State of Wisconsin

# CORRESPONDENCE/MEMORANDUM

Received 10/14/91

DATE: 10/17/91

File Code: 4530

PRELIMINARY STACK TEST REVIEW

By: Marty Burkholder Test Date: 9/19/91

Name of Source: Bichl Construction FID #: 999011970

Address: W6567 Campbell Road

City: Town of Byron Permit #: 999011970-N01

Description of Source Tested: Asphalt Plant - 180 TPH Barber Greene Batch Mix

Description of Control Equipment: Astec Baghouse

Test Firm: Badger Laboratories & Engineering Co. Inc.

Crew Chief & Phone#: Bruce Lamers 414/739-9213

Pollutant Tested: Part. Test Method: US EPA 5

Pollutant Tested: Formaldehyde Test Method: NIOSH 3500

Pollutant Tested: - Test Method:

Test Production Level: @ 155 TPH (86% of rated) ~~Fuel~~ Aggregate - wet

Rated Production Level: 180 TPH

Discussion of Results:

___ The stack test is invalid and will have to be redone because _____

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The test average result of 0.007 lbs/1000 lbs stack gas (0.67 lbs/hr.) is X is not ___ in compliance with the emission limit of .03 lbs/1000 lbs stack (40 lbs/hr.).

Formaldehyde = 0.586 lb/hr.

cc: Joe Perez-AM/3
US EPA Region V

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AIR MANAGE

PARTICULATE CHECKLIST

Name of Source: Biehl Construction Test Date: 9/19/91

1. Are the isokinetics per run between 90 and 110%? YES X NO__
   If the %I for a run is outside the range, void the run. See 5.

2. Is the sample volume per run ≥ 30 DSCF? YES X NO__
   If the sample volume for a run is < 30 DSCF, void the run. See 5.

3. Is the sample time per run ≥ 60 min.? YES X NO__
   If the sample time for a run is < 60 min., void the run. See 5.

4. Is the sample time per sample point ≥ two min.? YES X NO__
   If the sample time per point for a run is < two min., void the run. See 5.

5. A stack test shall consist of three valid runs or, at a minimum, two valid runs if one run is voided. Is this a valid test? YES X NO__
   If no, inform the District or the source that the test is unacceptable and should be redone. Your review is over.

6. Is the total particulate per run added correctly? YES X NO__
   If an incorrect total is found, call the consultant and ask for a correction.

7. Was the backhalf included in the total particulate? YES X NO__
   NSPS sources are exempt from including the backhalf. All other sources must include the backhalf. If they don't, the test is invalid. See 5.

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Eq. 1 Gr/DSCF = 15.43* g of part./sample volume of run in DSCF

Eq. 2 Lb/DSCF = (Gr/DSCF)/7000

Eq. 3 Lb/Hr = 60*DSCFM*(Lb/DSCF)

Eq. 4 $Lb/10^6$ BTU = (Lb/DSCF)*F Factor*20.9/(20.9-Stack $O_2$)

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8. If the emission limit is in Gr/DSCF, Lb/DSCF, Lb/Hr, or $Lb/10^6$ BTU, solve Eq. 1-4. Do your results match the consultant's? YES X NO__
   If no, fix the problem or call the consultant for a correction.

9. Is the three run(or two run) average correct? YES X NO__
   If no, write in the correct average.

10. Is the average result in compliance? YES X NO__
    If no, the District should issue an NOV.

11. Was the source operating at a level representative of full capacity? YES X NO__
    If no, the permit release may need to provide conditions to cap the source at the test level until a stack test at a higher production level(showing compliance) is performed. If the test was not for permit release, other actions may be warranted.

## Biehl Construction Asphalt Plant Emission Test

### I. Introduction and Summary

Badger Laboratories & Engineering Co., Inc. was retained by Biehl Construction to determine the concentration of Particulate, Formaldehyde and Visible emissions in the exhaust from an Asphalt Plant located at W5659 Campbell Road, in the Town of Byron; Fond du Lac County. A Fabric Filter collection device is in place.

Emission tests were conducted September 19, 1991 by Bruce Lamers and Marcus Klaeser. Mr Jeff Jennerjohn, certified by the WDNR on April 10, 1991 performed the visual emission tests. Mr. Martin Burkholder from the Wisconsin Department of Natural Resources was present to witness the tests. Testing was performed following U.S. EPA Methods. Mr. Steve Biehl is the company contact.

A summary of the Particulate results are as follows:

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### PARTICULATE EMISSION RESULTS

| Test Run | Volumetric Flow Rate scfh | Isokinetic Ratio, % | Particulate lb/hr. | Emission lbs./1000# stack gas |
|---|---|---|---|---|
| 1 | $1.059 \times 10^6$ | 102.9 | 0.78 | 0.008 |
| 2 | $1.038 \times 10^6$ | 103.7 | 0.65 | 0.007 |
| 3 | $1.004 \times 10^6$ | 104.2 | 0.59 | 0.006 |
| | | Ave 103.6 | Ave .67 | Ave 0.007 |

---

The arithmatic average of the results is 0.007 lbs./1000 lbs. stack gas. The limitation for this source is given as 0.3 lbs./1000 lbs. stack gas. This source is operating at 2% of the limitation.

| | |
|---|---|
| **Location:** | **Biehl Construction** |
| **Date:** | **9-19-91** |
| **Time:** | **7:46 - 8:52 AM** |
| **Test Run:** | **#1** |

---

## Stack Gas Data:

| | |
|---|---|
| Temperature, °F. | 175.7 |
| Velocity, ft./sec. | 40.176 |
| Gas Volume, ACFM | 27,068 |
| Gas Volume, SCFM (Wet) | 22,182 |
| Gas Volume, SCFM (Dry) | 17,657 |
| Moisture, % | 20.4 |
| Carbon Dioxide, % (Dry) | 4.3 |
| Oxygen, % (Dry) | 15.7 |
| Carbon Monoxide + Nitrogen, % (Dry) | 80.0 |
| Molecular Weight (Wet) | 27.007 |

## Sampling Data:

| | |
|---|---|
| Total Time, min. | 60 |
| Volume, SCF (Dry) | 43.582 |
| Isokinetic Ratio, % | 102.9 |

## Particulate:

| | |
|---|---|
| Amount Collected, mg. (including condensible) | 14.5 |
| Concentration, grains/SCF | 0.005 |
| Emission Rate, lb/hr. | 0.78 |
| Emission Rate, lb/1000 lb stack gas | 0.008 |

| | |
|---|---|
| **Location:** | **Biehl Construction** |
| **Date:** | **9-19-91** |
| **Time:** | **10:30 - 11:35 AM** |
| **Test Run:** | **#2** |

---

## Stack Gas Data:

| | |
|---|---|
| Temperature, °F. | 175.7 |
| Velocity, ft./sec. | 39.902 |
| Gas Volume, ACFM | 26,884 |
| Gas Volume, SCFM (Wet) | 22,031 |
| Gas Volume, SCFM (Dry) | 17,294 |
| Moisture, % | 21.5 |
| Carbon Dioxide, % (Dry) | 5.3 |
| Oxygen, % (Dry) | 14.6 |
| Carbon Monoxide + Nitrogen, % (Dry) | 80.1 |
| Molecular Weight (Wet) | 26.974 |

## Sampling Data:

| | |
|---|---|
| Total Time, min. | 60 |
| Volume, SCF (Dry) | 43.048 |
| Isokinetic Ratio, % | 103.7 |

## Particulate:

| | |
|---|---|
| Amount Collected, mg. (including condensible) | 12.3 |
| Concentration, grains/SCF | 0.004 |
| Emission Rate, lb/hr. | 0.65 |
| Emission Rate, lb/1000 lb stack gas | 0.007 |

| | |
|---|---|
| **Location:** | **Biehl Construction** |
| **Date:** | **9-19-91** |
| **Time:** | **1:00 - 2:05 PM** |
| **Test Run:** | **#3** |

---

## Stack Gas Data:

| | |
|---|---|
| Temperature, °F. | 181.8 |
| Velocity, ft./sec. | 39.338 |
| Gas Volume, ACFM | 26,504 |
| Gas Volume, SCFM (Wet) | 21,520 |
| Gas Volume, SCFM (Dry) | 16,743 |
| Moisture, % | 22.2 |
| Carbon Dioxide, % (Dry) | 5.2 |
| Oxygen, % (Dry) | 14.1 |
| Carbon Monoxide + Nitrogen, % (Dry) | 80.7 |
| Molecular Weight (Wet) | 26.866 |

## Sampling Data:

| | |
|---|---|
| Total Time, min. | 60 |
| Volume, SCF (Dry) | 41.860 |
| Isokinetic Ratio, % | 104.2 |

## Particulate:

| | |
|---|---|
| Amount Collected, mg. (including condensible) | 11.2 |
| Concentration, grains/SCF | 0.004 |
| Emission Rate, lb/hr. | 0.59 |
| Emission Rate, lb/1000 lb stack gas | 0.006 |

## FORMALDEHYDE EMISSION RESULTS

| Test Run | $V_{m\ std}$, ft.$^3$ | Formaldehyde mg. | Formaldehyde lb/hr. |
|---|---|---|---|
| 1 | 1.139 | 0.3644 | 0.747 |
| 2 | 1.062 | 0.2631 | 0.567 |
| 3 | 1.047 | 0.2101 | 0.444 |

The arithmatic average of the three results is 0.586 lb/hr. The Nr 445 limitation for Formaldehyde is 250 lb/year.

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## OPACITY EMISSION RESULTS

| Test Run | Highest 6 Min. Ave. | Hourly Ave. |
|---|---|---|
| 1 | 4.6 | 2.8 |
| 2 | 5.4 | 3.9 |
| 3 | 5.6 | 4.5 |

The limitation for this source is 40%.

## II. Process Description

The stack carries exhaust gases from a Barber Greene Batch Mix Asphalt Plant rated at 180 tons/hr. The burner is fired with waste oil meeting the specifications of the permit. There is no recycle material used in the mix. An Astec baghouse is used to control Particulate Emissions.

The following is a summary of the Process Data:

## Process Data

| Test Run | Asphalt Tons/hour | Pressure Drop Across Baghouse, in $H_2O$ |
|---|---|---|
| 1 | 147 | 3.0 |
| 2 | 160 | 3.0 |
| 3 | 159 | 3.0 |

# Formaldehyde Laboratory Data

| | Test Run | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Blank |
| Collection Solution Volume 1% Bisulfite, 20 mls/impinger | 45 | 45 | 45 | --- |
| Volume Analyzed - impinger 1 | 1 | 1 | 1 | |
| - impinger 2 | 4 | 4 | 4 | 4 |
| Absorption - impinger 1 | 0.711 | 0.512 | 0.407 | |
| - impinger 2 | 0.008 | 0.005 | 0.005 | 0.006 |
| Calibration Curve Data: | | | | |
| Standard Curve | Blank | 1 ppm | 2 ppm | 4 ppm |
| | 0.001 | 0.038 | 0.088 | 0.196 |

correlation coefficient = .9972
intercept = 0

## Formaldehyde - Field Data

| Test Run | Time | $V_{mstd}$, ft.$^3$ | Flow Rate (Liters) |
|---|---|---|---|
| 1 | 7:55-8:25 | 1.139 | 1 |
| 2 | 10:35-11:10 | 1.062 | 1 |
| 3 | 1:05-1:35 | 1.047 | 1 |

## Calculations

$V_{mstd}$, ft.$^3$ = Sample Air Volume

Mn Formaldehyde = mg. Formaldehyde

$C_s$ Formaldehyde = $2.205 \times 10^{-6} \frac{Mn}{V_{mstd}}$

$Q_s$ scfh = Volumetric Flow Rate

lb/hr. Formaldehyde = $C_s$ formaldehyde x $Q_s$

## Table of Contents

## Biehl Construction Asphalt Plant Emission Test

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A summary of the Particulate results are as follows:

---

**PARTICULATE EMISSION RESULTS**

| Test Run | Volumetric Flow Rate scfh | Isokinetic Ratio, % | Particulate Emission lb/hr. | Particulate Emission lbs./1000# stack gas |
|---|---|---|---|---|
| 1 | $1.059 \times 10^6$ | 102.9 | 0.78 | 0.008 |
| 2 | $1.038 \times 10^6$ | 103.7 | 0.65 | 0.007 |
| 3 | $1.004 \times 10^6$ | 104.2 | 0.59 | 0.006 |

---

The arithmatic average of the results is 0.007 lbs./1000 lbs. stack gas. The limitation for this source is given as 0.3 lbs./1000 lbs. stack gas. This source is operating at 2% of the limitation.

