 0.0 ml, 2 ml, 4 ml, 6 ml., and 8 ml of the $KNO_3$ working standard solution (1 ml = 100 μg $NO_2$) to a series of five 50-ml volumetric flasks. To each flask, add 25 ml of absorbing solution, 10 ml deionized, distilled water, and sodium hydroxide (1 N) dropwise until the pH is between 9 and 12 (about 25 to 35 drops each). Dilute to the mark with deionized, distilled water. Mix thoroughly and pipette a 25-ml aliquot of each solution into a separate porcelain evaporating dish. Beginning with the evaporation step, follow the analysis procedure of Section 4.3 until the solution has been transferred to the 100 ml volumetric flask and diluted to the mark. Measure the absorbance of each solution, at the optimum wavelength, as determined in Section 5.2.1. This calibration procedure must be repeated on each day that samples are analyzed. Calculate the spectrophotometer calibration factor as follows:

$$K_c = 100\,\frac{A_1+2A_2+3A_3+4A_4}{A_1^2+A_2^2+A_3^2+A_4^2}$$

Equation 7–1

where:

$K_c$ = Calibration factor

$A_1$ = Absorbance of the 100-μg $NO_2$ standard

$A_2$ = Absorbance of the 200-μg $NO_2$ standard

$A_3$ = Absorbance of the 300-μg $NO_2$ standard

$A_4$ = Absorbance of the 400-μg $NO_2$ standard

5.3 Barometer. Calibrate against a mercury barometer.

5.4 Temperature Gauge. Calibrate dial thermometers against mercury-in-glass thermometers.

5.5 Vacuum Gauge. Calibrate mechanical gauges, if used, against a mercury manometer such as that specified in 2.1.6.

5.6 Analytical Balance. Calibrate against standard weights.

6. *Calculations*

Carry out the calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

6.1 Nomenclature.

$A$ = Absorbance of sample.

$C$ = Concentration of $NO_x$ as $NO_2$, dry basis, corrected to standard conditions, 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 $NO_x$ as $NO_2$ in gas sample, μg.

$P_f$ = Final absolute pressure of flask, mm Hg (in. Hg).

$P_i$ = Initial absolute pressure of flask, mm Hg (in. Hg).

$P_{std}$ = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

$T_f$ = Final absolute temperature of flask, °K (°R).

$T_i$ = Initial absolute temperature of flask, °K (°R).

$T_{std}$ = Standard absolute temperature 293° K (528° R)

$V_{sc}$ = Sample volume at standard conditions (dry basis), ml.

$V_f$ = Volume of flask and valve, ml.

$V_a$ = Volume of absorbing soluton, 25 ml.

2 = 50/25, the aliquot factor. (If other than a 25-ml aliquot was used for analysis, the corresponding factor must be substituted).

6.2 Sample volume, dry basis, corrected to standard conditions.

$$V_{sc} = \frac{T_{std}}{P_{std}}(V_f - V_a)\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$
$$= K_1(V_f - 25\text{ ml})\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

Equation 7–2

where:

$$K_1 = 0.3858\,\frac{°K}{\text{mm Hg}}\text{ for metric units}$$
$$= 17.64\,\frac{°R}{\text{in. Hg}}\text{ for English units}$$

6.3 Total μg $NO_2$ per sample.

$$m = 2K_c AF$$

Equation 7–3

NOTE.—If other than a 25-ml aliquot is used for analysis, the factor 2 must be replaced by a corresponding factor.

6.4 Sample concentration, dry basis, corrected to standard conditions.

$$C = K_2\,\frac{m}{V_{sc}}$$

Equation 7–4

# APPENDIX A4

## Field Data Sheets and Computations
## Opacity/Method 9

Emissions ~5-10 lb/hr. on oil

SK

SHOLTES & KOOGLER, ENVIRONMENTAL CONSULTANTS

VISIBLE EMISSIONS DATA SHEET

Plant AMAX
Date 2-16-84
Wind Direction and Speed NE - 5/8
Stack Dryer - Coal/Oil Mix
Time 0810
Observer R. Sholtes

| min. \ sec. | 0 | 15 | 30 | 45 | min. \ sec. | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 31 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 32 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 33 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 35 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 36 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 | 37 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 | 39 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 | 40 | 0 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 | 0 | 41 | 0 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 | 0 | 42 | 0 | 0 | 0 | 0 |
| 13 | 0 | 0 | 0 | 0 | 43 | 0 | 0 | 0 | 0 |
| 14 | 0 | 0 | 0 | 0 | 44 | 0 | 0 | 0 | 0 |
| 15 | 0 | 0 | 0 | 0 | 45 | 0 | 0 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 46 | 0 | 0 | 0 | 0 |
| 17 | 0 | 0 | 0 | 0 | 47 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 48 | 0 | 0 | 0 | 0 |
| 19 | 0 | 0 | 0 | 0 | 49 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 |
| 21 | 0 | 0 | 0 | 0 | 51 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 52 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 54 | 0 | 0 | 0 | 0 |
| 25 | 0 | 0 | 0 | 0 | 55 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 56 | 0 | 0 | 0 | 0 |
| 27 | 0 | 0 | 0 | 0 | 57 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 0 | 58 | 0 | 0 | 0 | 0 |
| 29 | 0 | 0 | 0 | 0 | 59 | 0 | 0 | 0 | 0 |

Sum of # Recorded ______

Total # of Readings ______

Opacity = Sum of # Recorded / Total # of Readings = ______

**Plume Description**

coning ✓
lofting __
fanning __
Detached ______
Color ______
looping __
fumigating __

**Point of Observation**

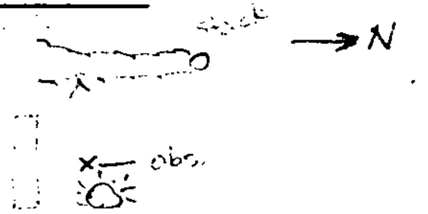
Steam Plant [illegible]

Distance to base of Source 300'

Height of discharge above ground 100'

Back Ground Description
Blue Sky w/ light scattered layer.

