# A STUDY OF ATMOSPHERIC EMISSIONS FROM MODEL 630-400C ASPHALT DRUM MIX PLANT

M.A. Segale, Inc
Asphalt Division
Post Office Box 88050
Tukwila, Washington 98188

Prepared by:
CH2M HILL NORTHWEST, INC.
2300 N.W. Walnut
Corvallis, Oregon 97330

S19456.A0
March 13, 1985

William Faught
Project Team Leader

Richard Kester, Ph.D, P.E.
Project Administrator

## INTRODUCTION

M.A. Segale, Inc., Asphalt Division, contracted CH2M HILL NORTHWEST, INC., to perform air sampling and analyses for particulate emissions from their hot mix plant located in Tacoma, Washington. The sampling was performed to demonstrate compliance with the plant's operating discharge permit. Field sampling was conducted March 13, 1985, by William Faught, Corvallis, Oregon, and Edward Powell, Bellevue, Washington. Observing the testing was Mr. Harlan Smith and Jerry Fox, both of M.A. Segale; Mr. David Newman, Puget Sound Air Pollution Control Agency, Seattle, Washington; and Ms. Sharon DelMoral, U.S. Environmental Protection Agency, Seattle, Washington.

## PROCESS INFORMATION

The Boeing Model 630-400c portable asphalt drum mix plant is used to manufacture asphalt concrete. The plant was operating at 454 tons per hour of hot mix throughput during testing using 10 percent recycle mix. Table 1 represents the mix characterization used on the day of testing. Chevron Grade AR-4000 liquid asphalt oil was used. No rejuvenating additives were added.

Figure 1 illustrates the layout and operation of the plant. Fresh aggregate enters the mix drum at the burner end. Recycle materials and liquid asphaltic oil enter the drums near the center. The Discharge Mix temperature during the sampling averaged 260°F. The plant has an actual rated capacity of 400 tons/hour on a continuous basis.

The plant operates a modified venturi wet scrubber system. Testing was conducted with a closed loop water system using recycle water. Fresh water was supplied by the City system as makeup water when needed.

The plant has a rectangular stack measuring 96x96-inch I.D. and stands 30 feet above the fan. Four sampling ports are installed in the stack approximately four duct diameters (30 feet) downstream from the fan and approximately 0.25 duct diameters (2 feet) upstream from the outlet.

Process operating data was collected during the testing and has been supplied to CH2M HILL by M.A. Segale. This data is presented in Appendix A.

## SAMPLING METHODOLOGY

Total suspended particulate (TSP) samples were collected in accordance with U.S. EPA Method 5 procedures "Determination

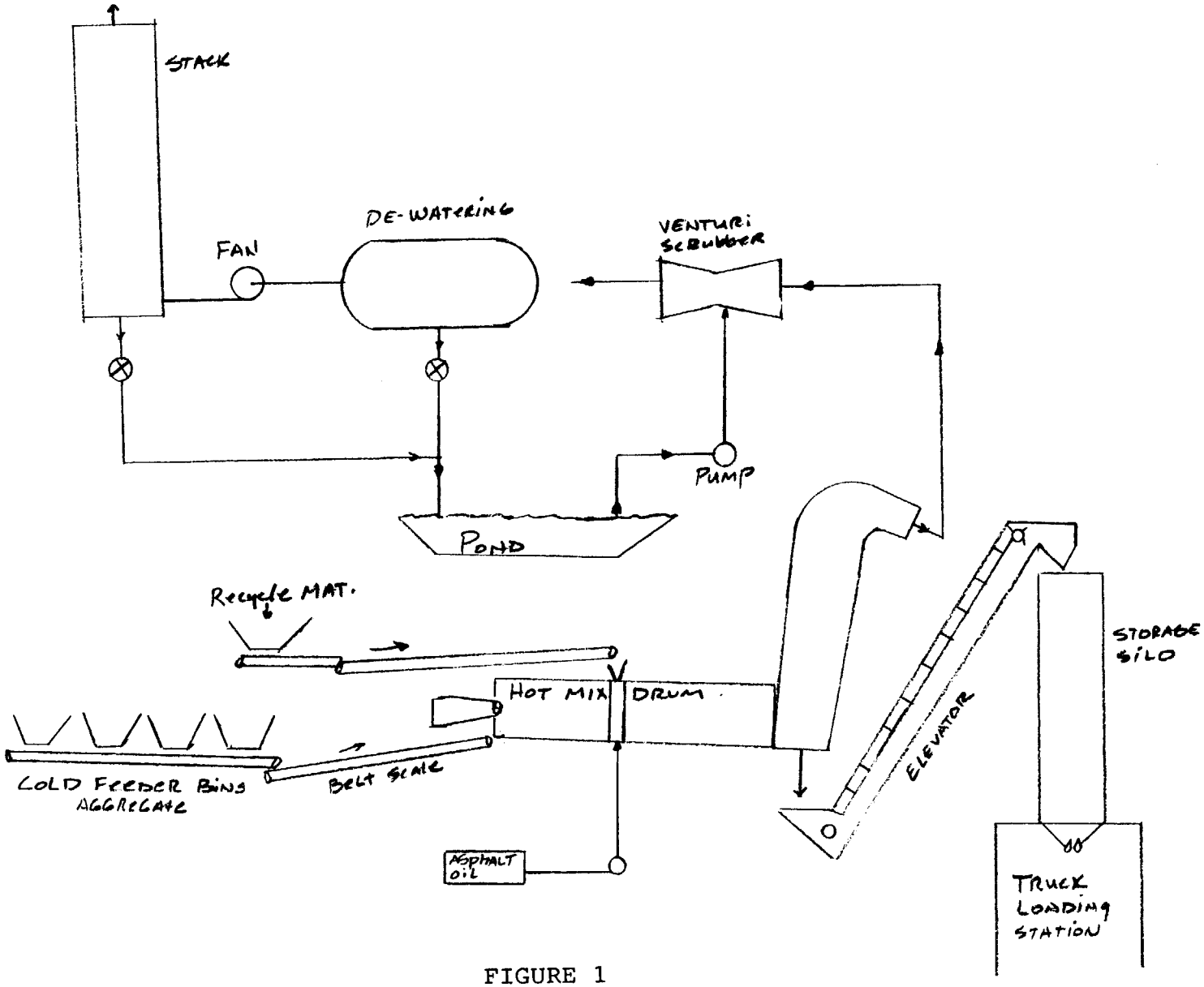



FIGURE 1

PLANT FLOW DIAGRAM

M. A. SEGALE, INC.

of Particulate Emissions from Stationary Sources," as published in the 1984 Federal Register.