## FORMALDEHYDE EMISSION RESULTS

| Test Run | $V_{m\,std}$, ft.$^3$ | Formaldehyde mg. | Formaldehyde lb/hr. |
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| 1 | 1.139 | 0.3644 | 0.747 |
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The arithmatic average of the three results is 0.586 lb/hr. The Nr 445 limitation for Formaldehyde is 250 lb/year.

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## OPACITY EMISSION RESULTS

| Test Run | Highest 6 Min. Ave. | Hourly Ave. |
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| 1 | 4.6 | 2.8 |
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| 3 | 5.6 | 4.5 |

The limitation for this source is 40%.

## II. Process Description

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The following is a summary of the Process Data:

## Process Data

| Test Run | Asphalt Tons/hour | Pressure Drop Across Baghouse, in $H_2O$ |
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| 1 | 147 | 3.0 |
| 2 | 160 | 3.0 |
| 3 | 159 | 3.0 |

## III. Comments

The testing on September 19, 1991 was performed without any problems to note. The production rate of 82% to 89% of the 180 tons/hour rating of the plant was the maximum production rate that day. The aggregate to be dried had a high moisture content due to recent rains.

## IV. Stack Testing and Analytical Procedures

The procedures for sampling, testing, instrumentation and analysis as described by the U.S. EPA were followed. The EPA reference methods used in the testing program are summarized below.

### Method 1: Sample and Velocity Traverse Locations

The sampling site lies in a straight section of 49" x 33" rectangular steel stack. The sampling ports (6) are 5.1 diameters downstream and 1.2 diameter upstream from the last flow disturbance. Twenty-four points were sampled, four on each traverse.

Sampling time was 2.5 minutes per point. The location of the ports and traverse points is shown below:

### Location of Ports and Traverse Points From Stack Wall

Inside Stack Diameter = 49" x 33"

| | Sample Port Location from side wall | Sample Point Location from back wall |
|---|---|---|
| 1 | 4.1" | 4.12" |
| 2 | 12.2" | 12.37" |
| 3 | 20.4" | 20.62" |
| 4 | 28.6" | 28.87" |
| 5 | 36.7" | |
| 6 | 44.9" | |

### Method 2: Stack gas velocity and Volumetric Flow Rate

For each test run, a velocity traverse was made with a calibrated "S" pitot tube having a co-efficient of 0.840. The velocity head was read on an inclined manometer to the nearest 0.01 inches of water. Temperature was measured with a chromel-alumel thermocouple.

Sampling site barometric pressure was read on site with a barometer and subsequently verified from National Weather Service data.

## Method 3: Component Gas Analysis

Analysis for Carbon Dioxide ($CO_2$), Oxygen ($O_2$), and Nitrogen plus Carbon Monoxide ($N_2$ + CO) were performed in the field using an Orsat type analyzer. Prior to testing, the Orsat apparatus was checked for leaks and the activity of the absorbing solution was determined to be adequate. Results were read and recorded to the nearest 0.2 percent volume, dry basis.

## Method 4: Moisture Content

The moisture content of the stack gas was determined by condensing in three impingers in an ice bath and absorbing any remaining moisture in a fourth impinger containing silica gel.

## Method 5: Particulate Emission

Particulate material is withdrawn isokinetically from the stack and collected on a glass fiber filter maintained in the temperature range of 223° F. - 273° F. The sample gas stream is dried as in Method 4 above. The sample gas is then passed through a metering system which measures both the cumulative volume of gas sampled and the instantaneous sampling rate.

## Sampling Train

A schematic of the sampling train used in this method is shown in Figure 5-1 (See Page #6). The sampling train consists of the following components:

Stainless steel, buttonhook-type nozzle.
Teflon tape gasket.
Stainless steel probe.
Fritted glass filter holder.
Electrically heated enclosed sample box.
Ice-water bath.
Modified Greenburg-Smith impinger.
Greenburg-Smith impinger.
Modified Greenburg-Smith impinger.
Modified Greenburg-Smith impinger.
Check valve.
Vacuum tube.
Vacuum gauge.
Main Valve.
Leak-free vacuum pump.
By-pass valve.
Dry gas meter.
Calibrated orifice.
Dual manometer.
Type "S" pitot tube.

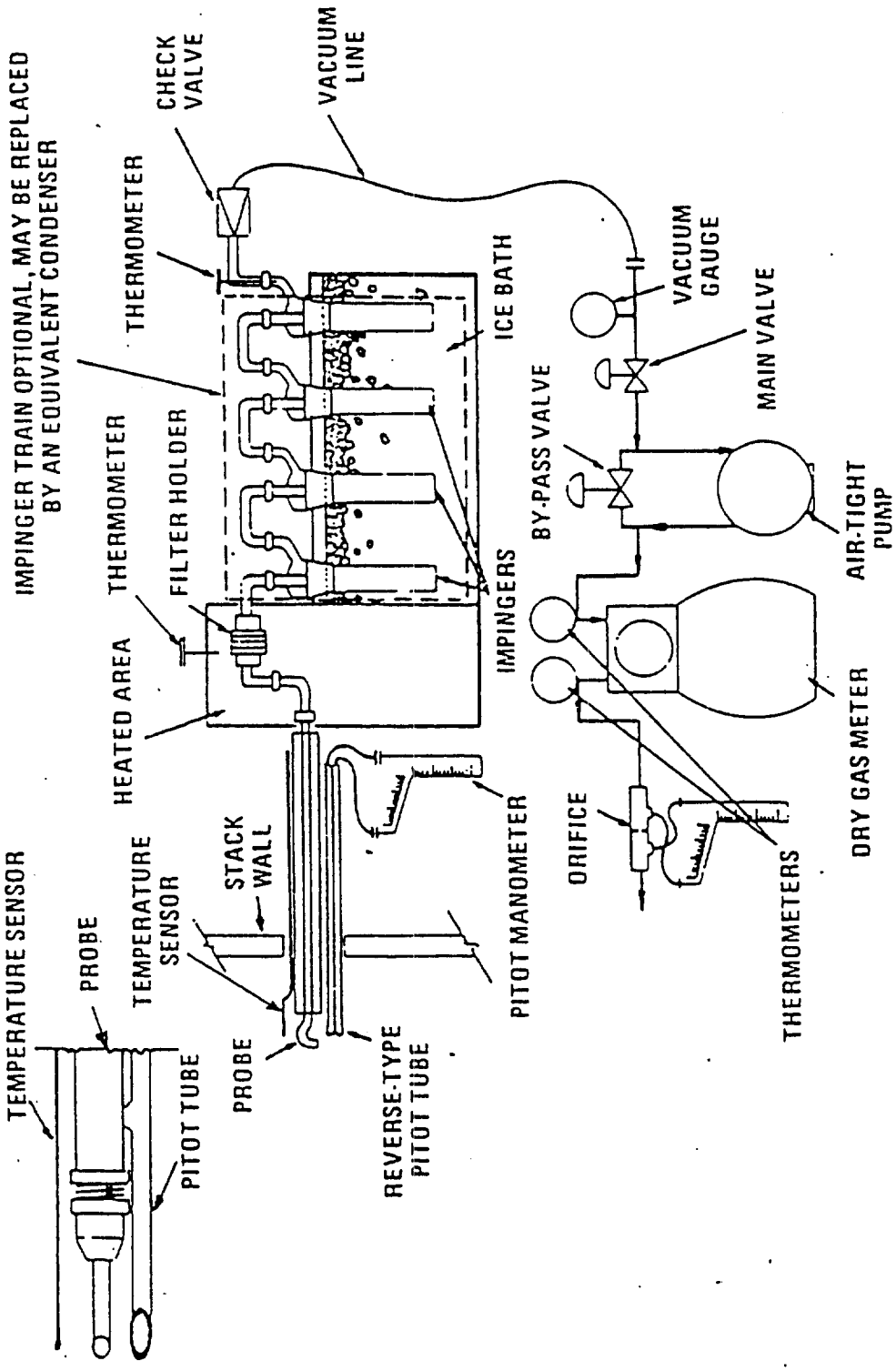


Figure 5-1. Particulate-sampling train.

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A more detailed description of the sampling train components follows:

1. Probe Nozzle: Stainless steel with sharp, tapered leading edge. A 0.287 inch diameter (as measured on site with a caliper) nozzle was used in all tests.

2. Probe Liner: Stainless steel with a heating system to maintain a gas temperature at the exit during sampling of 223° F. to 273° F.

3. Pitot Tube: A Type "S" pitot tube attached to the probe allowed constant monitoring of the stack gas velocity. The pitot tube has a coefficient of 0.840. ▲P was read from an inclined manometer.

4. Differential Pressure Gauge: A Dwyer magnehelic gauge with a range of 0 - 10 inches water was used to obtain ▲H.

5. Filter Holder: Borosilicate glass, with a glass frit filter support and a silicone rubber gasket.

6. Filter Heating System: Thermostat controlled electrical resistance type heater capable of maintaining a temperature of 223°F. - 273°F. around the filter holder.

7. Impingers: Four pyrex glass impingers connected in series with a leak-free ground glass fitting. The first, third, and fourth impingers were Greenburg-Smith design with a modified (straight) tip. The second impinger was a Greenburg-Smith design with a standard tip. A thermometer was in place to measure the temperature at the outlet of the fourth impinger.

8. Metering System: The vacuum gauge, leak-free pump, thermometer, temperature compensated dry gas meter, and related equipment are shown in Figure 5-1. The sampler is a LSI Model 31.

## Sampling Procedures

Prior to testing, the sampling train is cleaned and set up as follows:

A four-inch diameter glass fiber filter was dried in a 105°C. oven overnight. The filter was then placed in a desiccator for two hours and weighed on an analytical balance to the nearest 0.1 milligram (mg.). One hundred milliliters (ml.) of distilled water was placed in each of the first two impingers. Two hundred grams dry silica gel (indicating) was placed in the fourth impinger. The third impinger was left dry and empty. The sampling train was assembled as shown in Figure 5-1 (Page #6). Based on the preliminary velocity and temperature traverse, an appropriate nozzle size was selected to provide an adequate sampling rate.