**Diagram of Stack**



SHOLTES & KOOGLER
ENVIRONMENTAL CONSULTANTS, INC.

## SUMMARY OF VISIBLE EMISSIONS

COMPANY NAME: AMAX Chemical Corporation  DATE: February 16, 1984

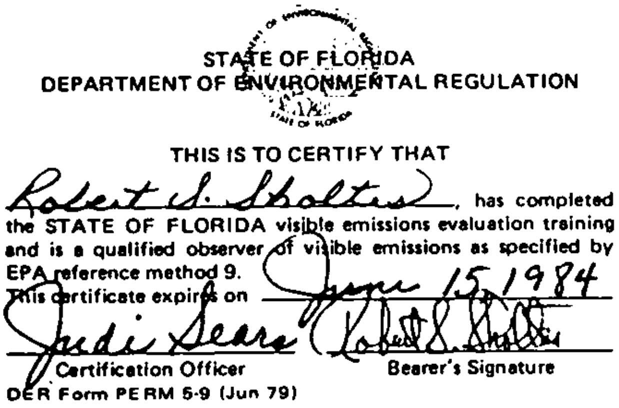
SOURCE: Fluid Bed Scrubber  TIME: 0810 - 0839

PERMIT NO.: AC29-65834

### SUMMARY OF AVERAGE OPACITY

| Set Number | Time Start - End | Opacity Sum | Opacity Average |
|---|---|---|---|
| 1 | 0810 - 0815 | 0 | 0.0 |
| 2 | 0816 - 0821 | 0 | 0.0 |
| 3 | 0822 - 0827 | 0 | 0.0 |
| 4 | 0828 - 0833 | 0 | 0.0 |
| 5 | 0834 - 0839 | 0 | 0.0 |

Readings ranged from 0 to 0 percent opacity. The source was in compliance with Chapter 17-2, Florida Administrative Code at the time evaluation was made.



STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

THIS IS TO CERTIFY THAT

Robert S. Sholtes, has completed the STATE OF FLORIDA visible emissions evaluation training and is a qualified observer of visible emissions as specified by EPA reference method 9.

This certificate expires on June 15, 1984

Judi Sears
Certification Officer

Robert S. Sholtes
Bearer's Signature

DER Form PERM 5-9 (Jun 79)

Signed: Robert S. Sholtes

Certificate Expires: June 15, 1984

SHOLTES & KOOGLER, ENVIRONMENTAL CONSULTANTS

VISIBLE EMISSIONS DATA SHEET

Plant AMAX

Stack Fluid Bed Scrubber.

Date 2-17-84

Time 1120

Wind Direction and Speed Calm

Observer R. Sholtes

| sec. / min. | 0 | 15 | 30 | 45 | sec. / min. | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 5 | 5 | 5 | 30 | | | | |
| 1 | 5 | 5 | 5 | 5 | 31 | | | | |
| 2 | 5 | 5 | 5 | 5 | 32 | | | | |
| 3 | 5 | 5 | 5 | 5 | 33 | | | | |
| 4 | 5 | 5 | 5 | 5 | 34 | | | | |
| 5 | 5 | 5 | 5 | 5 | 35 | | | | |
| 6 | 5 | 5 | 5 | 5 | 36 | | | | |
| 7 | 5 | 5 | 5 | 5 | 37 | | | | |
| 8 | 5 | 5 | 5 | 5 | 38 | | | | |
| 9 | 5 | 5 | 5 | 5 | 39 | | | | |
| 10 | 5 | 5 | 5 | 5 | 40 | | | | |
| 11 | 5 | 5 | 5 | 5 | 41 | | | | |
| 12 | 5 | 5 | 5 | 5 | 42 | | | | |
| 13 | 5 | 5 | 5 | 5 | 43 | | | | |
| 14 | 5 | 5 | 5 | 5 | 44 | | | | |
| 15 | 5 | 5 | 5 | 5 | 45 | | | | |
| 16 | 5 | 5 | 5 | 5 | 46 | | | | |
| 17 | 5 | 5 | 5 | 5 | 47 | | | | |
| 18 | 5 | 5 | 5 | 5 | 48 | | | | |
| 19 | 5 | 5 | 5 | 5 | 49 | | | | |
| 20 | 5 | 5 | 5 | 5 | 50 | | | | |
| 21 | 5 | 5 | 5 | 5 | 51 | | | | |
| 22 | 5 | 5 | 5 | 5 | 52 | | | | |
| 23 | 5 | 5 | 5 | 5 | 53 | | | | |
| 24 | 5 | 5 | 5 | 5 | 54 | | | | |
| 25 | 5 | 5 | 5 | 5 | 55 | | | | |
| 26 | 5 | 5 | 5 | 5 | 56 | | | | |
| 27 | 5 | 5 | 5 | 5 | 57 | | | | |
| 28 | 5 | 5 | 5 | 5 | 58 | | | | |
| 29 | 5 | 5 | 5 | 5 | 59 | | | | |

Sum of # Recorded

Total # of Readings

Opacity = $\frac{\text{Sum of \# Recorded}}{\text{Total \# of Readings}}$ =

Plume Description

coning ___ Detached ___

lofting ___ Color ___

fanning ___ looping ___

fumigating ___

Point of Observation

Steam Plume

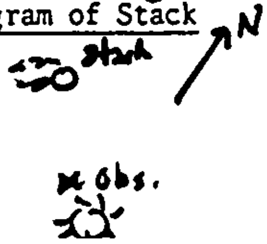
Distance to base of Source 200'

Height of discharge above ground 100'

Back Ground Description

Blue Sky - No Clouds

Diagram of Stack



Plume is ½ - ¾ Stk hght.