Samples were collected through four existing sample ports (see Figure 2) located on a 4x6 matrix. A Standard Method 5 sampler, manufactured by Research Appliance Company (RAC), Atlanta, Georgia, was used to collect representative samples (Figure 3).

These sample runs were conducted using a 24-point velocity profile and collection matrix. Sample run 1 consisted of an 84-minute time period. Twelve of the 24 points were sampled for 3 minutes each and twelve were sampled for 4 minutes each. The reasoning for this was that after two ports had been sampled, it was noticed that only 12.7 cubic feet had been collected (25 $ft^3$ total); therefore, the decision to increase the sample time to 4 minutes for the remaining points was made. The decision was made by William Faught and David Newman. This would ensure that the required 30 cubic feet would be collected.

The remaining two sample runs were sampled for 72 minutes each using a larger nozzle (.375). During the tests, stack temperature was continuously monitored using a Type K thermocouple assembly and pyrometer. Periodic gas samples were analyzed using a Hays 621 orsat analyzer for measurement of $CO_2$ (carbon dioxide) and periodic samples were analyzed using a teledyne oxygen analyzer to subsequent the $CO_2$ analyses. These results are listed on the field data sheets representing each run. The results from these gas analyses were used to calculate stack gas molecular weight.

Before and after each sample run, the assembled train was checked for leaks. In all cases, the leak rate was less than the allowed 0.02 cfm. In addition, the entire velocity measuring system was leak tested the day prior to sampling. The velocity lines, pitot tube, and manometers all proved to be leak free. Leak test documentation is presented on the corresponding field data sheet.

## SAMPLE ANALYSIS

Sample analyses were conducted gravimetrically using Standard Method 5 procedures. The total weight of material was determined in the front and back half of the sampler. These parts are as follows:

- Probe Wash--Reagent grade acetone, distilled deionized water, and a soft-bristled brush were used to clean and recover the material collected in the nozzle, probe, and front half of the filter holder. The washings were collected in containers, labeled, and transported to the laboratory.

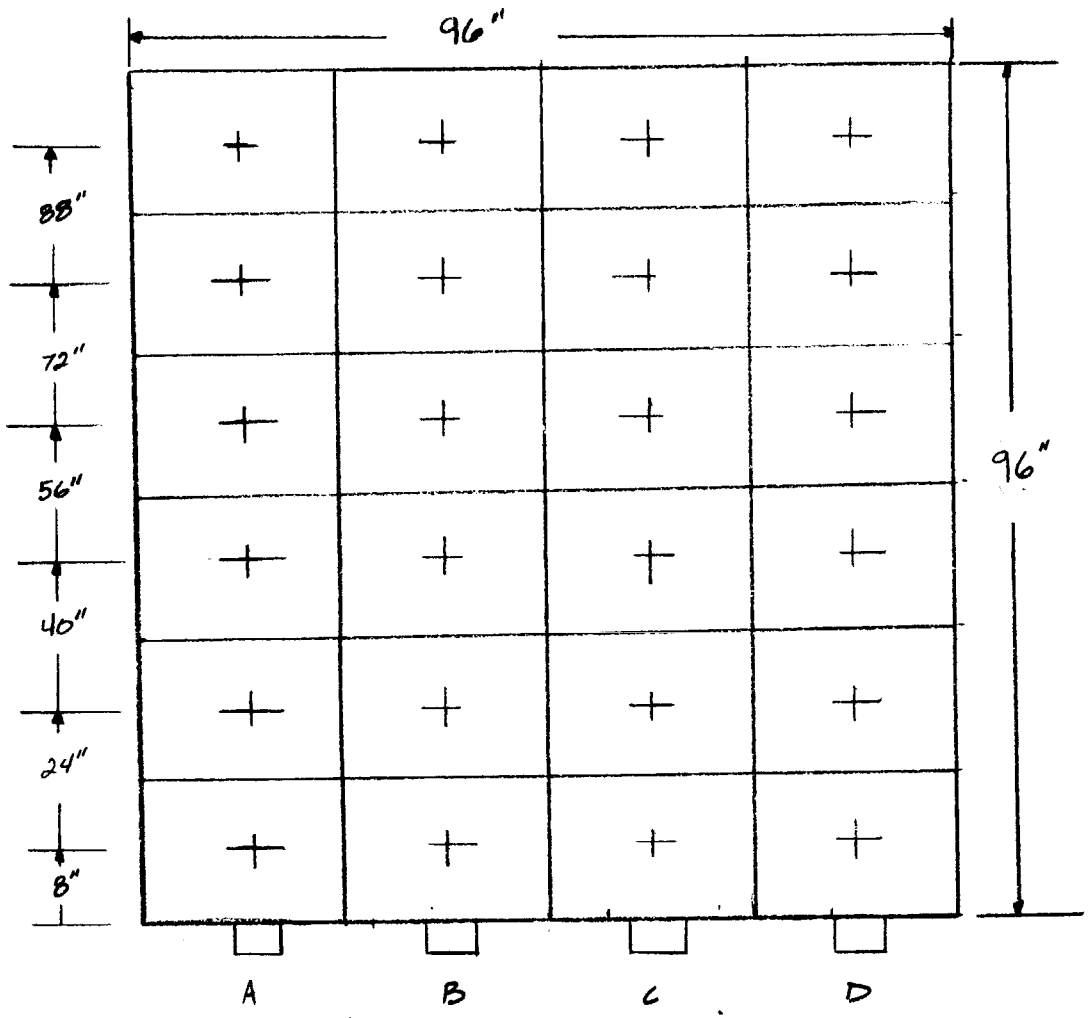



FIGURE 2

SAMPLING PORT AND VELOCITY MATRIX

M.A. SEGALE, INC.

- o Filter--The exposed filters were taken out of the holders after each use and placed in individual petri dishes and labeled. After desiccation, the filters were reweighed and reported to the nearest 0.1 mg.

- o Back Half--The extractable, nonextractable components of the impinger water collected was determined by organic extraction. The extraction procedure uses chloroform and ether solvents to extract the organic materials.

  The solvents and subsequent organics are removed from the water and allowed to evaporate to dryness. The nonextractable fraction is determined by allowing the remaining water (or a portion thereof) to evaporate to dryness.

The total weight of material (after evaporation and desiccation) was used in conjunction with the total volume of gas sampled (corrected to STP) to calculate the emission concentration in grains per dry standard cubic feet (gr/dscf). In addition, the emission concentration in gr/dscf was used in conjunction with the total stack gas flowrate at standard conditions (scfm) to calculate the total mass emission rate in pounds per hour (lbs/hr).