After assembly, the sampling train was leak-checked at the inlet to the nozzle at 15 inches mercury vacuum. If a leak rate of greater than 0.02 $ft.^3/min.$ was observed, the system was checked and leaks corrected. The leak-check procedure was repeated until the leakage rate was less than 0.02 $ft.^3/min.$

Approximately one half hour before the start of the test, the probe and filter box heaters were turned on and allowed to warm up to sampling temperatures. Ice was placed around the impingers. At the start of a test run, the dry gas meter reading was recorded on the data sheet, the probe was placed in the stack at the first sampling point, and the velocity pressure was read. Using an isokinetic flow rate calculator, the desired orifice meter pressure was determined. The sample pump was then turned on and the time was recorded. The main and by-pass valves were immediately adjusted to give the desired sampling rate. For each point, the following data was recorded: Traverse Point Number, Sampling Time, Stack Temperature, Velocity Head, Orifice Meter Reading, Dry Gas Meter Volume, Meter Temperature, Box Temperature, and Pump Vacuum. Near the end of the sampling time (approximately 10 seconds remaining), the nozzle was moved to the next point and exactly at the start of the next sampling period, the dry gas meter volume was recorded. The point by point sampling procedures were then repeated until the test run was completed. While moving between ports, the pump was turned off. At the completion of the test run, the pump was turned off, the dry gas meter volume recorded, and the probe was removed from the stack. The sampling train was leak-checked from the sample nozzle at the highest vacuum pulled during the test to verify the leak-free integrity of the system.

## Sample Recovery

Sample recovery of the probe and probe nozzle was accomplished near the sampling site. The inner surfaces of each was rinsed with acetone along with cleaning by a brush until no visible particulate was present in the rinse. The impingers and filter holder contents were recovered back at the lab. The contents of the first three impingers were measured volumetrically and placed in a clean container. The silica gel in the fourth impinger was transferred to a clean, dry container and weighed. The filter was carefully transferred to a petri dish. Any filter material which stuck to the gasket was scraped loose and transferred to the petri dish. The upstream portion of the filter holder was washed with acetone. The wash from the filter holder was combined with the washes from the probe and probe nozzle. The container was labelled to identify the test run.

## Sample Analysis

In the laboratory, the filter and any loose particulate were placed in a desiccator for 24-hours. The material was then weighed on an analytical balance to the nearest 0.1 mg.

The volume of the upstream acetone wash was measured and transferred to a tared beaker. The acetone was evaporated at room temperature. After desiccation, the beaker was reweighed. Simultaneously, a 100 ml. acetone blank was evaporated and the residue weight was determined. The net residue weight of the sample washes has been adjusted for the acetone blank.

The water collected from the first three impingers was measured to the nearest ml. All the sample exposed glassware was rinsed with acetone and placed in a separate clean, dry container. This was evaporated in the same manner as the probe wash. The water collected was extracted with 3-50 ml. portions of methylene chloride. The extracts were evaporated in a tarred beaker at 20°C. A 100 ml. portion of the remaining water was evaporated in a tarred beaker at 103°C. The two weight gains were included in the total particulate. The total particulate collected is then the summation of the acetone wash weight gain plus the filter weight gain, plus the water extract weight gain plus the water residue weight gain.

The silica gel from each run was weighed to the nearest 0.1 gr. The weight gain of the silica gel was added to the volume of the liquid water collected in the first three impingers to obtain the total amount of water collected.

## Particulate Emission Rate Equation

1). Volume, DG Meter scf wet = $\frac{\text{Volume, DG Meter scf dry}}{(1 - B_{wo})}$

2). Particulate, lbs./scf wet = $\frac{\text{Particulate, mg. } (2.205 \times 10^{-6})}{\text{Volume, DG Meter scf wet}}$

3). $C''_s = C_s \frac{1}{R} \frac{1}{M_s} 1000$

where...

$B_{wo}$ = Proportion of water vapor in gas stream.

$C''_s$ = Concentration of particulate, lbs./1000 lbs. stack gas-wet.

$C_s$ = Concentration of particulate, lbs./scf - wet.

R = Ideal gas constant $\frac{1 \text{ lb. - mole}}{386 \text{ scf}}$

$M_s$ = Molecular weight of stack gas, wet $\frac{\text{lb.}}{\text{lb. mole}}$

## FORMALDEHYDE TEST METHOD

NIOSH Method 3500 was followed for sampling and analysis of formaldehyde. A sampling rate of one liter per minute for 30 minutes was performed. The two midget impingers contained 20 mls. of 1% Sodium Bisulfite solution. Formaldehyde was analyzed using the Chromatropic Acid Colormetric Procedure. The sampling system used was a Napp, Inc.; Model 63 Gas Sampling System. The system consist of a diaphragm pump, rotameter and dry gas meter with inlet and outlet thermometers.

### Data Handling and Calculations

All mathematical calculations were made according to accepted techniques using U.S. EPA equations. Standard conditions of 29.92 inches mercury pressure and 68°F. temperature were used. Field calculations were rechecked, and the final results for each test run are presented in detail in the Appendix.

# Appendix

| | |
|---|---|
| **Location:** | **Biehl Construction** |
| **Date:** | **9-19-91** |
| **Time:** | **7:46 - 8:52 AM** |
| **Test Run:** | **#1** |

---

## Stack Gas Data:

| | |
|---|---|
| Temperature, °F. | 175.7 |
| Velocity, ft./sec. | 40.176 |
| Gas Volume, ACFM | 27,068 |
| Gas Volume, SCFM (Wet) | 22,182 |
| Gas Volume, SCFM (Dry) | 17,657 |
| Moisture, % | 20.4 |
| Carbon Dioxide, % (Dry) | 4.3 |
| Oxygen, % (Dry) | 15.7 |
| Carbon Monoxide + Nitrogen, % (Dry) | 80.0 |
| Molecular Weight (Wet) | 27.007 |

## Sampling Data:

| | |
|---|---|
| Total Time, min. | 60 |
| Volume, SCF (Dry) | 43.582 |
| Isokinetic Ratio, % | 102.9 |

## Particulate:

| | |
|---|---|
| Amount Collected, mg. (including condensible) | 14.5 |
| Concentration, grains/SCF | 0.005 |
| Emission Rate, lb/hr. | 0.78 |
| Emission Rate, lb/1000 lb stack gas | 0.008 |

| | |
|---|---|
| **Location:** | **Biehl Construction** |
| **Date:** | **9-19-91** |
| **Time:** | **10:30 - 11:35 AM** |
| **Test Run:** | **#2** |

---

## Stack Gas Data:

| | |
|---|---|
| Temperature, °F. | 175.7 |
| Velocity, ft./sec. | 39.902 |
| Gas Volume, ACFM | 26,884 |
| Gas Volume, SCFM (Wet) | 22,031 |
| Gas Volume, SCFM (Dry) | 17,294 |
| Moisture, % | 21.5 |
| Carbon Dioxide, % (Dry) | 5.3 |
| Oxygen, % (Dry) | 14.6 |
| Carbon Monoxide + Nitrogen, % (Dry) | 80.1 |
| Molecular Weight (Wet) | 26.974 |

## Sampling Data:

| | |
|---|---|
| Total Time, min. | 60 |
| Volume, SCF (Dry) | 43.048 |
| Isokinetic Ratio, % | 103.7 |

## Particulate:

| | |
|---|---|
| Amount Collected, mg. (including condensible) | 12.3 |
| Concentration, grains/SCF | 0.004 |
| Emission Rate, lb/hr. | 0.65 |
| Emission Rate, lb/1000 lb stack gas | 0.007 |

| | |
|---|---|
| **Location:** | **Biehl Construction** |
| **Date:** | **9-19-91** |
| **Time:** | **1:00 - 2:05 PM** |
| **Test Run:** | **#3** |

---

## Stack Gas Data:

| | |
|---|---|
| Temperature, °F. | 181.8 |
| Velocity, ft./sec. | 39.338 |
| Gas Volume, ACFM | 26,504 |
| Gas Volume, SCFM (Wet) | 21,520 |
| Gas Volume, SCFM (Dry) | 16,743 |
| Moisture, % | 22.2 |
| Carbon Dioxide, % (Dry) | 5.2 |
| Oxygen, % (Dry) | 14.1 |
| Carbon Monoxide + Nitrogen, % (Dry) | 80.7 |
| Molecular Weight (Wet) | 26.866 |

## Sampling Data:

| | |
|---|---|
| Total Time, min. | 60 |
| Volume, SCF (Dry) | 41.860 |
| Isokinetic Ratio, % | 104.2 |

## Particulate:

| | |
|---|---|
| Amount Collected, mg. (including condensible) | 11.2 |
| Concentration, grains/SCF | 0.004 |
| Emission Rate, lb/hr. | 0.59 |
| Emission Rate, lb/1000 lb stack gas | 0.006 |

# Laboratory Data

**Company:** Biehl Construction
**Date:** 10-3-91
**Test Run:** 1

---

**Filter: No. 13**

| | | |
|---|---|---|
| Final Weight, mg. | 623.8 | |
| Tare Weight, mg. | 619.1 | |
| Weight Gain, mg. | | 4.7 |

**Acetone Probe Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 68290.8 | |
| Tare Weight, mg. | 68286.7 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 45 | |
| Weight Gain, mg. | | 4.1 |

**Impinger Acetone Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 66099.7 | |
| Tare Weight, mg. | 66098.9 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 60 | |
| Weight Gain, mg. | | 0.8 |

**Impinger Water Extracts:**
($CH_2CL_2$)

| | | |
|---|---|---|
| Final Weight, mg. | 66450.8 | |
| Tare Weight, mg. | 66445.3 | |
| Blank Correction, mg. | 1.2 | |
| Weight Gain, mg. | | 4.3 |

**Impinger Water Residue:** (100 ml. Aliquot)

| | | |
|---|---|---|
| Final Weight, mg. | 50496.8 | |
| Tare Weight, mg. | 50496.2 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 460 | |
| Weight Gain, mg. | | 0.6 |
| **Total Particulate, mg.** | | 14.5 |

# Laboratory Data

| | |
|---|---|
| **Company:** | Biehl Construction |
| **Date:** | 10-3-91 |
| **Test Run:** | 2 |

---

**Filter: No. 14**

| | | |
|---|---|---|
| Final Weight, mg. | 620.1 | |
| Tare Weight, mg. | 617.5 | |
| Weight Gain, mg. | | 2.6 |

**Acetone Probe Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 69107.2 | |
| Tare Weight, mg. | 69102.8 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 50 | |
| Weight Gain, mg. | | 4.4 |

**Impinger Acetone Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 80218.1 | |
| Tare Weight, mg. | 80215.8 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 74 | |
| Weight Gain, mg. | | 2.3 |

**Impinger Water Extracts:**
**($CH_2CL_2$)**

| | | |
|---|---|---|
| Final Weight, mg. | 68764.8 | |
| Tare Weight, mg. | 68760.9 | |
| Blank Correction, mg. | 1.2 | |
| Weight Gain, mg. | | 2.7 |

**Impinger Water Residue:** (100 ml. Aliquot)

| | | |
|---|---|---|
| Final Weight, mg. | 50403.5 | |
| Tare Weight, mg. | 50403.2 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 500 | |
| Weight Gain, mg. | | 0.3 |
| **Total Particulate, mg.** | | 12.3 |

# Laboratory Data

| | |
|---|---|
| **Company:** | **Biehl Construction** |
| **Date:** | **10-3-91** |
| **Test Run:** | **3** |

---

**Filter: No. 15**

| | | |
|---|---|---|
| Final Weight, mg. | 609.3 | |
| Tare Weight, mg. | 606.8 | |
| Weight Gain, mg. | | 2.5 |

**Acetone Probe Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 80581.5 | |
| Tare Weight, mg. | 80579.0 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 36 | |
| Weight Gain, mg. | | 2.5 |

**Impinger Acetone Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 80766.4 | |
| Tare Weight, mg. | 80763.3 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 64 | |
| Weight Gain, mg. | | 3.1 |

**Impinger Water Extracts:**
($CH_2CL_2$)

| | | |
|---|---|---|
| Final Weight, mg. | 81136.3 | |
| Tare Weight, mg. | 81132.0 | |
| Blank Correction, mg. | 1.2 | |
| Weight Gain, mg. | | 3.1 |

**Impinger Water Residue:** (100 ml. Aliquot)

| | | |
|---|---|---|
| Final Weight, mg. | 51139.2 | |
| Tare Weight, mg. | 51139.5 | |
| Blank Correction, mg. | 0.0 | |
| Volume, ml. | 520 | |
| Weight Gain, mg. | | 0.0 |
| **Total Particulate, mg.** | | 11.2 |

# Laboratory Data

**Company:** Biehl Construction
**Date:** 10-3-91
**Test Run:** Blanks

---

**Filter: No.**

Final Weight, mg.
Tare Weight, mg.
Weight Gain, mg.