SHOLTES & KOOGLER
ENVIRONMENTAL CONSULTANTS, INC.

## SUMMARY OF VISIBLE EMISSIONS

COMPANY NAME: AMAX Chemical Corporation DATE: February 17, 1984

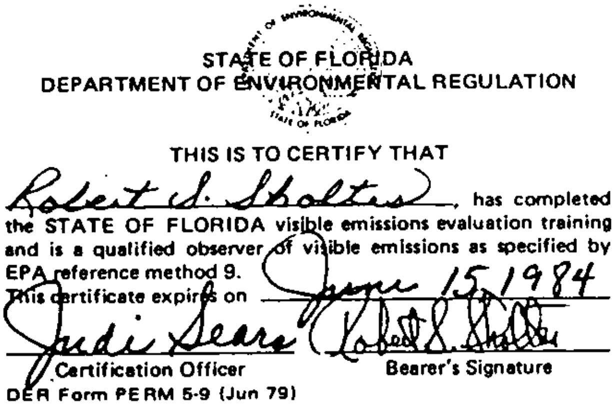
SOURCE: Fluid Bed Scrubber (Fuel is Oil) TIME: 1120 - 1149

PERMIT NO.: AC29-65834

### SUMMARY OF AVERAGE OPACITY

| Set Number | Time Start - End | Opacity Sum | Opacity Average |
|---|---|---|---|
| 1 | 1120 - 1125 | 120 | 5.0 |
| 2 | 1126 - 1131 | 120 | 5.0 |
| 3 | 1132 - 1137 | 120 | 5.0 |
| 4 | 1138 - 1143 | 120 | 5.0 |
| 5 | 1144 - 1149 | 120 | 5.0 |

Readings ranged from 5 to 5 percent opacity. The source was in compliance with Chapter 17-2, Florida Administrative Code at the time evaluation was made.



STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

THIS IS TO CERTIFY THAT

Robert S. Sholtes, has completed the STATE OF FLORIDA visible emissions evaluation training and is a qualified observer of visible emissions as specified by EPA reference method 9.

This certificate expires on June 15, 1984

Judi Sears — Certification Officer

Robert S. Sholtes — Bearer's Signature

DER Form PERM 5-9 (Jun 79)

Signed: Robert S. Sholtes

Certificate Expires: June 15, 1984

# APPENDIX B

## Plant Operating Data

# PART I
## SPECIFIC CONDITIONS

1. The phosphate rock dryer shall meet all applicable requirements of 40 CFR 60, Subpart NN - Standards of Performance for Phosphate Rock Plants.

2. Phosphate rock feed to the dryer shall not exceed 300 TPH.

3. Particulate emissions from the dryer shall not exceed 0.06 lbs/ton of wet phosphate rock feed or 18 pounds per hour, whichever is more restrictive. Visible emissions shall not exceed 10 percent opacity. Particulate emissions and opacity shall be determined in accordance with reference methods prescribed under 40 CFR §60.404.

4. Sulfur dioxide emissions shall not exceed 1.1 lbs per million BTU heat input. Sulfur dioxide emissions shall be determined by reference method 6, Appendix A, 40 CFR 60.

5. Nitrogen oxides emissions shall not exceed 35.5 lbs per hour. Nitrogen oxides emissions shall be determined by reference method 7, Appendix A, 40 CFR 60.

6. Heat input to the dryer shall not exceed 118 million BTU per hour.

7. Sulfur content of the fuels used in the dryer shall be of an appropriate value to ensure emissions of sulfur dioxide do not exceed the applicable limit (Specific Condition 4), but in no case shall the sulfur content exceed 2.5 percent by weight.

8. At a minimum, the owner/operator of the facility shall install, calibrate, and maintain devices meeting the requirements of 40 CFR §60.403(c) and (d), and maintain on site a daily log of scrubber operation which shall include:

   a. Pressure drop of the gas in inches of water.
   b. Flow rate of the scrubber water in GPM.
   c. pH of the scrubber water.
   d. Pressure of scrubber water feed.
   e. Scrubber feed water make up rate.

   These items shall be recorded at the time of performance tests and used in subsequent inspections as an indication of operating conditions necessary for compliance with emissions limits. Rock feed input rate, approximate product rock and rock feed moisture content, fuel sulfur content and heating value, scrubbing effluent particulate concentration, and scrubber water make up rate shall also be recorded during performance testing.