## QUALITY ASSURANCE STATEMENT

Measures of quality assurance used for this study include the following:

### FIELD Q.A.

Prior to and after each test run in the field, the assembled sampling train was checked for leaks.

In addition, prior to any sampling, the entire velocity measuring system was also leak checked. This includes the pitot tube, manometer, and connecting lines.

### LABORATORY Q.A.

Laboratory equipment used for the study includes balance, oven, hot plate, desiccator, solvents, and miscellaneous glassware. Calibration of these items is performed in accordance with the U.S. EPA regulations for yearly standards and certifications.

The Method 5 field equipment used is calibrated on a semi-annual basis. The calibration data for the specific equipment used on this study is enclosed in Appendix B.

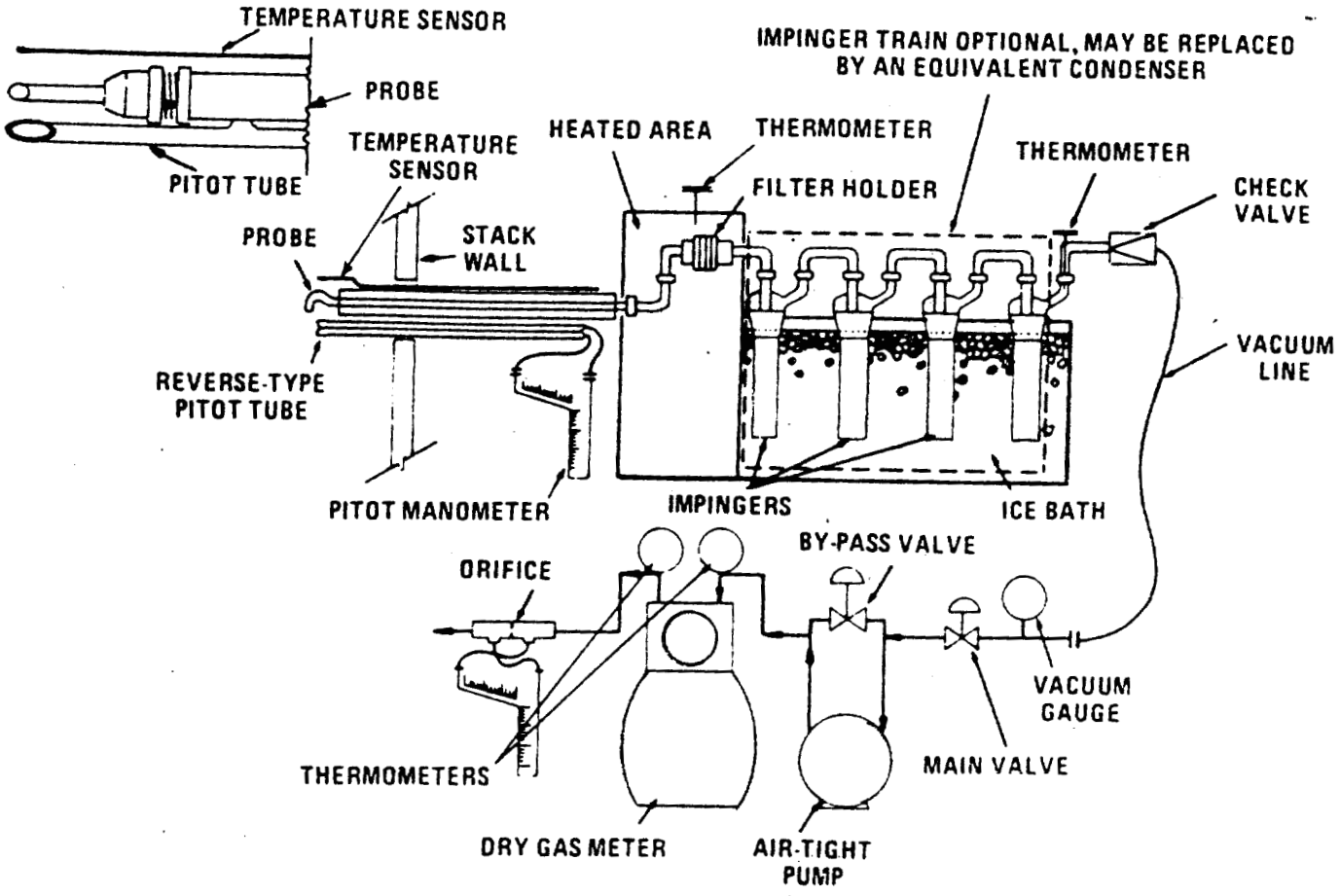



FIGURE 3 METHOD 5 SAMPLING TRAIN

Table 2
SUMMARY OF RESULTS
M.A. Segale, Inc.
March 13, 1985

| Parameters | Run 1 | Run 2 | Run 3 | Average |
|---|---|---|---|---|
| Stack Gas Temperature, °F | 162 | 162 | 165 | 163 |
| Stack Gas Moisture, V/V | 29.97 | 30.16 | 31.56 | 30.56 |
| Stack Gas Molecular Weight | 29.13 | 29.21 | 29.31 | 29.22 |
| Percent Oxygen, % | 13.00 | 12.98 | 12.06 | 12.68 |
| Stack Gas Velocity, fpm | 1,125.1 | 1,200.5 | 1,018.9 | 1,114.8 |
| Stack Gas Flowrate, scfm | 43,480 | 46,260 | 38,290 | 42,680 |
| Stack Gas Flowrate, acfm | 72,010 | 76,830 | 65,210 | 71,350 |
| Emission Results--Front Half | | | | |
| Emission Concentration, gr/dscf | 0.017 | 0.017 | 0.017 | 0.017 |
| Mass Emission Rates, lbs/hr | 6.33 | 6.74 | 5.58 | 6.22 |
| Emission Results--Total | | | | |
| Emission Concentration, gr/dscf | 0.047 | 0.049 | 0.042 | 0.046 |
| Mass Emission Rate, lbs/hr | 17.5 | 19.4 | 13.8 | 16.9 |
| Operating Perameters | | | | |
| Hot Mix through put, tons/hr | - | - | - | 454 |
| Mix temperature at outlet, °F | - | - | - | 260 |
| Venturi pressure drop, inch $H_2O$ | - | - | - | 20 |
| Venturi water circulation rate, gal/min. | - | - | - | 200 |
| Make up water injection rate, $Ft^3$/min. | - | - | - | 3.2 |
| Scrubber Water Analysis | | | | |
| Total solids, mg/l | - | - | - | 389 |
| Suspended solids, mg/l | - | - | - | 275 |

/CVR63/052

## RESULTS

The results from this sampling are presented in Table 2. The results demonstrate compliance for TSP emissions of 0.05 grains per dry standard cubic foot as regulated by the Puget Sound Air Pollution Control Agency.