**Acetone Blank Wash:**

| | | |
|---|---|---|
| Final Weight, mg. | 80536.2 | |
| Tare Weight, mg. | 80536.2 | |
| Blank Concentration, mg. | | |
| Volume, ml. | | |
| Weight Gain, mg. | | 0mg./100ml. |

**Impinger Acetone Wash:**

Final Weight, mg.
Tare Weight, mg.
Blank Concentration, mg.
Volume, ml.
Weight Gain, mg.

**Impinger Water Extracts:**
($CH_2CL_2$)

| | | |
|---|---|---|
| Final Weight, mg. | 80882.9 | |
| Tare Weight, mg. | 80881.7 | |
| Blank Concentration, mg. | | |
| Weight Gain, mg. | | 1.2mg. |

**Impinger Water Residue:** (100 ml. Aliquot)

| | | |
|---|---|---|
| Final Weight, mg. | 72854.5 | |
| Tare Weight, mg. | 72854.5 | |
| Blank Concentration, mg. | | |
| Volume, ml. | 135 | |
| Weight Gain, mg. | | 0.0 mg./100 ml. |

**Total Particulate, mg.**

# Formaldehyde Laboratory Data

| | Test Run | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Blank |
| Collection Solution Volume 1% Bisulfite, 20 mls/impinger | 45 | 45 | 45 | --- |
| Volume Analyzed - impinger 1 | 1 | 1 | 1 | |
| - impinger 2 | 4 | 4 | 4 | 4 |
| Absorption - impinger 1 | 0.711 | 0.512 | 0.407 | |
| - impinger 2 | 0.008 | 0.005 | 0.005 | 0.006 |
| Calibration Curve Data: Standard Curve | Blank | 1 ppm | 2 ppm | 4 ppm |
| | 0.001 | 0.038 | 0.088 | 0.196 |

correlation coefficient = .9972
intercept = 0

## Formaldehyde - Field Data

| Test Run | Time | $V_{mstd}$, ft.$^3$ | Flow Rate (Liters) |
|---|---|---|---|
| 1 | 7:55-8:25 | 1.139 | 1 |
| 2 | 10:35-11:10 | 1.062 | 1 |
| 3 | 1:05-1:35 | 1.047 | 1 |

## Calculations

$V_{mstd}$, ft.$^3$ = Sample Air Volume

Mn Formaldehyde = mg. Formaldehyde

$C_s$ Formaldehyde = $2.205 \times 10^{-6} \frac{Mn}{V_{mstd}}$

$Q_s$ scfh = Volumetric Flow Rate

lb/hr. Formaldehyde = $C_s$ formaldehyde x $Q_s$

CALCULATIONS FOR: Biehl Construction - Fond du Lac Date: 9/19/91 Test Run: 1

| | | | | | |
|---|---|---|---|---|---|
| Dry Gas Meter Volume | $V_m$ = 42.502 $ft^3$ | | Particulates Collected | $M_n$ = 14.5 | mg |
| Total Water Collected | $V_{lc}$ = 237.4 | ml | Stack Area | R = 11229 | $ft^2$ |
| Absolute Stack Pressure | $P_s$ = 29.52 | in.Hg | Total Sampling Time | = 60 | min |
| Absolute Meter Pressure | $P_m$ = 29.67 | in.Hg | Pitot Tube Coefficient | $C_p$ = .84 | |
| Absolute Stack Temperature | $T_s$ = 635.7 | °R | Average Velocity Head ($\sqrt{\Delta P}$) | $\sqrt{\Delta P}_{avg}$ = .626533 | |
| Absolute Meter Temperature | $T_m$ = 522.3 | °R | Nozzle Area | $A_n$ = .000449 | $ft^2$ |

Volume of Sample at Standard Conditions, Dry Basis.

$$Y\,[17.647]\,V_m\,\frac{P_m}{T_m} = 1.0229\,[17.647]\,(42.502)\,\left(\frac{29.67}{522.3}\right) = V_{mstd} = 43.582\ ft^3$$

Volume of Water Vapor in Sample at Standard Conditions.

$$[0.04707]\,V_{lc} = [0.04707]\,(237.4) = V_{wstd} = 11.174\ ft^3$$

Proportion of Water Vapor in Gas Stream.

$$\frac{V_{wstd}}{V_{mstd} + V_{wstd}} = \frac{(11.174)}{(43.582) + (11.174)} = B_{wo} = 0.204$$

Concentration of Particulate Matter, Dry Basis.

$$[0.0154]\,\frac{M_n}{V_{mstd}} = [0.0154]\,\left(\frac{14.5}{43.582}\right) = c'_s = .005\ gr/scf$$

$$[2.205 \times 10^{-6}]\,\frac{M_n}{V_{mstd}} = [2.205 \times 10^{-6}]\,\left(\frac{14.5}{43.582}\right) = c_s = 0.734 \times 10^{-6}\ lb/sc$$

Dry Molecular Weight of Stack Gas.

$0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2+\%CO)$ = 0.44 x 4.3 = 1.892; 0.32 x 15.7 = 5.024; 0.28 x 80.0 = 22.4 = $M_d$ = 29.316

Molecular Weight of Stack Gas, Wet Basis.

$$M_d\,(1 - B_{wo}) + 18\,B_{wo} = (29.316)(.796) + 18(.204) = M_s = 27.007$$

Stack Gas Velocity.

$$[85.49]\,C_p\,(\sqrt{\Delta P})_{avg}\,\sqrt{\frac{T_s}{P_s M_s}} = [85.49](.84)(.626533)\sqrt{\frac{(635.7)}{(29.52)(27.01)}} = V_s = 40.176$$

Volumetric Flow Rate, Dry Basis, Standard Conditions.

$$[63529]\,(1 - B_{wo})\,V_s A\,\frac{P_s}{T_s} = [63529](.796)(40.176)(11.229)\,\left(\frac{29.52}{635.7}\right) = Q_s = 1059408\ scfh$$

Emission Rate.

$$Q_s \times c_s = (1.059 \times 10^6)(.734 \times 10^{-6}) = E.R. = 0.78\ lb/hr$$

Percent of Isokinetic Sampling.

$$\frac{K_1\,[K_2\,V_{lc} + \frac{V_m}{T_m}\,P_m]\,T_s}{V_s\,P_s\,A_n} = \frac{[1.667]\,[(.00267)(237.4) + \frac{1.0229 \times 42.502}{522.3}(29.67)]\,(635.7)}{(60)(40.176)(29.52)(.000449)} = I = 102.9\ \%$$

CALCULATIONS FOR: Bickle Construction, Fond du Lac Date: 9/19/91 Test Run: 2

| | | | | | |
|---|---|---|---|---|---|
| Dry Gas Meter Volume | $V_m$ = 42.375 ft³ | | Particulates Collected | $M_R$ = 12.3 | mg |
| Total Water Collected | $V_{lc}$ = 250.5 ml | | Stack Area | $A_R$ = 11.229 | ft² |
| Absolute Stack Pressure | $P_s$ = 29.52 in.Hg | | Total Sampling Time | $\theta$ = 60 | min |
| Absolute Meter Pressure | $P_m$ = 29.67 in.Hg | | Pitot Tube Coefficient | $C_p$ = .84 | |
| Absolute Stack Temperature | $T_s$ = 635.7 °R | | Average Velocity Head $(\sqrt{\Delta P})_{avg}$ | = .62188 | |
| Absolute Meter Temperature | $T_m$ = 527.2 °R | | Nozzle Area | $A_n$ = .000449 | ft² |

Volume of Sample at Standard Conditions, Dry Basis.

$$K_1 [17.647] V_m \frac{P_m}{T_m} = 1.0229 [17.647] \left( 42.375 \right) \left( \frac{29.67}{527.2} \right) = V_{mstd} = 43.048 \text{ ft}^3$$

Volume of Water Vapor in Sample at Standard Conditions.

$$[0.04707] V_{lc} = [0.04707] (250.5) = V_{wstd} = 11.791 \text{ ft}^3$$

Proportion of Water Vapor in Gas Stream.

$$\frac{V_{wstd}}{V_{mstd} + V_{wstd}} = \frac{(11.791)}{(43.048) + (11.791)} = B_{wo} = .215$$

Concentration of Particulate Matter, Dry Basis.

$$[0.0154] \frac{M_n}{V_{mstd}} = [0.0154] \left( \frac{12.3}{43.048} \right) = c'_s = .004 \text{ gr/scf}$$

$$[2.205 \times 10^{-6}] \frac{M_n}{V_{mstd}} = [2.205 \times 10^{-6}] \left( \frac{12.3}{43.048} \right) = c_s = .630 \times 10^{-6} \text{ lb/s}$$

Dry Molecular Weight of Stack Gas.