737 Executive Park, Louisville, Kentucky 40207
(502) 893-0106

**COALIQUID, INC.**

## FUEL ANALYSIS SHEET

SAMPLE # 1033

DATE 02-13-84

CUSTOMER Mobil

**COAL USED**

Seam: Taggert & Imboden
Source: Mann Coal Comp.
BTU/Lb.: 12,485
Ash (%): 10.5
Sulfur (%): 0.8
Moisture (%): 6.86
Hardness: 51.5
Fusion (Ash):
Volatiles (%):
Fixed Carbon (%):
Percent Passing 200 Mesh: 50.65

**OIL USED**

Type: #6 Bunker C
Source: Union 76
BTU/Lb.: 18,357
Ash (%): 0.05
Sulfur (%): 2.42
B. S. & W.:
Sp. Grav.: 0.9944
API: 10.8 @ 60°F
Lb/Gal.: 8.2814
Viscosity (@ 122°F): 340 Cp
Flash: 185°F

**COM**

Coal (%): 50.06
Oil (%): 39.66
Water (%): 10.28
BTU/Lb.: 14,660
Sulfur: 1.69
Ash (%): 4.90
Sp. Grav.: 1.115 @ 72°F
Lb/Gal.: 9.29 @ 72°F ; 8.61 @ 122°F
Flash:
Viscosity (@ 122°F): 7650 Cp.

**BROOKFIELD VISCOSITY (COM)**

| Temp. (F) | Centipoise | Temp. (F) | Centipoise |
|---|---|---|---|
| 50 | | 140 | 5180 |
| 60 | | 150 | 4200 |
| 70 | | 160 | 3500 |
| 80 | | 170 | 2850 |
| 90 | | 180 | 2250 |
| 100 | 12,900 | 190 | |
| 110 | 10,100 | 200 | |
| 120 | 8080 | 220 | |
| 130 | 6300 | 240 | |