Opacity readings were taken by Sharon Del Moral of the USEPA during test run 2. These results indicate the plant to be in compliance with the 20 percent rgulation.

Field and laboratory data sheets are presented in Appendix B. Production data documentary plant operations are presented in Appendix A.

# Appendix A

## PLANT OPERATING DATA LOGS

M. A. SEGALE, INC.
GENERAL CONTRACTORS

March 29, 1985

Puget Sound Air Pollution Control Agency
200 West Mercer
P. O. Box 9863
Seattle, WA 98109

Attn: Mr. Fred Austin

Gentlemen:

The attached production information was taken from our asphalt plant operating at Tacoma during a source test on March 13, 1985. The source test was conducted by $CH_2M$ Hill Engineers of Corvalis, Oregon.

If you have any questions, please let me know.

Very truly yours,

M. A. SEGALE, INC.

Harlan B Smith

Harlan B. Smith
Design Engineer

HBS:sb

enc.

M. A. SEGALE, INC.
GENERAL CONTRACTORS

## PLANT 2605

**MARCH 13, 1985**

| | |
|---|---|
| Plant Production | 454 TPH |
| Daily Production Average | 472 TPH |
| Recycle Percentage | 11% |
| Type of Asphalt | AR 4000 |
| Drum Outlet Gas Temperature | 260 |
| Mix Temperature | 250 |
| Scrubber Water Flow | 180 GPM |
| Scrubber Water Pressure | 100 PSI |
| Scrubber Air Pressure Drop | 20 Inches of Water Column |
| Fan Speed | Variable |

Scrubber water was recycled from a settling tank. Make up water was measured at 3.23 cubic feet/minute or 24.2 gallons/minute.

P.O. BOX 88050 ▪ 18010 SOUTHCENTER PARKWAY ▪ TUKWILA, WASHINGTON 98188 ▪ TELEPHONE: (206) 575-3200

by
SHARON DEL MORAL
PSAPCA 3/13/85

Source Test Observation Checklist
Asphalt Batch Plants

Process Drum Mix Asphalt Plant

Asphalt Paving Plant M.A. Segale - Tacoma

Drum Mix Description Boeing M.S. 400 Drum Mix

Identification No. 630-400C Installed 10/3/84

Process Rate 454 Tons/hr Firing Rate — Gal/hr

Type of Fuel Propane Smoke Point —

Injection Location Asphalt injection at mid drum

Asphalt Discharge Temp. 260 °F Gravel Moisture ~5.0 %

Fines In Gravel (-200 mesh) ~ 5.1

Operation Personnel Harlen Smith / "Ben"

Asphalt Supplier Chevron USA - Richmond Beach / AR 4000

Density 7.48 lb/gal #/gal Flash Point NA @ Plant °F

Asphalt Mix temp ~ 246°F Stack Temp ~ 161°F Asphalt rate of 22.3 T/Hr = ~6000 gal/min

Control Equipment

Description or Name Venturi wet scrubber

Water Press PSI Rate ~ 200 gal Gal/min

Water: Reused, Clean? clean injection at 3.2 ft³/min

Venturi Press ΔP = 20" wg Inch

Static = +.02 Inch

Air Flow from V/C rated at 34,000 Cfm

Saturated Stack yes

Appendix B

FIELD AND LABORATORY DATA

EQUIPMENT CALIBRATION

OPACITY OBSERVATIONS

CHAIN OF CUSTODY FORM

## PARTICULATE SAMPLING CALCULATIONS

**Constant Parameters**

Po = Barometric Pressure - 30.29 in Hg
As = Stack Area - 9216.000 $in^2$ (64 $FT^2$)
Dn = Nozzle Diameter - _____ in
Cp = Pitot Coef. 0.098 / 0.141

Plant M.A. Segale
Sampling Location STACK PORTS
Date of Test MARCH 13, 1985

| Symbol | Definition, Units | Calculating Equation | Run 1 | Run 2 | Run 3 | Avg |
|---|---|---|---|---|---|---|
| Ts | Stack Temp, °R | Avg from Field Data Sheet | 622 | 622 | 625 | 623 |
| Ps | Stack Pressure in Hg abs | Avg from Vel Calc Sheet | 30.29 | 30.29 | 30.29 | 30.29 |
| ΔH | Orifice Pressure Drop in $H_2O$ | Avg from Field Data Sheet | .464 | 1.091 | 0.766 | — |
| Δt | Total Sampling Time, min | Total from Field Data Sheet | 84 | 72 | 72 | — |
| tm | Gas Meter Temp, °F | Avg from Field Data Sheet | 524 | 533 | 534 | — |
| S | $\sqrt{\Delta P} \times Ts$ | Avg from Vel Calc Sheet | 7.23 | 7.72 | 7.74 | — |
| Qm | Sample Gas Volume at Meter Conditions, $ft^3$ | Avg from Field Data Sheet | 29.380 | 38.430 | 32.350 | 33.387 |
| Qd | Dry Gas Sample Vol at Std Cond, scf | $Qd = \frac{17.7\ (Qm^1)(Po + \frac{\Delta H}{13.6})}{(tm + 460)}$ | 30.009 | 38.649 | 32.[illegible] | — |
| Vv | Tot Vol of Condensed Water, ml | Total from Lab Data Sheet | 270.9 | 358.2 | 315.5 | — |
| Qv | Tot Vol Condensed Water Vapor @ Std Cond, scf | $Qv = 0.0474(Vv + Qv^1)$<br>$Qv^1$ = Water Vapor Thru Meter | 12.84 | 16.69 | 14.96 | — |
| mv | % Moisture in Stack Gas | $mv = \frac{100\ Qv}{Qv + Qd}$ | 29.97 | 30.16 | 31.56 | 30.56 |
| md | Mole Frac of Dry Gas | $md = \frac{Qd}{Qv + Qd}$ | 0.700 | 0.698 | 0.684 | — |
| Md | Mole Wt of Dry Gas | Gas Analysis | 29.13 | 29.21 | 29.31 | 29.22 |
| Ms | Mole Wt of Stack Gas | $Ms = mdMd + 18(1-md)$ | 25.79 | 25.83 | 25.73 | — |
| Vs | Stack Vel at Stack, fpm | $Vs = 5129\ Cp\ S\ (\frac{1}{Ps\ Ms})^{\frac{1}{2}}$ | 1125.1 | 1200.5 | 1018.9 | 1114.8 |
| qs | Stack Flowrate at Std Cond, scfm | $qs = \frac{0.123(Vs)(As)(md)(Ps)}{Ts}$ | 43,476 | 46,258 | 38,289 | 42,674 |
| I | Percent Isokinetic | $I = \frac{1032\ Ts Qd}{(Vs)(Ps)(md)(Dn^2)(\Delta t)}$ | 98.1 | 96.3 | 97.7 | 97.4 ✓ |
| W | Wt of Particulate Sample, mg | Total from Lab Data Sheet | 34.1<br>91.6 | 43.5<br>122.8 | 36.7<br>89.2 | |
| Cg | Total Particulate Grain Loading, gr/scf | $Cg = \frac{0.0154W}{Qd}$ Front 1/2<br>Total | 0.017<br>0.047 | 0.017<br>0.049 | 0.017<br>0.042 | 0.017<br>0.046 ✓ |
| $C^1g$ | Grain Loading at 12% $CO_2$ gr/scf | $C^1g = Cg \times \frac{12}{(\%\ CO_2)}$ | — | — | — | — |
| Ct | Tot Particulate Emission, lb/hr | $Ct = .00857\ (Cg)(qs)$ Front 1/2<br>Total | 6.33<br>17.5 | 6.74<br>19.4 | 5.58<br>13.8 | 6.22<br>16.9 |
| $V_{b1}$ | Percent Excess Air | $V_{b1} = \frac{100 \times (\%\ O_2 - \frac{\%\ CO}{2})}{0.264 \times \%\ N_2 - (\%\ O_2 - \frac{\%\ CO}{2})}$ | — | — | — | — |