$0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$

| | | |
|---|---|---|
| 0.44 x 5.3 | = | 2.332 |
| 0.32 x 14.6 | = | 4.672 |
| 0.28 x 80.1 | = | 22.428 |

$M_d$ = 29.432

Molecular Weight of Stack Gas, Wet Basis.

$$M_d (1 - B_{wo}) + 18 B_{wo} = (29.432)(.785) + 18(.215) = M_s = 26.974$$

Stack Gas Velocity.

$$[85.49] C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_s}{P_s M_s}} = [85.49] (.84)(.62188) \sqrt{\frac{(635.7)}{(29.52)(26.97)}} = V_s = 39.902$$

Volumetric Flow Rate, Dry Basis, Standard Conditions.

$$[.63529] (1 - B_{wo}) V_s A \frac{P_s}{T_s} = [.63529] (.785)(39.902)(11.229) \left( \frac{29.52}{635.7} \right) = Q_s = 4037643 \text{ scfh}$$

Emission Rate.

$$Q_s \times c_s = (1.038 \times 10^{6})(.630 \times 10^{-6}) = \text{E.R.} = 0.65 \text{ lb/hr}$$

Percent of Isokinetic Sampling.

$$\frac{K_1 [K_2 V_{lc} + \frac{V_m}{T_m} P_m] T_s}{\theta V_s P_s A_n} = \frac{[1.667] [(.00267)(250.5) + \frac{1.0229 \times 42.375}{527.2} (29.67)] (635.7)}{(60)(39.902)(29.52)(.000449)} = I = 103.7 \%$$

CALCULATIONS FOR: Biehl Construction - Fond du Lac Date: 9/19/91 Test Run: 3

| | | | | | |
|---|---|---|---|---|---|
| Dry Gas Meter Volume | $V_m$ = 41.550 ft³ | | Particulates Collected | $M_n$ = 11.2 mg | |
| Total Water Collected | $V_{lc}$ = 253.7 ml | | Stack Area | $A$ = 11.229 ft² | |
| Absolute Stack Pressure | $P_s$ = 29.53 in.Hg | | Total Sampling Time | $\theta$ = 60 min | |
| Absolute Meter Pressure | $P_m$ = 29.67 in.Hg | | Pitot Tube Coefficient | $C_p$ = .84 | |
| Absolute Stack Temperature | $T_s$ = 641.8 °R | | Average Velocity Head ($\sqrt{\Delta P}$) | $\overline{\sqrt{\Delta P}}$ = .60906 | |
| Absolute Meter Temperature | $T_m$ = 531.6 °R | | Nozzle Area | $A_n$ = .00449 ft² | |

Volume of Sample at Standard Conditions, Dry Basis.

$$K_1 [17.647] V_m \frac{P_m}{T_m} \quad .02669[17.647]\left(41.550\right)\left(\frac{29.67}{531.6}\right) = V_{mstd} = 41.860 \text{ ft}^3$$

Volume of Water Vapor in Sample at Standard Conditions.

$$[0.04707] V_{lc} = [0.04707]\left(253.7\right) = V_{wstd} = 11.942 \text{ ft}^3$$

Proportion of Water Vapor in Gas Stream.

$$\frac{V_{wstd}}{V_{mstd} + V_{wstd}} = \frac{\left(41.860\right)}{\left(41.860\right) + \left(11.942\right)} = B_{wo} = .222$$

Concentration of Particulate Matter, Dry Basis.

$$[0.0154] \frac{M_n}{V_{mstd}} = [0.0154]\left(\frac{11.2}{41.860}\right) = c'_s = .004 \text{ gr/scf}$$

$$[2.205 \times 10^{-6}] \frac{M_n}{V_{mstd}} = [2.205 \times 10^{-6}]\left(\frac{11.2}{41.860}\right) = c_s = .590 \times 10^{-6} \text{ lb/sc}$$

Dry Molecular Weight of Stack Gas.

$0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2+\%CO)$

| | | | |
|---|---|---|---|
| 0.44 x | 5.2 | = | 2.288 |
| 0.32 x | 14.1 | = | 4.512 |
| 0.28 x | 80.7 | = | 22.596 |

$M_d$ = 29.396

Molecular Weight of Stack Gas, Wet Basis.

$$M_d (1 - B_{wo}) + 18 B_{wo} = \left(29.396\right)\left(.778\right) + 18\left(.222\right) = M_s = 26.866$$

Stack Gas Velocity.

$$[85.49] C_p \overline{\sqrt{\Delta P}} \text{ avg.} \sqrt{\frac{T_s}{P_s M_s}} = [85.49]\left(.84\right)(.60906)\sqrt{\frac{\left(641.8\right)}{\left(29.53\right)\left(26.866\right)}} = V_s = 39.338$$

Volumetric Flow Rate, Dry Basis, Standard Conditions.

$$[63529] (1 - B_{wo}) V_s A \frac{P_s}{T_s} = [63529]\left(.778\right)(11.229)(39.338)\left(\frac{29.53}{641.8}\right) = Q_s = 1004558 \text{ scfh}$$

Emission Rate.

$$Q_s \times c_s = (1.004 \times 10^6)(.590 \times 10^{-6}) = \text{E.R.} = 0.59 \text{ lb/hr}$$

Percent of Isokinetic Sampling.

$$\frac{K_1 [K_2 V_{lc} + \frac{V_m}{T_m} P_m] T_s}{\theta V_s P_s A_n} = \frac{[1.667]\left[(.00267)(253.7) + \frac{1.0229 \times 41.55}{531.6}\right](29.67)](641.8)}{(60)(39.338)(29.53)(.00449)} = I = 104.2 \%$$

COMPANY Bird Constr. | AMBIENT TEMPERATURE 50 | SAMPLE BOX # |

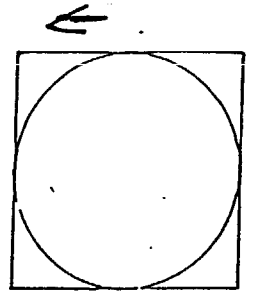
LOCATION Asphalt plant | BAROMETRIC PRESSURE 30.34 -.8 | METER BOX # |

DATE 9/19 | ASSUMED MOISTURE, % 20 | METER H@ 1.99

TEST RUN # 1 | HEATER BOX SETTING 23 | C FACTOR 10229

STACK AREA 49x33 | PROBE HEATER SETTING 250 | PROBE LENGTH 3'

OPERATOR BF | FILTER NUMBER 13 | NOZZLE DIAMETER .287



STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE (in.$H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD (Δp) | ($\sqrt{\Delta p}$) | ORIFICE METER (ΔH) | DRY GAS METER VOLUME ($V_m$, ft³) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM (in.Hg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7:46-5 | 1 | 2.5 | | 165 | .40 | .6324 | 1.76 | 21.620 | 42 | 44 | 250 | 3.0 | |
| 49 | 2 | | | 169 | .44 | .6633 | 1.91 | 23.40 | 59 | 45 | | | 23.37 |
| 51.5 | 3 | | | 174 | .44 | .6633 | 1.96 | 25.22 | 67 | 46 | | | 25.20 |
| 54/56.5 | 4 | | | 173 | .35 | .5916 | 1.57 | 27.03 | 70 | 46 | | | 27.06 |
| 7:57-5 | 2 1 | | -.21 | 172 | .50 | .7071 | 2.24 | 28.74 | 70 | 47 | | | 28.72 |
| 8:00 | 2 | | | 175 | .43 | .6557 | 1.93 | 30.70 | 74 | 47 | | | 30.70 |
| 02-5 | 3 | | | 179 | .41 | .6403 | 1.85 | 32.56 | 77 | 47 | | | 32.53 |
| 5/7.5 | 4 | | | 179 | .36 | .60 | 1.62 | 34.37 | 77 | 47 | | | 34.33 |
| 9 | 3 1 | | | 177 | .52 | .7211 | 2.34 | 36.11 | 75 | 48 | | 4.0 | 36.02 |
| 11.5 | 2 | | | 177 | .40 | .6324 | 1.81 | 38.12 | 77 | 48 | | | 38.04 |
| 14 | 3 | | | 175 | .50 | .6324 | 1.82 | 39.89 | 80 | 49 | | | 39.82 |
| 16.5/19 | 4 | | | 180 | .40 | .6324 | 1.82 | 41.68 | 81 | 49 | | | 41.60 |
| TOTAL | | | -.21 | 2095 | | 7.7720 | 22.63 | 43.47 | 849 | 363 | | | |
| AVERAGE | | | | | | | | | | | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 | PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|---|---|---|---|---|
| FINAL | | | 420 | 217.4 | FINAL | | |
| INITIAL | | | 200 | 200 | TARE | | |
| NET $H_2O$ | | | 220 | 17.4 | NET GAIN | | |
| TOTAL $H_2O$ COLLECTED, ml | 237.4 | | | | TOTAL WEIGHT, mg | | |

| ORSAT TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| 7:45 | | | | |
| | | | | |
| | | | | |
| AVERAGE | | | | |

COMMENTS:

leak ck before at 15" Hg OK

leak ck pitot tube before at >3" $H_2O$ OK

COMPANY Bill Construction | AMBIENT TEMPERATURE 50 | SAMPLE BOX #

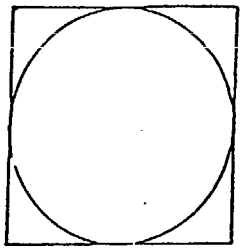
LOCATION | BAROMETRIC PRESSURE | METER BOX #

DATE 9/19 | ASSUMED MOISTURE, % | METER H@

TEST RUN # 1 | HEATER BOX SETTING | C FACTOR

STACK AREA | PROBE HEATER SETTING | PROBE LENGTH

OPERATOR BO | FILTER NUMBER 13 | NOZZLE DIAMETER



STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE ($in.H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD ($\Delta p$) | ($\sqrt{\Delta p}$) | ORIFICE METER ($\Delta H$) | DRY GAS METER VOLUME ($V_m$, $ft^3$) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM ($in.H_g$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8:20 | 41 | 2.5 | | 176 | .30 | .7071 | 2.28 | 43.47 | 74 | 49 | 250 | | 43.39 |
| 22.5 | 2 | | | 179 | .35 | .5916 | 1.59 | 45.43 | 81 | 50 | | | 45.38 |
| 25 | 3 | | | 180 | .35 | .5916 | 1.59 | 47.12 | 82 | 50 | | | 47.06 |
| 27.5/30 | 4 | | -.20 | 181 | .37 | .6083 | 1.68 | 48.80 | 82 | 50 | | | 48.72 |
| 31 | 51 | | | 178 | .46 | .6782 | 2.09 | 50.55 | 80 | 50 | | | 50.44 |
| 33.5 | 2 | | | 182 | .31 | .5568 | 1.41 | 52.47 | 81 | 51 | | 3.0 | 52.36 |
| 36 | 3 | | | 183 | .32 | .5657 | 1.46 | 54.10 | 83 | 51 | | | 53.93 |
| 38.5/41 | 4 | | | 177 | .35 | .5916 | 1.60 | 55.67 | 83 | 51 | | | 55.52 |
| 42 | 61 | | | 171 | .39 | .6245 | 1.78 | 57.35 | 80 | 51 | | | 57.20 |
| 44.5 | 2 | | | 175 | .34 | .5831 | 1.56 | 59.13 | 83 | 51 | | | 58.96 |
| 47 | 3 | | | 174 | .34 | .5831 | 1.57 | 60.80 | 84 | 52 | | | 61.64 |
| 49.5/52 | 4 | | | 166 | .34 | .5831 | 1.58 | 62.45 | 84 | 52 | | | 62.27 |
| TOTAL | | | -.20 | 2122 | | 7.2647 | 20.19 | 64.122 | 977 | 605 | | | 63.94 |
| AVERAGE | | | -.20 | 175.7 | | .6000 .6053 | 1.78 | 42.502 | 76.08 | 48.79 | | | 62.3 |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| FINAL | | | | |
| INITIAL | | | | |
| NET $H_2O$ | | | | |
| TOTAL $H_2O$ COLLECTED, ml | | | | |

| PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|
| FINAL | | |
| TARE | | |
| NET GAIN | | |
| TOTAL WEIGHT, mg | | |

| ORSAT TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| | 4.2 | 15.8 | | |
| | 4.4 | 15.6 | | |
| | | | | |
| AVERAGE | 4.3 | 15.7 | | 800 |