* Percentages are by weight.
* Typical Fuel

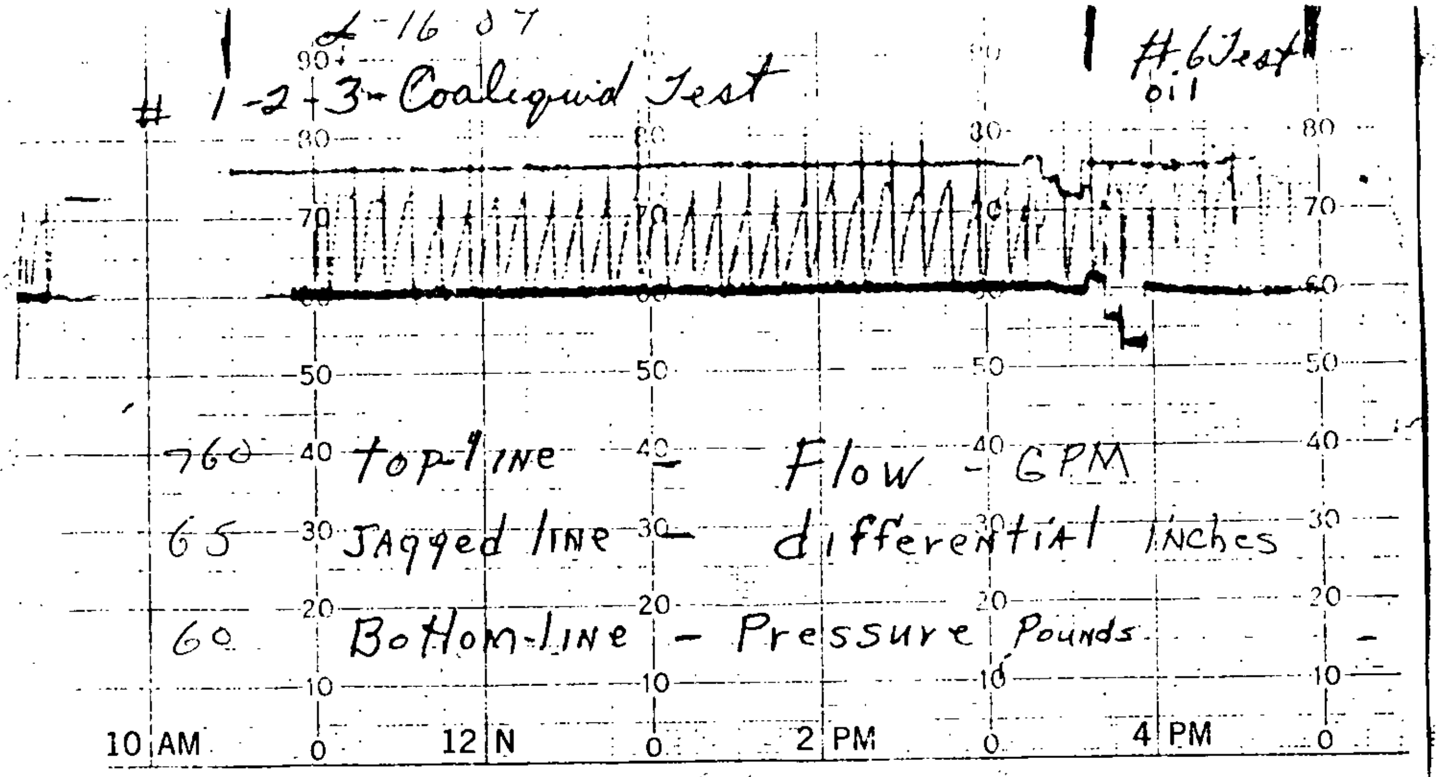
Name
Position Q C

A Subsidiary of
MCDONNELL DOUGLAS

2-16-87

# 1-2+3-Coaliquid Test

#6 Test oil

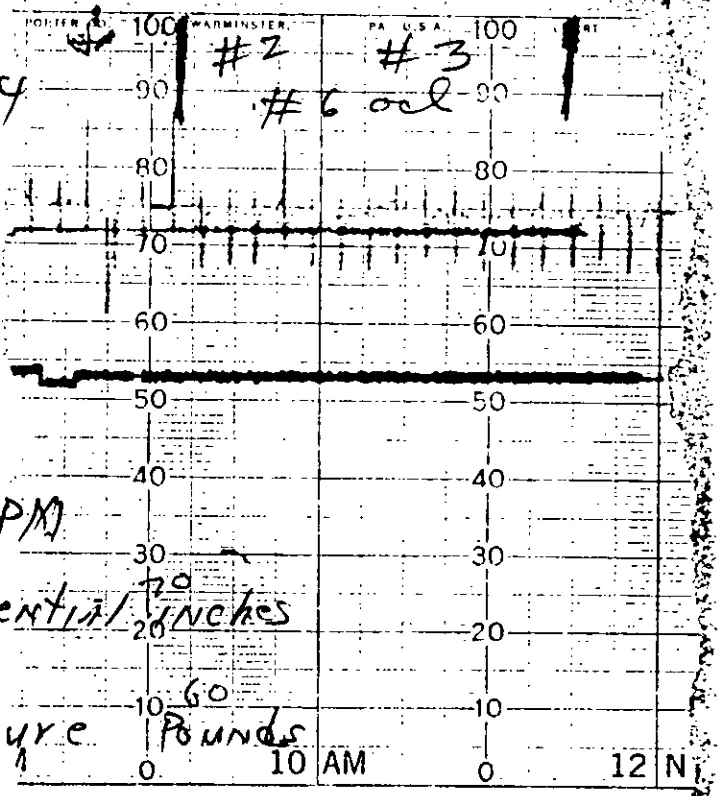


760 top line - Flow - GPM

65 Jagged line - differential inches

60 Bottom line - Pressure Pounds

2-17-84



Top line - Flow 700 GPM

Jagged line - differential 70 inches

Bottom line Pressure 60 Pounds

— Across FAN

# DRYER LOG

OPERATOR: R. Guion SHIFT: 1 DATE: 2-10-84

| HOUR | SCALE READING | TONS PER HOUR | FUEL OIL READING | GALLONS PER HOUR | OIL PRESSURE-1 | OIL PRESSURE-2 | OIL TEMPERATURE | STEAM PRESS. BURNER | PLENIM TEMPERATURE | PLENIM PRESSURE | BED TEMPERATURE | BED PRESSURE | BED LEVEL | EXHAUST FAN INLET PRESS. | SCRUBBER INLET PRESS. | EXHAUST FAN AMPS | PRIMARY FAN AMPS | COMBUSTION FAN AMPS | PRODUCT TEMPERATURE | EXHAUST TEMPERATURE | TYPE ROCK | SILO | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 150870 | | 1390740 | | 100° | 50 | 240 | | 1600 | 33 | 210 | 7 | 9 | 5.5 | 0 | 59 | 51 | 20 | 245 | 185 | A2/0 | B | change to |
| 8 | 151090 | 220 | 1391050 | | | 70 | 230 | | 1600 | 36 | 210 | 7 | 9 | 5.4 | 0 | 59 | 53 | 23 | 245 | 190 | A2/0 | B | B rock 8:00 |
| 9 | 151340 | 250 | | | | 75 | 225 | | 1700 | 35 | 215 | 7 | 9 | 5.2 | 0 | 58 | 52 | 20 | 245 | 185 | B | B | Down 9:23 |
| 10 | 151450 | 110 | | | | | | | | | | | | | | | | | | | A/0 | A | Start 10:40 |
| 11 | 151550 | 100 | | | | 70 | 225 | | 1750 | 37 | 210 | 7 | 9 | 5.4 | 0 | 58 | 52 | 20 | 245 | 185 | B/0 | A | |
| 12 | 151820 | 270 | | | | 70 | 225 | | 1700 | 36 | 205 | 7 | 9 | 5.2 | 0 | 58 | 52 | 21 | 245 | 180 | B/0 | A | |
| 1 | 152090 | 270 | | | | 65 | 245 | | 1700 | 36 | 205 | 7 | 9 | 4.8 | 0 | 58 | 53 | 21 | 245 | 180 | B/0 | A | |
| 2 | 152360 | 270 | | | | 68 | 180 | | 1700 | 38 | 210 | 7 | 9 | 5.0 | 0 | 58 | 52 | 21 | 245 | 185 | B/0 | A | |
| | | | | | | | | | | | | | | | | | | | | | | | |

270

com = 132,525 btu/gal. 9.325/gal. 14,250 btu/lb.