$Q_{ACFM}$ = stack velocity, FPM x $A_S$, $FT^2$ =

1) 72,010
2) 76,830
3) 65,210

= 71,350 ACFM

ENVIRONMENTAL LABORATORY
1600 S.W. Western
Corvallis, Oregon 97330

CH2M HILL

6

# METHOD 5 SAMPLE ANALYSIS

Client Name: M.A. SEGALE INC Date: MARCH 15, 1995

Location: TACOMA, Washington Project No.: S19456.A6

Source: BATCH PLANT.

| Sample Identity | 1 | 2 | 3 | Blank |
|---|---|---|---|---|
| • Probe Wash | | | | |
| Tare No. | 1 | 2 | 3 | ACETONE/WATER |
| Tare + Residue | 67.1208 | 74.4760 | 72.4787 | 75.9613 |
| Tare Wt. | 67.1120 | 74.4696 | 72.4703 | 75.9603 |
| Residue Wt. | 0.0088 | 0.0064 | 0.0084 | 0.0010 |
| Blk. Corr. | 0.0010 | 0.0010 | 0.0010 | - |
| Residue Wt. | 0.0078 | 0.0054 | 0.0074 | - |
| • Filter Collection | | | | |
| Filter No. | X01 | X02 | X03 | X17 |
| Tare + Part. | 0.7099 | 0.7236 | 0.7126 | 0.6811 |
| Tare Wt. | 0.6834 | 0.6853 | 0.6831 | 0.6809 |
| Part. Wt. | 0.0265 | 0.0383 | 0.0295 | +0.0002 |
| Blk. Corr. | -0.0002 | -0.0002 | -0.0002 | - |
| Paticulate Wt. | 0.0263 | 0.0381 | 0.0293 | - |
| | 0.0341 | 0.0435 | 0.0367 | |
| • Impinger Water | | | | |
| Total Volume, ml (T) | 840 | 760 | 695 | 400 |
| Organic Extraction | | | | |
| Volume Extracted, ml (Ex) | 840 | 760 | 695 | 400 |
| Tare No. | 1 ORG. | 2 ORG. | 3 ORG | BLK ORG. |
| Tare + Extract | 76.5826 | 76.1519 | 65.8455 | 73.8490 |
| Tare Wt. | 76.5271 | 76.0744 | 65.7974 | 73.8485 |
| Extract Wt. | 0.0555 | 0.0775 | 0.0481 | 0.0005 |
| Blk. Corr. | 0.0005 | 0.0005 | 0.0005 | - |
| Extract Wt. x (T/Ex) | 0.0550 | 0.0770 | 0.0476 | - |
| Residue on Evaporation | | | | |
| Volume Evap., ml (Ev) | 100 | 100 | 100 | 100 |
| Tare No. | 1 RES. | 2 RES. | 3 RES. | BLK RES. |
| Tare + Residue | 75.2681 | 74.6570 | 76.3113 | 76.6397 |
| Tare Wt. | 75.2667 | 74.6556 | 76.3095 | 76.6386 |
| Residue Wt. | 0.0014 | 0.0014 | 0.0018 | 0.0011 |
| Blk. Corr. | 0.0011 | 0.0011 | 0.0011 | |
| Residue Wt. x (T/Ev) | 0.0025 | 0.0023 | 0.0049 | |
| • Total Sample Weight | 0.0916 | 0.1228 | 0.0892 | |
| | 91.6 mg | 122.8 | 89.2 | |

The information shown on this sheet is test data only and no analysis or interpretation is intended or implied.

Samples will be retained 30 days unless otherwise requested.

W.R. Faught
Reported by:

ENVIRONMENTAL LABORATORY
1600 S.W. Western
Corvallis, Oregon 97330

CH2M HILL

# METHOD 5 SAMPLE ANALYSIS

Client Name: M.A. SEGALE INC Date: MARCH 15, 1985

Location: TACOMA, WASHINGTON Project No.: S19456.A6

Source: BATCH PLANT.