COMMENTS:

leak ck after at 6 "Hg .005 CFM OK

COMPANY Reid Construction
LOCATION Asphalt plant
DATE 9/19/95
TEST RUN # 2
STACK AREA 49x33
OPERATOR BS

AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 30.34
ASSUMED MOISTURE, % 20
HEATER BOX SETTING 250
PROBE HEATER SETTING 250
FILTER NUMBER 14

SAMPLE BOX #
METER BOX #
METER H@ 1.99
C FACTOR 1.0229
PROBE LENGTH 3
NOZZLE DIAMETER .287

STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE (in.$H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD (Δp) | ($\sqrt{\Delta p}$) | ORIFICE METER (ΔH) | DRY GAS METER VOLUME ($V_m$, ft³) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM (in.Hg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10:30 | 1 1 | 2.5 | | 153 | .44 | .6633 | 1.95 | 064.407 | 50 | 52 | 250 | | |
| 32.5 | 2 | | | 161 | .51 | .7141 | 2.30 | 66.30 | 67 | 53 | | | 66.26 |
| 35 | 3 | | | 166 | .46 | .6782 | 2.11 | 68.33 | 71 | 53 | | | 68.26 |
| 37/40 | 4 | | | 161 | .37 | .6083 | 1.69 | 70.27 | 76 | 53 | | | 70.19 |
| 41 | 2 1 | | -.26 | 167 | .53 | .7280 | 2.44 | 72.00 | 74 | 53 | | 4.0 | 71.91 |
| 43.5 | 2 | | | 170 | .46 | .6782 | 2.13 | 74.05 | 78 | 52 | | | 73.98 |
| 46 | 3 | | | 173 | .42 | .6481 | 1.93 | 75.99 | 81 | 52 | | | 75.91 |
| 48.5/52 | 4 | | | 173 | .42 | .6481 | 1.93 | 77.84 | 82 | 52 | | 3.0 | 77.75 |
| 52 | 3 1 | | | 173 | .54 | .7483 | 2.57 | 79.69 | 82 | 52 | | 4.0 | 79.58 |
| 54.5 | 2 | | | 175 | .37 | .6083 | 1.70 | 81.79 | 82 | 52 | | 4 | 81.70 |
| 57 | 3 | | | 178 | .36 | .6 | 1.66 | 83.51 | 84 | 52 | | | 83.43 |
| 59.5/62 | 4 | | | 180 | .36 | .6 | 1.65 | 85.21 | 85 | 53 | | | 85.13 |
| TOTAL | | | -.26 | 2030 | | 7.9229 | 24.06 | 869.2 | 912 | 629 | | | |
| AVERAGE | | | | | | | | | | | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 | PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|---|---|---|---|---|
| FINAL | | | 434 | 216.5 | FINAL | | |
| INITIAL | | | 200 | 200 | TARE | | |
| NET $H_2O$ | | | 234 | 16.5 | NET GAIN | | |
| TOTAL $H_2O$ COLLECTED, ml | 250.5 | | | | TOTAL WEIGHT, mg | | |

| ORSAT'S TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| 10:30 | | | | |
| | | | | |
| | | | | |
| AVERAGE | | | | |

COMMENTS:
leak ck before at 15" Hg
OK

COMPANY Biehl Construction | AMBIENT TEMPERATURE _____ | SAMPLE BOX # _____

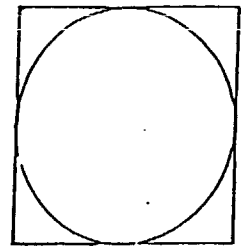
LOCATION Fond du Lac | BAROMETRIC PRESSURE _____ | METER BOX # _____

DATE 9/19/91 | ASSUMED MOISTURE, % _____ | METER H@ _____

TEST RUN # 2 | HEATER BOX SETTING _____ | C FACTOR _____

STACK AREA 49x33 | PROBE HEATER SETTING _____ | PROBE LENGTH _____

OPERATOR BE | FILTER NUMBER _____ | NOZZLE DIAMETER _____



STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE (in.$H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD (Δp) | ($\sqrt{\Delta p}$) | ORIFICE METER (ΔH) | DRY GAS METER VOLUME ($V_m$, $ft^3$) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM (in.$H_g$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11:03 | 4 | 2.5 | | 180 | .49 | .7 | 2.25 | 86.92 | 82 | 53 | 250 | | 86.83 |
| 5.5 | 2 | | | 181 | .32 | .5657 | 1.47 | 88.87 | 85 | 53 | | | 88.82 |
| 8 | 3 | | | 184 | .33 | .5744 | 1.52 | 90.50 | 86 | 54 | | | 90.42 |
| 10.5/13 | 4 | | | 185 | .36 | .6 | 1.66 | 92.10 | 86 | 54 | | 30 | 92.05 |
| 14 | 1 | | -.20 | 184 | .41 | .6403 | 1.89 | 93.89 | 84 | 54 | | | 93.76 |
| 16.5 | 2 | | | 182 | .31 | .5568 | 1.43 | 95.60 | 86 | 54 | | | 95.58 |
| 19 | 3 | | | 185 | .31 | .5568 | 1.43 | 97.20 | 87 | 55 | | | 97.16 |
| 21.5/24 | 4 | | | 184 | .31 | .5568 | 1.43 | 98.78 | 88 | 55 | | | 98.74 |
| 11:25 | 1 | | | 179 | .37 | .6083 | 1.71 | 100.36 | 82 | 55 | | | 100.32 |
| 27.5 | 2 | | | 184 | .31 | .5568 | 1.43 | 2.69 | 87 | 55 | | | 2.06 |
| 30 | 3 | | | 183 | .30 | .5477 | 1.39 | 3.69 | 88 | 56 | | | 3.64 |
| 32.5/35 | 4 | | | 176 | .29 | .5385 | 1.35 | 5.25 | 89 | 56 | | | 5.20 |
| TOTAL | | | -.20 | 2187 | | 7.0021 | 18.96 | 106.782 | 1030 | 654 | | | 6.74 |
| AVERAGE | | | -.23 | 175.7 | | 0.62188 | 1.79 | 42.375 | 67.2 | | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 | PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|---|---|---|---|---|
| FINAL | | | | | FINAL | | |
| INITIAL | | | | | TARE | | |
| NET $H_2O$ | | | | | NET GAIN | | |
| TOTAL $H_2O$ COLLECTED, ml | | | | | TOTAL WEIGHT, mg | | |

| ORSAT'S TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| | 5.4 | 14.6 | | 80.0 |
| | 5.2 | 14.6 | | 80.2 |
| | | | | |
| AVERAGE | 5.3 | 14.6 | | 80.1 |

COMMENTS:

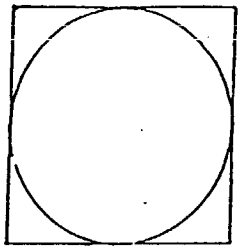
leak ck after at 6 "Hg <.005 CFM OK

leak ck pitot tube at >3" $H_2O$ OK

COMPANY Buell Constr.
LOCATION Fort du Lac Asphalt Plant
DATE 9/19/91
TEST RUN # 3
STACK AREA 49x33
OPERATOR BTO

AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 30.34
ASSUMED MOISTURE, % 20
HEATER BOX SETTING 250
PROBE HEATER SETTING 250
FILTER NUMBER 15

SAMPLE BOX # —
METER BOX # —
METER H@ 1.99
C FACTOR .10229
PROBE LENGTH 3'
NOZZLE DIAMETER .287


STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE (in.$H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD (Δp) | ($\sqrt{\Delta p}$) | ORIFICE METER (ΔH) | DRY GAS METER VOLUME ($V_m$, $ft^3$) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM (in.$H_g$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1:00 | 1 1 | 2.5 | | 167 | .40 | .6324 | 1.83 | 107.108 | 58 | 57 | 250 | 5.0 | |
| 2.5 | 2 | | | 174 | .46 | .6782 | 2.11 | 8.87 | 73 | 57 | | | 8.90 |
| 5 | 3 | | | 177 | .44 | .6633 | 2.03 | 10.80 | 78 | 58 | | | 10.92 |
| 7.5/10 | 4 | | | 179 | .32 | .5657 | 1.47 | 12.70 | 80 | 58 | | | 12.71 |
| 11 | 2 1 | | | 178 | .47 | .6856 | 2.16 | 14.33 | 80 | 58 | | 6.0 | 14.31 |
| 13.5 | 2 | | -20 | 179 | .43 | .6557 | 1.98 | 16.20 | 83 | 58 | | | 16.25 |
| 16 | 3 | | | 171 | .55 | .7416 | 2.55 | 18.06 | 86 | 58 | | 7.0 | 18.12 |
| 18.5/21 | 4 | | | 182 | .37 | .6083 | 1.72 | 20.12 | 87 | 58 | | | 20.23 |
| 22 | 3 1 | | | 182 | .45 | .6708 | 2.10 | 21.86 | 84 | 58 | | | 21.97 |
| 24.5 | 2 | | | 182 | .35 | .5916 | 1.63 | 23.75 | 87 | 58 | | | 23.88 |
| 27 | 3 | | | 186 | .36 | .6 | 1.67 | 25.48 | 88 | 58 | | | 25.57 |
| 29.5/32 | 4 | | | 186 | .39 | .6245 | 1.81 | 27.20 | 89 | 58 | | | 27.28 |
| TOTAL | | | -.20 | 2143 | | 7.7177 | 23.06 | 29.00 | 973 | 694 | | | |
| AVERAGE | | | | | | | | | | | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 | PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|---|---|---|---|---|
| FINAL | | | | | FINAL | | |
| INITIAL | | | | | TARE | | |
| NET $H_2O$ | | | | | NET GAIN | | |
| TOTAL $H_2O$ COLLECTED, ml | | | | | TOTAL WEIGHT, mg | | |

| ORSAT'S TIME | $CO_2$ | $O_2$ | CO | $H_2$ |
|---|---|---|---|---|
| 1:00 | | | | |
| | | | | |
| | | | | |
| AVERAGE | | | | |