SCALE STOP: 393120

SCALE START: 391370

TOTAL: 1750

8 68.70

12 2.09

1:30

A51

B-11

C-E

D-E

A 6410

B 6550

OIL STOP: 1391050

OIL START: 1390320

TOTAL: 730

# DRYER LOG

OPERATOR: M. Hawkins SHIFT: 2nd DATE: 2/16/84

| HOUR | SCALE READING | TONS PER HOUR | FUEL OIL READING | GALLONS PER HOUR | OIL PRESSURE-1 | OIL PRESSURE-2 | OIL TEMPERATURE | STEAM PRESS. BURNER | PLENIM TEMPERATURE | PLENIM PRESSURE | BED TEMPERATURE | BED PRESSURE | BED LEVEL | EXHAUST FAN INLET PRESS. | SCRUBBER INLET PRESS. | EXHAUST FAN AMPS | PRIMARY FAN AMPS | COMBUSTION FAN AMPS | PRODUCT TEMPERATURE | EXHAUST TEMPERATURE | TYPE ROCK | SILO | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 152340 | 270 | Coal Liquid | | | 68 | 180 | | 1700 | 38 | 210 | 7 | 9 | 5.0 | 0 | 58 | 52 | 21 | 245 | 185 | B/D | A | Change to #6 |
| 3 | 152630 | 270 | | | | 65 | 180 | | 1700 | 36 | 210 | 7 | 9 | 5.2 | 0 | 58 | 52 | 21 | 245 | 185 | B/D | A | Oil 3:45 |
| 4 | 152900 | 270 | 1391160 | 110 | 100 | 25 | 220 | | 1600 | 39 | 200 | 8 | 9 | 5.5 | 0 | 59 | 55 | 20 | 240 | 175 | B/D | A | |
| 276.7 5 | 153170 | 270 | 1391760 | 600 | 100 | 30 | 220 | | 1700 | 36 | 210 | 8 | 8 | 5.2 | 0 | 59 | 53 | 20 | 245 | 185 | B/D | A | Changed to D |
| 6 | 153350<br>153460 | 290 | 1392210 | 450 | 100 | 29 | 230 | | 1600 | 34 | 190 | 8 | 8 | 5.6 | 0 | 62 | 55 | 20 | 230 | 165 | B/D<br>D | A/D | silo 5:30 |
| 7 | 153760 | 300 | 1392790 | 580 | 100 | 25 | 230 | | 1500 | 33 | 175 | 7 | 8 | 5.5 | 0 | 60 | 54 | 20 | 220 | 165 | D | D | |
| 8 | 154060 | 300 | 1393340 | 550 | 100 | 22 | 230 | | 1500 | 33 | 175 | 7 | 8 | 5.2 | 0 | 61 | 54 | 20 | 220 | 165 | D | D | |
| 9 | 154360 | 300 | 1393880 | 540 | 100 | 21 | 230 | | 1400 | 33 | 170 | 8 | 8 | 5.4 | 0 | 61 | 55 | 20 | 215 | 160 | D | D | |
| 10 | 154700 | 300 | 1394420 | 540 | 100 | 21 | 250 | | 1450 | 34 | 170 | 8 | 8 | 5.4 | 0 | 62 | 55 | 20 | 215 | 160 | D | D | |

1:30 A-51
B-11
C-E
D-E

9:05 A-39
B-F
C-E
D-45

SCALE STOP: 395380
SCALE START: 393120
TOTAL: 2270

OIL STOP: 1394426
OIL START: 1391050
TOTAL: 3370

2:00- 2.4
4:00-2.57 68.00
6:00-1.51 72.80
8:00- 72.20 1.87

#6 oil 148,000 btu/gal.

DRYER LOG

OPERATOR: R. Guion SHIFT: 1 DATE: 2-17-84

| HOUR | SCALE READING | TONS PER HOUR | FUEL OIL READING | GALLONS PER HOUR | OIL PRESSURE-1 | OIL PRESSURE-2 | OIL TEMPERATURE | STEAM PRESS. BURNER | PLENIM TEMPERATURE | PLENIM PRESSURE | BED TEMPERATURE | BED PRESSURE | BED LEVEL | EXHAUST FAN INLET PRESS. | SCRUBBER INLET PRESS. | EXHAUST FAN AMPS | PRIMARY FAN AMPS | COMBUSTION FAN AMPS | PRODUCT TEMPERATURE | EXHAUST TEMPERATURE | TYPE ROCK | SILO | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 156910 | 300 | 1398420 | 560 | 100 | 26 | 225 | | 1420 | 34 | 170 | 8 | 8 | 5.3 | 0 | 61 | 56 | 20 | 215 | 170 | D | C | [illegible] |
| 7 | 157210 | 300 | 1398960 | 560 | 100 | 26 | 225 | | 1400 | 35 | 165 | 8 | 8 | 5.4 | 0 | 61 | 57 | 20 | 210 | 155 | D | C | [illegible] |
| 8 | 157510 | 300 | 1399510 | 750 | 100 | 28 | 225 | | 1500 | 34 | 175 | 8 | 8 | 5.4 | 0 | 61 | 54 | 20 | 220 | 160 | D | C | 8:20 |
| 9 | 157660<br>157750 | 270 | 1400130 | 620 | 100 | 30 | 225 | | 1550 | 36 | 205 | 8 | 8 | 5 | 0 | 61 | 55 | 19 | 240 | 180 | D<br>A:D | C<br>A | |
| 10 | 158050 | 270 | 1400760 | 630 | 100 | 30 | 225 | | 1600 | 34 | 210 | 8 | 8 | 5 | 0 | 61 | 53 | 19 | 240 | 180 | A/D | A | |
| 11 | 158320 | 270 | 1401300 | 640 | 100 | 30 | 225 | | 1600 | 34 | 210 | 8 | 8 | 5 | 0 | 61 | 54 | 19 | 245 | 180 | A/D | A | |
| 12 | 158590 | 270 | 1401940 | 640 | 100 | 30 | 220 | | 1600 | 34 | 205 | 8 | 8 | 4.8 | 0 | 61 | 57 | 19 | 240 | 180 | A/D | A | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |

300

270

A-39
B F
C-E
D-F

SCALE STOP:

SCALE START: 397640

TOTAL:

6:00 7150

10: 65.98 7.88

OIL STOP:

OIL START: 1398420

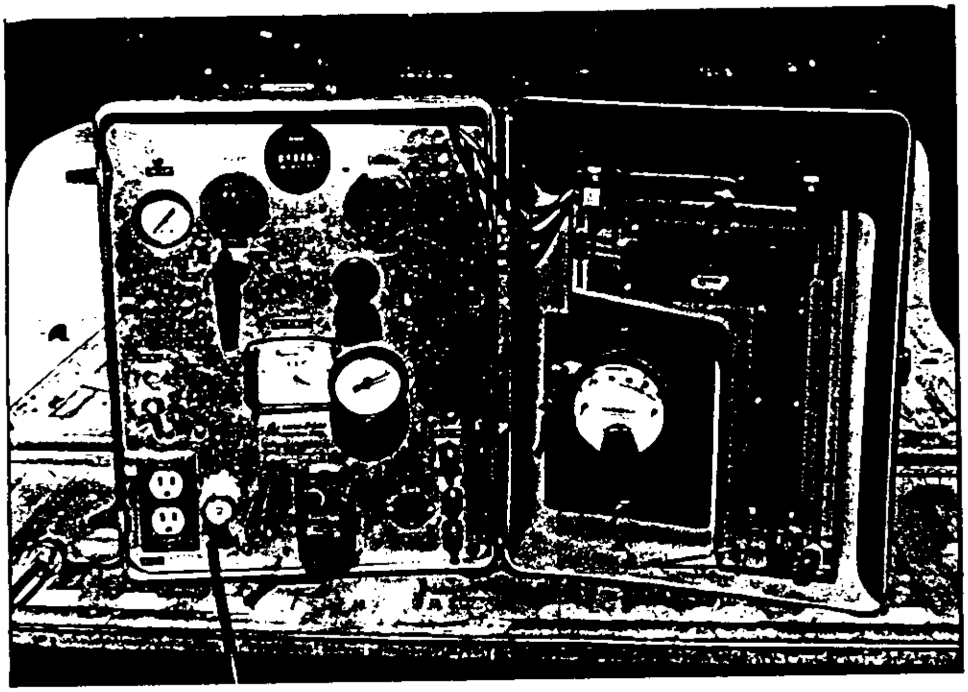
TOTAL:

# APPENDIX C

## Calibrations and Project Participants

SHOLTES & KOOGLER
ENVIRONMENTAL CONSULTANTS, INC.

SOURCE SAMPLING EQUIPMENT



S.K.E.C. Meter Box

Equipment used in Source Sampling is either manufactured by or assembled by SKEC. The guidelines followed are A.P.T.D. 0581, Details of Isokinetic Source Sampling Equipment, and A.P.T.D. 0576, Maintenance, Calibration and Operation of Isokinetic Source Sampling Equipment.

SK-81

# PITOT TUBE CALIBRATION MEASUREMENTS

DATE CALIBRATED 5-11-82

Pitot tube assembly level? X yes ______ no

Pitot tube openings damaged? ______ yes (explain below) X no

$\alpha_1$ = 1.5 ° (<10°), $\alpha_2$ = 0.5 ° (<10°), $\beta_1$ = 1.5 ° (<5°),
$\beta_2$ = 1.5 ° (<5°)

$\gamma$ = 0.5 °, $\theta$ = 3.5 °, A = .960 in. = (Pa + Pb)

$z = A \sin \gamma$ = 0.008 in. ; <0.32 <1/8 in.
$w = A \sin \theta$ = 0.059 in. ; <0.08 <1/32 in.

$P_A$ .386 in. $P_b$ 574 in.

$D_t$ = .375

Comments: ______

Calibration required? ______ yes X no

Calibrated by: George F. Gabel

# CALIBRATION FORM

Date 2-8-84

Box No. SK-1

Barometric Pressure 30.36 inches Hg

| ΔHT | ΔHD | Teledyne Mass Flow Meter |  | Gas Volume, Dry Gas Meter |  |  | Temp. Teledyne | Temp. of Dry Meter | Time Minutes |
|---|---|---|---|---|---|---|---|---|---|
|  |  | Desired liters/min | Actual liters/min | Initial | Final | Actual ft.$^3$ |  |  |  |
| 0 | 0.97 | 15 | 15 | 7.0 | 9.724 | 2.724 | 68 | 79 | 5 |
| 0 | 1.75 | 20 | 20 | 45.0 | 48.654 | 3.654 | 68 | 87 | 5 |
| 0 | 2.60 | 25 | 25 | 1.0 | 5.489 | 4.489 | 68 | 80 | 5 |
| 0 | 3.85 | 30 | 30 | 39.0 | 44.352 | 5.352 | 68 | 86 | 5 |
| 0 | 5.00 | 35 | 35 | 16.0 | 22.169 | 6.169 | 68 | 83 | 5 |

## GAS METER THERMOMETER CALIBRATION

| N.B.S. °F | METER BOX |
|---|---|
| 33 | 34 |
| 51 | 50 |
| 72 | 72 |
| 93 | 94 |
| 115 | 114 |

```
                                                              --MEAN--
DELTA-H :  1.868    1.868    1.800    1.830    1.756          1.825

      Y :  0.990    0.997    0.999    1.014    1.018          1.003

   SCFM :  0.537    0.716    0.895    1.075    1.254

     OF :  4.150    5.615    6.800    8.321    9.457
```

Signature George F. Gabel

SHOLTES & KOOGLER,
ENVIRONMENTAL CONSULTANTS, INC.