| Sample Identity | 1 | 2 | 3 | Blank |
|---|---|---|---|---|
| • Probe Wash | | | | |
| Tare No. | 1 | 2 | 3 | ACETONE/WATER |
| Tare + Residue | 67.1208 | 74.4760 | 72.4787 | 75.9613 |
| Tare Wt. | 67.1120 | 74.4696 | 72.4703 | 75.9603 |
| Residue Wt. | 0.0088 | 0.0064 | 0.0084 | 0.0010 |
| Blk. Corr. | 0.0010 | 0.0010 | 0.0010 | - |
| Residue Wt. | 0.0078 | 0.0054 | 0.0074 | - |
| • Filter Collection | | | | |
| Filter No. | X01 | X02 | X03 | X17 |
| Tare + Part. | 0.7099 | 0.7236 | 0.7126 | 0.6811 |
| Tare Wt. | 0.6834 | 0.6853 | 0.6831 | 0.6809 |
| Part. Wt. | 0.0265 | 0.0383 | 0.0295 | +0.0002 |
| Blk. Corr. | -0.0002 | -0.0002 | -0.0002 | - |
| Paticulate Wt. | 0.0263 | 0.0381 | 0.0293 | - |
| | 0.0341 | 0.0435 | 0.0367 | |
| • Impinger Water | | | | |
| Total Volume, ml (T) | 840 | 760 | 695 | 400 |
| Organic Extraction | | | | |
| Volume Extracted, ml (Ex) | 840 | 760 | 695 | 400 |
| Tare No. | 1 ORG. | 2 ORG. | 3 ORG | BLK ORG. |
| Tare + Extract | 76.5826 | 76.1519 | 65.8455 | 73.8490 |
| Tare Wt. | 76.5271 | 76.0744 | 65.7974 | 73.8485 |
| Extract Wt. | 0.0555 | 0.0775 | 0.0481 | 0.0005 |
| Blk. Corr. | 0.0005 | 0.0005 | 0.0005 | - |
| Extract Wt. x (T/Ex) | 0.0550 | 0.0770 | 0.0476 | - |
| Residue on Evaporation | | | | |
| Volume Evap., ml (Ev) | 100 | 100 | 100 | 100 |
| Tare No. | 1 RES. | 2 RES. | 3 RES. | BLK RES. |
| Tare + Residue | 75.2681 | 74.6520 | 76.3113 | 76.6397 |
| Tare Wt. | 75.2667 | 74.6556 | 76.3095 | 76.6386 |
| Residue Wt. | 0.0014 | 0.0014 | 0.0018 | 0.0011 |
| Blk. Corr. | 0.0011 | 0.0011 | 0.0011 | |
| Residue Wt. x (T/Ev) | 0.0025 | 0.0023 | 0.0049 | |
| • Total Sample Weight | 0.0916 | 0.1228 | 0.0892 | |
| | 91.6 mg | 122.8 | 89.2 | |

The information shown on this sheet is test data only and no analysis or interpretation is intended or implied.

Samples will be retained 30 days unless otherwise requested.

W.R. Faught
Reported by:

## SOURCE DESCRIPTION

Run No. 1

1. Name of Firm M.A. SEGALE
2. Location of Plant TACOMA, WA.
3. Type of Source ASPHALT BATCH PLANT
4. Control Equipment SCRUBBER (VENTURI)
5. Sampling Point Location STACK
6. Load [illegible]
7. Type of Fuel PROPANE
8. Pollutants Sampled PARTICULATE MATTER
9. Time of Test:

   Date 3/13 85, Begin 9:40, End 11:13
10. Filter No. 1
11. Filter Holder No. 1
12. Sampler No. 1
13. General Comments Good test!

### IMPINGER $H_2O$ CONDENSATE

| Impinger No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Final Volume | 704.7 | 892.2 | 479.8 | 854.2 |
| Initial Volume | 582.6 | 756.9 | 474.1 | 846.4 |
| Volume Collected | 122.1 | 135.3 | 5.7 | 7.8 |

Total (Vv) = 270.9

# VELOCITY TRAVERSE DATA

Date 3/13/85 Time 9:00 Run No. 1

Sampling Point Location STACK PORTS

Stack I.D. 96 x 96 INCH in

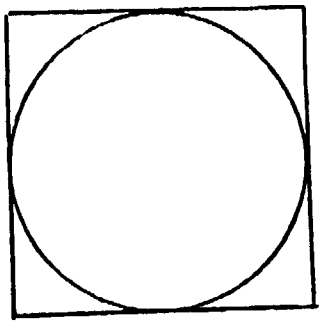
Wet Bulb Temperature ($T_{hj}$), °F 161

Dry Bulb Temperature ($T_{hk}$), °F 160

Barometric Pressure ($P_{hl}$), in Hg absolute = 30.29

Stack Pressure, in $H_2O$ 0.02/13.6 + 30.29 = 30.29

Thermocouple Reference Junction Temp N/A



Drawing of stack cross section

| Point No. | Distance from ref point, in. | Stack Temperature: Thermocouple m.v. | Stack Temperature: ($T_{hd}$), °F | Stack Temperature: ($T_{hd}$ + 460), °R | Velocity head ($V_a$), in $H_2O$ | $V_a$ x ($T_{hd}$ + 460) | $\sqrt{V_a \times (T_{hd} + 460)}$ |
|---|---|---|---|---|---|---|---|
| 1 | 8" | N/A | 162 | 622 | 0.11 | 68.42 | 8.27 |
| 2 | 24" | | 163 | 623 | 0.085 | 59.19 | 7.69 |
| 3 | 40" | | 162 | 622 | 0.10 | 62.20 | 7.89 |
| 4 | 56" | | 161 | 621 | 0.10 | 62.10 | 7.88 |
| 5 | 72" | | 160 | 620 | 0.09 | 55.80 | 7.47 |
| 6 | 88" | | 158 | 618 | 0.11 | 67.98 | 8.24 |
| 7 | Ditto | | 161 162 | 621 622 | 0.18 0.09 | 111.78 55.98 | 10.57 7.48 |
| 8 | | | 161 161 | 621 621 | 0.05 0.05 | 31.05 31.05 | 5.57 5.57 |
| 9 | | | 161 161 | 621 621 | 0.04 0.065 | 24.84 40.37 | 4.98 6.35 |
| 10 | | | 161 162 | 621 622 | 0.16 0.15 | 99.36 93.30 | 9.97 9.66 |
| 11 | | | 162 163 | 622 623 | 0.04 0.04 | 24.88 24.92 | 4.99 4.99 |
| 12 | | | 161 160 | 621 620 | 0.035 0.08 | 21.74 49.60 | 4.66 7.04 |
| 13 | | | 158 164 | 618 624 | 0.14 0.11 | 86.52 68.64 | 9.30 8.28 |
| 14 | | | 164 165 | 624 625 | 0.08 0.075 | 49.92 46.88 | 7.07 6.85 |
| 15 | | | 165 159 | 625 619 | 0.07 0.06 | 43.75 37.14 | 6.61 6.09 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | 7.23 |

# RTI [illegible] SAMPLING FIELD DATA

Run No. 1
Plant M.A. Schatz
Sampling Location Stack ports
Date 3/12/85
Operator Knight
Assistant Powell

Leak check @ 15" Hg. < 0.02

**IMPORTANT**
Nozzle Dia., Dn= 5/16 in.
Heater Box Setting 250 °F
"C" Factor 5.385 @ 260 °F
Assumed Moisture 28 Vol.%

Ambient Temp. 50 °F
Bar Pressure, Po= [illegible] in. Hg
Begin Sampling Time 1140
Sampling Time Interval 3/4 min
Probe Heater Setting [illegible]
Stack Pressure +0.02 in. $H_2O$

2 points @ 3 min/pt
2 points @ 4 min/pt.