COMMENTS:
leak ch before at 15" Hg OK

COMPANY _____ AMBIENT TEMPERATURE _____ SAMPLE BOX # _____

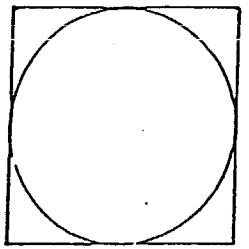
LOCATION _____ BAROMETRIC PRESSURE _____ METER BOX # _____

DATE 9-19-91 ASSUMED MOISTURE, % _____ METER H@ _____

TEST RUN # 3 HEATER BOX SETTING _____ C FACTOR _____

STACK AREA _____ PROBE HEATER SETTING _____ PROBE LENGTH _____

OPERATOR BT FILTER NUMBER _____ NOZZLE DIAMETER _____



STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE (in.$H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD ($\Delta p$) | ($\sqrt{\Delta p}$) | ORIFICE METER (ΔH) | DRY GAS METER VOLUME ($V_m$, ft³) | INLET ($T_{mi}$, °F) | OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM (in.$H_g$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | 4 1 | 2.5 | | 179 | .49 | .7 | 2.27 | 29.00 | 85 | 58 | 250 | | 29.04 |
| 35.5 | 2 | | | 181 | .32 | .5657 | 1.48 | 30.95 | 89 | 58 | | | 31.06 |
| 38 | 3 | | | 187 | .33 | .5744 | 1.53 | 32.61 | 89 | 58 | | 4.0 | 32.66 |
| 40-5/43 | 4 | | | 188 | .33 | .5744 | 1.52 | 34.24 | 90 | 59 | | | 34.30 |
| 46 | 5 1 | | | 183 | .45 | .6708 | 2.07 | 35.84 | 86 | 58 | | | 35.93 |
| 46-5 | 2 | | | 182 | .32 | .5657 | 1.48 | 37.75 | 89 | 59 | | | 37.84 |
| 49 | 3 | | | 187 | .30 | .5477 | 1.40 | 39.42 | 91 | 59 | | | 39.45 |
| 51-3/54 | 4 | | | 187 | .30 | .5477 | 1.40 | 40.97 | 91 | 59 | | | 41.01 |
| 55 | 6 1 | | -.15 | 185 | .31 | .5568 | 1.44 | 42.52 | 86 | 59 | | | 42.58 |
| 57.5 | 2 | | | 190 | .29 | .5385 | 1.35 | 44.08 | 89 | 59 | | | 44.17 |
| 2:00 | 3 | | | 191 | .29 | .5385 | 1.35 | 45.62 | 91 | 59 | | | 45.79 |
| 2-3/05 | 4 | | | 180 | .27 | .5196 | 1.26 | 47.15 | 91 | 59 | | | 47.24 |
| TOTAL | | | -.15 | 2220 | | 6.8998 | 18.55 | 148.658 | 1067 | 704 | | | 48.72 |
| AVERAGE | | | -.18 | 181.8 | | .60906 | 1.73 | 41.550 | 71.6 | | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 | PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|---|---|---|---|---|
| FINAL | | | 438 | 215.7 | FINAL | | |
| INITIAL | | | 200 | 200 | TARE | | |
| NET $H_2O$ | | | 238 | 15.7 | NET GAIN | | |
| TOTAL $H_2O$ COLLECTED, ml | | | 253.7 | | TOTAL WEIGHT, gr | | |

| ORSAT'S TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| | 5.2 | 14.0 | | |
| | 5.2 | 14.2 | | |
| | | | | |
| AVERAGE | 5.2 | 14.1 | | 80.7 |

COMMENTS:

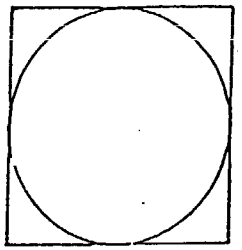
Back at after at
7" Hg
< .01 CFM
OK

formaldehyde test

COMPANY Biehl Construction
LOCATION Fond du Lac
DATE 9/19/91
TEST RUN # 1
STACK AREA 49x33
OPERATOR BJT

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE HEATER SETTING
FILTER NUMBER

SAMPLE BOX #
METER BOX #
METER H@
C FACTOR 1.00
PROBE LENGTH
NOZZLE DIAMETER


STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE ($in.H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD (Δp) | ($\sqrt{\Delta p}$) | ORIFICE METER (LH) | DRY GAS METER VOLUME ($V_m$, $ft^3$) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM ($in.H_g$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7:55 | | 0 | | | | | 1 LPM | 258.826 | 38 | 46 | | | |
| 8:00 | | 5 | | | | | | 59.01 | 40 | 46 | | | |
| 5 | | 10 | | | | | | 59.19 | 40 | 46 | Vm=1.10 | | |
| 10 | | 15 | | Tot 1 | | | | 59.35 | 41 | 46 | Tm=43.4 | | |
| 15 | | 20 | | | | | | 59.55 | 42 | 46 | 1.10×17.647×29.54/503.4 | | |
| 20 | | 25 | | | | | | 59.76 | 42 | 46 | Vmstd=1.139 | | |
| 8:25 | | 30 | | | | | | 259.926 | 42 | 46 | | | |
| 10:35 | | 0 | | | | | | 259.926 | 43 | 48 | | | |
| 40 | | 5 | | Tot 2 | | | | 60.10 | 43 | 48 | Vm=1.032 | | |
| 50 | | 10 | | | | | | 60.27 | 43 | 48 | Tm=46.8 | | |
| 55 | | 15 | | | | | | 60.44 | 45 | 49 | 1.032×17.647×29.59/506.8 | | |
| 11:00 | | 20 | | | | | | 60.62 | 46 | 49 | Vmstd=1.062 | | |
| TOTS | | 25 | | | | | | 60.79 | 47 | 50 | | | |
| 11:40 | | 30 | | | | | | 260.958 | 47 | 50 | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| FINAL | | | | |
| INITIAL | | | | |
| NET $H_2O$ | | | | |
| TOTAL $H_2O$ COLLECTED, ml | | | | |

| PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|
| FINAL | | |
| TARE | | |
| NET GAIN | | |
| TOTAL WEIGHT, mg | | |

| ORSAT'S TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| AVERAGE | | | | |

COMMENTS:

# formaldehyde Test

COMPANY Bill Construction | AMBIENT TEMPERATURE _____ | SAMPLE BOX # _____

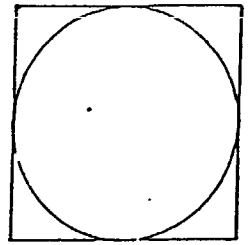
LOCATION Fond du Lac | BAROMETRIC PRESSURE _____ | METER BOX # _____

DATE 9/19/91 | ASSUMED MOISTURE, % _____ | METER H@ _____

TEST RUN # 3 | HEATER BOX SETTING _____ | C FACTOR _____

STACK AREA _____ | PROBE HEATER SETTING _____ | PROBE LENGTH _____

OPERATOR _____ | FILTER NUMBER _____ | NOZZLE DIAMETER _____



STACK CROSS SECTION

| | TRAVERSE POINT NUMBER | SAMPLING TIME (θ, min) | STATIC PRESSURE ($in.H_2O$) | STACK TEMP ($T_s$, °F) | VELOCITY HEAD ($\Delta p$) | ($\sqrt{\Delta p}$) | ORIFICE METER (ΔH) | DRY GAS METER VOLUME ($V_m$, $ft^3$) | DRY GAS METER INLET ($T_{mi}$, °F) | DRY GAS METER OUTLET ($T_{mo}$, °F) | BOX TEMP (°F) | PUMP VACUUM ($in.H_g$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1:05 | | 0 | | | | | 1LPM | 260.958 | 49 | 53 | | | |
| 10 | | 5 | | | | | | 61.13 | 48 | 53 | | | |
| 15 | | 10 | | | | | | 61.30 | 49 | 53 | | | |
| 20 | | 15 | | | | | | 61.47 | 50 | 53 | | | |
| 25 | | 20 | | | | | | 61.65 | 50 | 53 | | | |
| 30 | | 25 | | | | | | 61.81 | 49 | 53 | | | |
| 1:35 | | 30 | | | | | | 261.985 | 49 | 53 | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | 1.027 | 51.1 | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | 1.027×1261.47×29.54/551.1 = | | | | | Vmstd = 1.047 |
| | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | |
| AVERAGE | | | | | | | | | | | | | |

| WATER COLLECTED | IMPINGERS 1 | 2 | 3 | 4 | PARTICULATE COLLECTED | FILTER | PROBE WASH |
|---|---|---|---|---|---|---|---|
| FINAL | | | | | FINAL | | |
| INITIAL | | | | | TARE | | |
| NET $H_2O$ | | | | | NET GAIN | | |
| TOTAL $H_2O$ COLLECTED, ml | | | | | TOTAL WEIGHT, mg | | |

| ORSAT'S TIME | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| AVERAGE | | | | |

COMMENTS:

Department of Natural Resources

**SMOKE FORM**
Form 4600-29 Rev. G-85

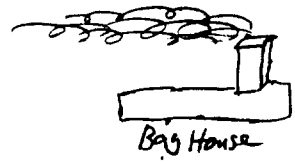
| | |
|---|---|
| e of Company: Biehl Construction | Date: 9-19-91 Run #1 |
| tion: Fon du lac | FID Number: |
| State, Zip Code: WI | Observer Certification Date: April 10, 1991 |
| harge Location: Baghouse Stack | Control Device: |
| ht of Discharge Above Ground: 35 ft. | Steam Plume? Attached X Yes X No Detached |

| | Initial | | Final |
|---|---|---|---|
| of Observation | 7:55:00 | | 8:54:55 |
| erver Location / Distance to Discharge | 800 ft | | same |
| Direction from Discharge | SE | | Same |
| Height of Observation Point in Relation to Discharge | ground - 35 ft | | Same |
| ne Description Color, Length, etc.) | white 500 ft | | white 350 ft. |
| me Background Description | white clouds / blue skies | | Blue skies |
| ather Conditions Wind Direction | NW 5-8 mph | | NW |
| Wind Speed | 5-8 mph | | 3-5 mph |
| Ambient Temperature | 37°F | | 39°F |
| Conditions (clear, overcast, % clouds, etc.) | clouds 60% | | blue skies 0% clouds |

Describe Point in Plume at Which Opacity was Determined
approx. 800-1000 ft after steam dissipation

Remarks:

readings here
NW




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

Summary of Average Opacity
(From Computer Program)

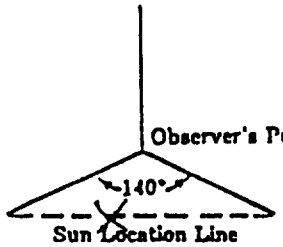
| Set Number | Time: Start — End | Opacity: Sum | Opacity: Average |
|---|---|---|---|
| 1 | 8-13 | 110 | 4.6 |
| 2 | 48-53 | 85 | 3.5 |
| 3 | 0-5 | 80 | 3.3 |
| 4 | 22-27 | 75 | 3.1 |
| 5 | 38-43 | 60 | 2.5 |
| 6 | 28-33 | 55 | 2.3 |
| 7 | 14-19 | 45 | 1.8 |
| 8 | 54-59 | 45 | 1.8 |
| | | | |
| | | | |

Signature of Observer: Jeff Jennerjohn

Name of Observer (Please print): Jeff Jennerjohn

Sketch of Observer, Discharge, and Sun Location.