## THERMOCOUPLE CALIBRATIONS

Read Out No. SK-1 Umbilical Cord 200' Date 10-14-83

| Probe Number | Ice Bath<br>N.B.S.* °F | PROBE °F | Ambient<br>N.B.S.* °F | PROBE °F | 150°<br>N.B.S.* °F | PROBE °F | 400°<br>N.B.S.* °F | PROBE °F |
|---|---|---|---|---|---|---|---|---|
| SK-21 | 32 | 32 | 65 | 66 | 171 | 168 | 391 | 395 |
| SK-41 | 32 | 31 | 66 | 67 | 173 | 175 | 396 | 396 |
| SK-61 | 32 | 31 | 66 | 66 | 168 | 168 | 420 | 422 |
| SK-62 | 32 | 32 | 67 | 65 | 163 | 164 | 428 | 427 |
| SK-71 | 33 | 34 | 68 | 68 | 158 | 155 | 419 | 421 |
| SK-81 | 32 | 32 | 68 | 67 | 140 | 138 | 421 | 423 |
| SK-91 | 33 | 35 | 68 | 69 | 151 | 152 | 398 | 400 |
| SK-101 | 33 | 34 | 68 | 68 | 144 | 145 | 404 | 408 |
| SK-111 | 32 | 33 | 68 | 70 | 162 | 160 | 378 | 377 |
| SK-51-T | 33 | 33 | 68 | 70 | 168 | 170 | 385 | 383 |
| SK-101-T | 34 | 32 | 67 | 68 | 170 | 170 | 391 | 392 |
| | | | | | | | | |
| | | | | | | | | |
| HEATED BOX NO. 1 | 33 | 34 | 64 | 63 | 188 | 185 | 370 | 372 |
| HEATED BOX NO. 2 | 33 | 35 | 64 | 64 | 186 | 188 | 374 | 374 |
| LAST IMPINGER PROBE NO. 1 | 34 | 34 | 64 | 65 | 182 | 184 | 381 | 380 |
| LAST IMPINGER PROBE NO. 2 | 34 | 33 | 64 | 65 | 178 | 176 | 386 | 387 |

* National Bureau of Standards Calibrated Mercury Thermometer

George F. Gebel
Signature

## CALIBRATION FORM

Date 7-18-83

Box No. Sb-3

Barometric Pressure 30.05 inches Hg

| ΔHT | ΔHD | Teledyne Mass Flow Meter |  | Gas Volume, Dry Gas Meter |  |  | Temp. Teledyne | Temp. of Dry Meter | Time Minutes |
|---|---|---|---|---|---|---|---|---|---|
|  |  | Desired liters/min | Actual liters/min | Initial | Final | Actual ft.$^3$ |  |  |  |
| 0 |  | 15,~~1~~6 |  | 94.2 | 97.115 | 2.915 | 68 | 95 | 5 |
| 0 |  | ~~20~~100 |  | 97.5 | 99.359 | 1.859 | 68 | 100 | 5 |
| 0 |  | 25 |  |  |  |  | 68 |  |  |
| 0 |  | 30 |  |  |  |  | 68 |  |  |
| 0 |  | 35 |  |  |  |  | 68 |  |  |

GAS METER THERMOMETER CALIBRATION

| N.B.S. °F | METER BOX |
|---|---|
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Signature R Paul

```
                                         --MEAN--

DELTA-H :     0.000        0.000         0.000

      Y :     0.993        1.007         1.000

   SCFM :     0.553        0.355

     OF :     0.000        0.000
```

# PROJECT PARTICIPANTS

| | |
|---|---|
| Robert S. Sholtes, Ph.D, P.E. | Project Advisor |
| Rodney C. Paul | Field Test Crew |
| George F. Gabel | Field Test Crew |

ail To: Gary Rust
BACT/LAER Clearinghouse
U.S. EPA (MD-15)
RTP, NC 27711

9.16
Source Category
5/10/84
Date of This Report

## BACT/LAER DETERMINATION REPORT

ource Type/Size: Fluidized bed phosphate rock dryer 300 TPH

mpany Name/Site Location: AMAX Phosphate, Inc. Bradley, Florida

etermination is: (circle appropriate efinition) [✓ BACT]/LAER For New/[✓ Modified] Source:

Date of Permit Issuance: October 7, 1983

Permit No.: PSD-FL-094

Date of Estimated Start-up: March 1, 1984

etermination Made By: Fl. Dept of Environmental Reg. (Agency) Willard Hanks (Person Directly Knowledgable About Permit) (904)488-1344 (Phone)

| ermit Parameters: ist all rocesses subject this permit) | Throughput capacity, weight rate, Btu input, etc. | Pollutant(s) emitted ($SO_2$ particulate, etc.) | BACT/LAER emission limit(s) and basis for the limits* (units of emissions/ units of input | Control equipment or process modification description** | Eff.% |
|---|---|---|---|---|---|
| Rock Dryer | $118 \times 10^6$ Btu/hr | Particulate | .06 lb/ton wet feed | Cyclone Separator | |
| | heat input | | | & Inpingement Scrubber | 97% |
| | | $SO_2$ | 1.1 lb/mmBtu | | |
| | | $NO_x$ | .3 lb/mmBtu | | |
| | | VE | Max 10% opacity | | |
| | | | | | |
| | | | | | |

tes***: The dryer was modified to fire a coal-oil-water mixture (COWM) containing max 2.5% Sulfur.

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*Indicate basis of emissions limit, i.e., BACT determined simply by technology and economics, NSPS, LAER, or determined by NAAQS or PSD increment constraints. (Example: 0.05 pounds particulate per million Btu input limit needed to protect Class I increment.) To promote consistency, please use NSPS emission limits where possible.

**To the extent possible in the space available, describe basic control or process equipment design details. Indicate unique or innovative features.

***Notes are optional and can address special items, unusual circumstances, or other clarifying information such as SIC codes.