Post test Leak Check [illegible]

| Clock Time | Point No. | Dry Gas Meter Qm, $ft^3$ | Pitot P "$H_2O$ | Orifice, H in $H_2O$ Desired | Orifice, H in $H_2O$ Actual | Dry Gas Temp tm, °F Inlet | Dry Gas Temp tm, °F Outlet | Pump Vacuum "Wg | Stack Temp. Ts, °F | Filter Temp. °F | Impinger Temp. °F | Stack Opacity O2 / CO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9:40 :43 | 1 2 | 760.4 761.7 | 0.11 0.095 | 0.69 0.51 | 0.69 0.51 | 42 42 | 42 50 | 3 3 | 162 163 | 240 | 54 | [illegible] |
| :46 :49 | 3 4 | 762.7 763.9 | 0.10 0.10 | 0.51 .51 | 0.51 .51 | 44 44 | 54 58 | 3 3 | 162 161 | 235 | — | |
| :52 :55 | 5 6 | 765.0 766.0 | .09 0.11 | .46 .57 | .46 .57 | 45 47 | 63 66 | 3 3 | 160 158 | 215 | [illegible] | |
| :58 | Port | | | | | | | | | | | |
| 10:01 :04 | 7 8 | 767.2 768.7 | 0.18 0.09 | 0.15 .15 | 0.15 0.48 | 49 30 | 63 72 | 4 3 | 161 162 | 235 | 50 | [illegible] |
| :07 :10 | 9 10 | 769.8 770.6 | 0.05 0.05 | 0.26 .26 | 0.26 .26 | 51 72 | 72 72 | 2 2 | 161 161 | 235 | | |
| :13 :16 | 11 12 | 771.0 772.2 | 0.04 0.04 | 0.21 .33 | 0.21 .33 | 53 53 | 73 74 | 2 2 | 161 161 | 235 | 45 | [illegible] |
| :19 | Port | | | | | | | | | | | |
| 10:28 :37 | 13 14 | 773.1 775.0 | .16 0.15 | .82 .77 | .82 .77 | 56 58 | 71 78 | 4 3½ | 161 162 | 230 | [illegible] | [illegible] 42 |
| :31 :34 | 15 16 | 776.9 777.9 | .04 .04 | .21 .21 | .21 .21 | 59 59 | 80 81 | 2 2 | 162 163 | [illegible] | | |
| :39 :42 | 17 18 | 779.0 779.9 | 0.035 0.08 | .18 .42 | .18 .42 | 62 68 | 81 81 | 2 3 | 161 160 | [illegible] | | |
| :48 | Port | | | | | | | | | | | |
| 10:51 :53 | 19 20 | 781.2 783.0 | .14 .11 | .73 .57 | .73 .57 | 63 64 | 78 84 | 4 3 | 158 164 | [illegible] | | [illegible] |
| :57 11:00 | 21 22 | 784.6 786.0 | .08 .075 | .42 .39 | .42 .39 | 65 65 | 85 [illegible] | 5 2 | 164 165 | [illegible] | | |
| 11:03 :06 | 23 24 | 787.3 788.6 | .07 .106 | .34 .31 | .36 .31 | 65 [illegible] | 84 [illegible] | 3 2 | 165 159 | 240 | | |
| 11:09 | END | 789.780 | | | | | | | | | | |
| | | | | | | | | | | | | |
| 84 | | | | Avg = 0.464 | | | | | | | | |
| Total = | | [illegible] | | Avg. gas temp. tm= | | 64°F = 524°R | | | | | | |

## ORSAT ANALYSIS FOR TEST

Date 3/13/85 Time _____ Run No. 1

Sampling Point Location Mid Scrubber Stack

| | Analysis 1 | Analysis 2 | Analysis 3 | Avg | x mole wt = | wt/mole (dry) |
|---|---|---|---|---|---|---|
| $CO_2$ ($V_{bf}$) % vol (dry) | Average of 6 Grab | Samples | | 3.83 | 44/100 | 1.69 |
| CO ($V_{bg}$) % vol (dry) | Assume 0 | | | 0 | 28/100 | + 0 |
| $O_2$ ($V_{bh}$) % vol (dry) | Average of 6 Grab | Samples | | 13.00 | 32/100 | + 4.16 |
| $N_2$ ($V_{bi}$) % vol (dry) | By Difference | | | 83.17 | 28/100 | + 23.29 |

$M_{bj}$ = Avg molecular wt of dry stack gas = 29.13

See Comments For Moisture Data

## IMPINGER $H_2O$ CONDENSATE

| Impinger No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Initial Volume | | | | |
| Final Volume | _____ | _____ | _____ | _____ |
| Volume Collected | | | | |

Total = _____

## SOURCE DESCRIPTION

Run No. 2

1. Name of Firm M.P. Secco
2. Location of Plant Tacoma Wash.
3. Type of Source Asphalt Batch Plant
4. Control Equipment Scrubber (Venturi)
5. Sampling Point Location Stack
6. Load 45[illegible] tons/hr
7. Type of Fuel Propane
8. Pollutants Sampled [illegible]
9. Time of Test:

   Date [illegible], Begin 12:42, End 2:08
10. Filter No. X02
11. Filter Holder No. 2
12. Sampler No. 3
13. General Comments Wow!

### IMPINGER $H_2O$ CONDENSATE

| Impinger No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Final Volume | 787.7 | 726.7 | 538.4 | 740.8 |
| Initial Volume | 605.1 | 603.8 | 511.9 | 720.6 |
| Volume Collected | 182.6 | 122.9 | 26.5 | 20.20 |