x Reading Point in Plume




Allowable Source Opacity 40%



hourly ave 2.8

Department of Natural Resources

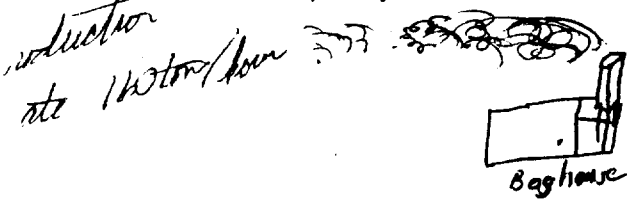
SMOKE FORM
Form 4500-29 Rev. 6-85

| | |
|---|---|
| e of Company: Biehl Construction | Date: 9-19-91 Run #2 |
| tion: Fondu lac | FID Number: |
| State, Zip Code: WI | Observer Certification Date: April 10, 1991 |
| harge Location: Baghouse Stack | Control Device: |
| ht of Discharge Above Ground: 35 ft | Steam Plume? Attached X Yes X No Detached |

| | Initial | | Final |
|---|---|---|---|
| : of Observation | 10:35:00 | | 11:34:55 |
| erver Location / Distance to Discharge | 400ft | | SAME |
| Direction from Discharge | SE | | SAME |
| Height of Observation Point n Relation to Discharge | ground-35ft | | SAME |
| ne Description Color, Length, etc.) | White 200ft | | SAME |
| me Background Description | Blue Sky White Clouds | | White/gray clouds |
| ather Conditions Wind Direction | N. | | SAME |
| Wind Speed | 2-6 mph | | 4-8 mph |
| Ambient Temperature | 40°F | | SAME |
| Conditions (clear, overcast, % clouds, etc.) | clouds 70% | | Clouds 100% |

scribe Point in Plume at Which Opacity was Determined
approx 400-500 ft after steam dissipation

marks:
readings taken here
NW



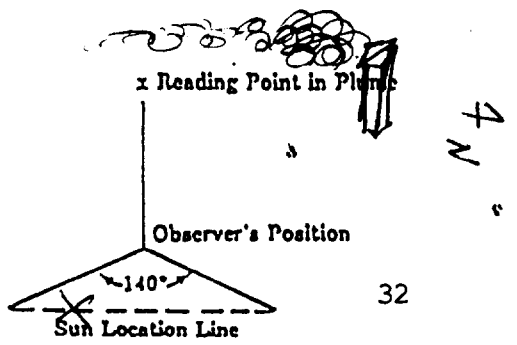

| SEC MIN | 0 | 15 | 30 | 45 | SEC MIN | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 5 | 0 | 0 | 30 | 5 | 5 | 5 | 10 |
| 1 | 0 | 0 | 5 | 10 | 31 | 5 | 5 | 5 | 5 |
| 2 | 0 | 0 | 5 | 0 | 32 | 5 | 5 | 5 | 5 |
| 3 | 0 | 5 | 0 | 0 | 33 | 0 | 0 | 5 | 5 |
| 4 | 5 | 5 | 5 | 0 | 34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

Summary of Average Opacity
(From Computer Program)

| Set Number | Time Start — End | Opacity Sum | Opacity Average |
|---|---|---|---|
| 1 | 27-32 | 130 | 5.4 |
| 2 | 43-48 | 115 | 4.8 |
| 3 | 50-55 | 110 | 4.6 |
| 4 | 5-10 | 105 | 4.4 |
| 5 | 15-20 | 105 | 4.4 |
| 6 | 33-38 | 100 | 4.2 |
| 7 | 21-26 | 65 | 2.7 |
| | | | |
| | | | |
| | | | |

Signature of Observer: Jeff Jennerjohn
Name of Observer (Please print): Jeff Jennerjohn

Sketch of Observer, Discharge, and Sun Location.




Allowable Source Opacity 40%

3.9% hourly ave

Department of Natural Resources

SMOKE FORM
Form 4500-29 Rev. 6-85

| | |
|---|---|
| e of Company: Bichl Construction | Date: 9-19-91 Run #3 |
| tion: FON DU LAC | FID Number: |
| State, Zip Code: WI | Observer Certification Date: April 10, 1991 |
| harge Location: Baghouse Stack | Control Device: |
| ht of Discharge Above Ground: 35 ft. | Steam Plume? Attached X Yes X No Detached |

| | Initial | | Final |
|---|---|---|---|
| : of Observation | 1:05:00 | | 2:04:55 |
| erver Location / Distance to Discharge | 400 ft. | | SAME |
| Direction from Discharge | SE | | SAME |
| Height of Observation Point n Relation to Discharge | ground - 35 ft. | | SAME |
| ne Description Color, Length, etc.) | white 200 ft. | | SAME |
| me Background Description | white/gray clouds | | SAME |
| ather Conditions Wind Direction | N-NW | | SAME |
| Wind Speed | 5-8 mph | | SAME |
| Ambient Temperature | 40°F | | SAME |
| Conditions (clear, overcast, % clouds, etc.) | 100% clouds | | SAME |

scribe Point in Plume at Which Opacity was Determined
approx 300-400 ft after steam dissipation

emarks:

Production 159 ton/hour

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

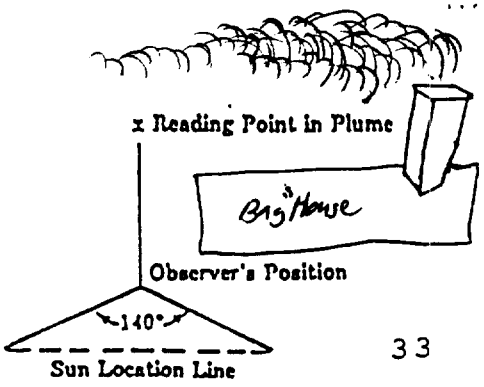
Summary of Average Opacity
(From Computer Program)

| Set Number | Time Start — End | Opacity Sum | Opacity Average |
|---|---|---|---|
| 1 | 27-32 | 135 | 5.6 |
| 2 | 37-42 | 135 | 5.6 |
| 3 | 47-52 | 120 | 5.0 |
| 4 | 3-8 | 115 | 4.8 |
| 5 | 19-24 | 115 | 4.8 |
| 6 | 53-58 | 110 | 4.6 |
| 7 | 10-15 | 100 | 4.2 |
| | | | |
| | | | |
| | | | |

gnature of Observer: Jeff Jennerjohn

Name of Observer (Please print): Jeff Jennerjohn

tch of Observer, Discharge, and Sun Location.




N

Allowable Source Opacity 40%

Hourly ave. 4.5%

## Thermocouple Calibration

| | | | |
|---|---|---|---|
| **Room Temperature:** | NBS Certified Thermometer | = | 68°F. |
| | Stack Sampler Thermocouple | = | 67°F. |
| **Hot Water Temperature:** | NBS Certified Thermometer | = | 192°F. |
| | Stack Sampler Thermocouple | = | 193°F. |

Calibrated September 12, 1991 by Bruce Lamers

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## Dry Gas Meter Calibration

Meter calibrated by Wisconsin Public Service in Green Bay on September 11, 1991.

| Reading before: | | Reading after adjustment: | |
|---|---|---|---|
| open% | check% | open% | check% |
| 99.0 | 99.0 | 100.0 | 100.0 |

The dry gas meter which was used in the testing was calibrated against the above by Bruce Lamers on September 11, 1991. The calibration factor is 1.0229.

Average Orifice ▲H Calibration = 1.99

## PITOT TUBE CALIBRATION

Date 9/12/91 Calibrated by BJ

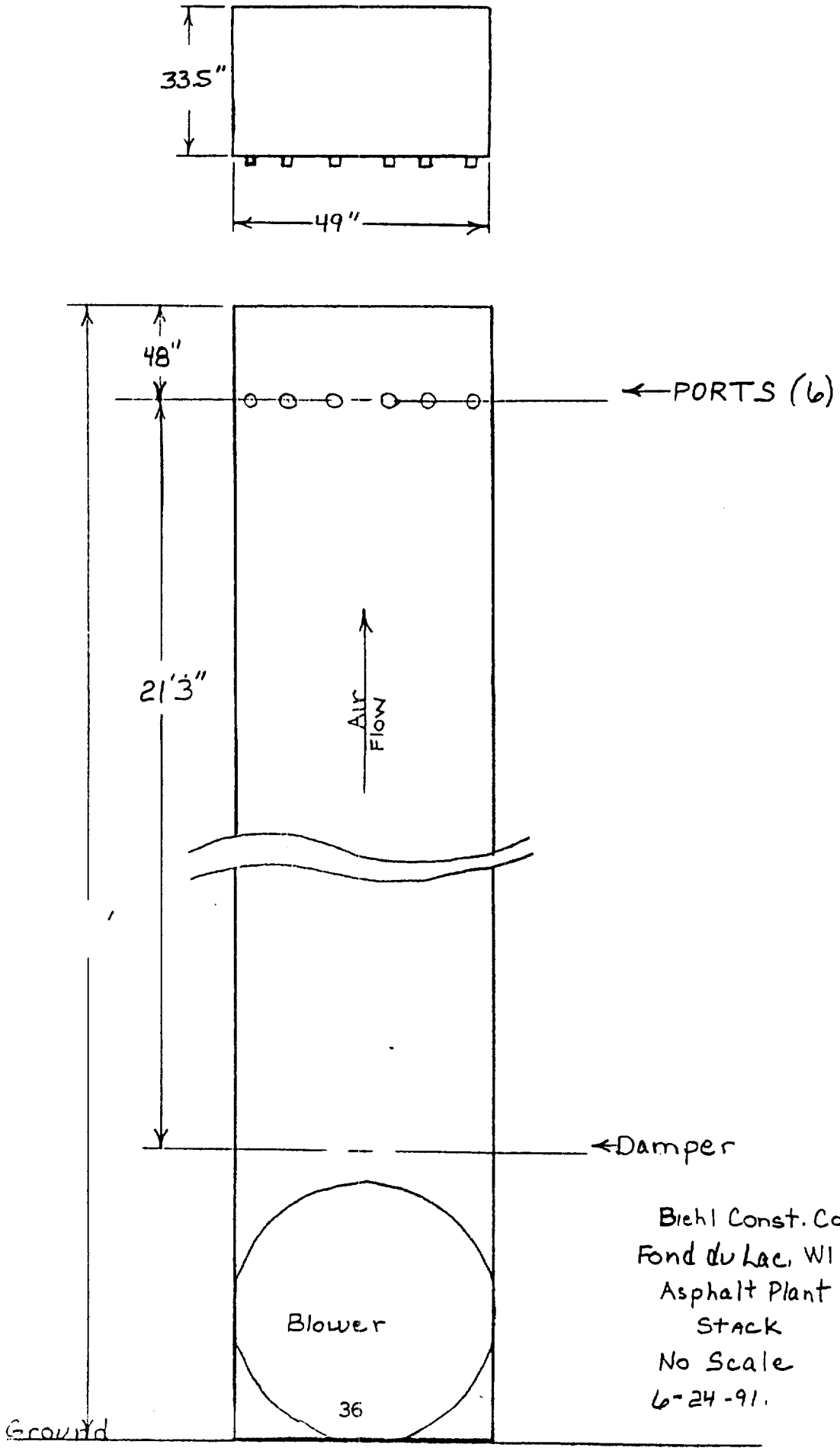
1. Face opening alignment OK? ✓
2. External tubing diameter $D_t$ = .375 in.
3. Base-to-opening plane distances $P_A$ = .500 in.; $P_B$ = .4169 in.
4. Pitot-nozzle distance X = 3/4" in.
5. Pitot-probe sheath distance Y = 2" in.
6. Pitot-thermocouple distance Z = 6.25" in.

### "A" SIDE CALIBRATION

| RUN NO. | $\Delta P_{std}$ in. $H_2O$ | $\Delta P_{std}$ in. $H_2O$ | $\Delta P_{std}$ $\Delta P_{(s)}$ | $C_{p(s)}$ | DEVIATION $\lvert C_{p(s)} - \bar{C}_p(A) \rvert$ |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| | | | $\bar{C}_p(A)$ = .84 | | $\sigma$ = |

$$C_{p(s)} = 0.99 \sqrt{\frac{\Delta P_{std}}{\Delta P_{(s)}}}$$

$$\sigma(A) = \frac{\sum \lvert C_{p(s)} - \bar{C}_p(A) \rvert}{3}$$




Biehl Const. Co., Inc.
Fond du Lac, WI
Asphalt Plant Exhaust Stack
No Scale
6-24-91.