Total (Vv) = 352.2

# VELOCITY TRAVERSE DATA

Date March 13, 1985 Time 12:40 Run No. 2

Sampling Point Location STACK PORTS

Stack I.D. 96 x 96 INCHES in

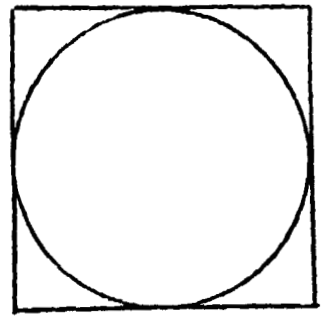
Wet Bulb Temperature ($T_{hj}$), °F 161

Dry Bulb Temperature ($T_{hk}$), °F 160

Barometric Pressure ($P_{hl}$), in Hg absolute = 30.29

Stack Pressure, in $H_2O$ $^{+}0.02 \div 13.6 + 30.29 = 30.29$

Thermocouple Reference Junction Temp N/A



Drawing of stack cross section

| Point No. | Distance from ref point, in. | Stack Temperature: Thermocouple m.v. | Stack Temperature: ($T_{hd}$), °F | Stack Temperature: ($T_{hd}$ + 460), °R | Velocity head ($V_a$), in $H_2O$ | $V_a$ x ($T_{hd}$ + 460) | $\sqrt{V_a \times (T_{hd} + 460)}$ |
|---|---|---|---|---|---|---|---|
| 1 2 | D+10 | N/A | 158 157 | 618 617 | .06 .10 | 37.08 61.70 | 6.09 7.85 |
| 3 4 | | | 161 162 | 621 622 | .13 .17 | 80.73 105.74 | 8.98 10.28 |
| 5 6 | | | 161 157 | 621 617 | .20 .19 | 124.20 117.23 | 11.14 10.83 |
| 7 8 | | | 161 162 | 621 622 | .18 .09 | 111.78 55.98 | 10.57 7.48 |
| 9 10 | | | 162 161 | 622 621 | .06 .03 | 37.32 18.63 | 6.11 4.32 |
| 11 12 | | | 162 162 | 622 622 | .035 .07 | 21.77 43.54 | 4.67 6.60 |
| 13 14 | | | 162 161 | 622 621 | .19 .08 | 118.18 49.68 | 10.87 7.05 |
| 15 16 | | | 162 163 | 622 623 | .04 .02 | 24.88 12.46 | 4.99 3.53 |
| 17 18 | | | 163 162 | 623 622 | .03 .11 | 18.69 68.42 | 4.32 8.27 |
| 19 20 | | | 162 164 | 622 624 | .19 .15 | 118.18 93.60 | 10.87 9.67 |
| 21 22 | | | 164 163 | 624 623 | .10 .09 | 62.40 56.07 | 7.90 7.49 |
| 23 24 | " | " | 163 162 | 623 622 | .09 .10 | 56.07 62.20 | 7.49 7.89 |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | 162 | 622 | | | 7.72 |

# PARTICULATE SOURCE SAMPLING DATA

Run No. 2
Plant M.A. Schapiro
Sampling Location Stack Ports
Date 3/13/85
Operator Yaniglos
Assistant Bissell

**IMPORTANT**
Nozzle Dia., Dn= 3/8 in.
Heater Box Setting 250 °F
"C" Factor 10.6 @ 160 °F
Assumed Moisture 22 Vol.%

Ambient Temp. 50 °F
Bar Pressure, Po= 30.29 in. Hg
Begin Sampling Time 12:42
Sampling Time Interval 3 min.
Probe Heater Setting 70%
Stack Pressure +0.02 in. $H_2O$

Leak check at start <0.02 CFM @ 15" Hg
Leak check after <0.02 @ 7" Hg

| Clock Time | Point No. | Dry Gas Meter Qm, ft³ | Pitot P "$H_2O$ | Orifice, H in $H_2O$ Desired | Orifice, H in $H_2O$ Actual | Dry Gas Temp tm, °F Inlet | Dry Gas Temp tm, °F Outlet | Pump Vacuum "Wg | Stack Temp. Ts, °F | Filter Temp. °F | Impinger Temp. °F | Stack Opacity 22 CO₂ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12:42 | 1 | 790.100 | 0.06 | .64 | .64 | 52 | 52 | 2½ | 158 | 220 | 50 | 13.0 |
| :45 | 2 | 791.4 | .10 | 1.07 | 1.07 | 53 | 60 | 3½ | 157 | | | 4.4 |
| :48 | 3 | 793.0 | .13 | 1.42 | 1.42 | 53 | 65 | 4½ | 161 | | 46 | |
| :51 | 4 | 794.9 | .17 | 1.77 | 1.77 | 53 | 76 | — | 160 | | | |
| :54 | 5 | 797.1 | .20 | 2.08 | 2.08 | 53 | 84 | 5½ | 161 | 250 | 42 | 13.3 |
| :57 | 6 | 799.2 | .19 | 1.97 | 1.98 | 56 | 90 | 5½ | 159 | | | 4.0 |
| 1:00 | Port | | | | | | | | | | | |
| 1:04 | 7 | 801.4 | .18 | 1.87 | 1.87 | 58 | 71 | 5½ | 161 | 235 | 56 | 12.8 |
| 1:07 | 8 | 803.6 | 0.09 | .94 | .94 | 61 | 83 | 3½ | 162 | | | 3.8 |
| 1:10 | 9 | 805.1 | .06 | .62 | .62 | 64 | 86 | 3 | 161 | 225 | | |
| :13 | 10 | 806.5 | .03 | .31 | .31 | 67 | 87 | 3½ | 162 | | | |
| 1:16 | 11 | 807.2 | .035 | .34 | .36 | 64 | 84 | 2½ | 162 | 230 | 58 | 13.0 |
| :19 | 12 | 808.3 | .07 | .73 | .73 | 65 | 84 | 3 | 162 | | | 4.4 |
| :22 | Port | | | | | | | | | | | |
| :26 | 13 | 809.6 | .19 | 1.85 | 1.98 | 66 | 82 | 5½ | 162 | 220 | 56 | |
| :29 | 14 | 812.1 | .08 | .83 | .93 | 66 | 84 | 3 | 161 | | | |
| :32 | 15 | 813.5 | .04 | .42 | .42 | 66 | 85 | 2 | 162 | 225 | | |
| :35 | 16 | 814.5 | 0.08 | .21 | .21 | 65 | 86 | 2 | 163 | | | 12.7 |
| :38 | 17 | 815.3 | .03 | .31 | .31 | 68 | 84 | 2 | 163 | | | 11.4 |
| :41 | 18 | 816.1 | .11 | 1.14 | 1.14 | 68 | 84 | 4 | 162 | | | |
| :44 | Port | | | | | | | | | | | |
| 1:48 | 19 | 817.8 | .19 | 1.98 | 1.98 | 70 | 74 | 6 | 162 | 230 | 55 | 13.0 |
| :51 | 20 | 819.9 | .15 | 1.56 | 1.36 | 70 | 86 | 5 | 164 | | | 5.0 |
| 1:54 | 21 | 822.0 | .10 | 1.04 | 1.04 | 70 | 89 | 4 | 169 | | | |
| :57 | 22 | 823.7 | 0.09 | .94 | .94 | 71 | 91 | 3½ | 163 | | | |
| 2:00 | 23 | 825.3 | .09 | .94 | .94 | 71 | 90 | 3½ | 163 | 240 | | |
| 2:03 | 24 | 826.9 | .10 | 1.04 | 1.04 | 72 | 94 | 3½ | 162 | | | |
| 2:08 | End | 828.530 | | | | | | | | | | |
| | | | | | | | | | | | | 12.98 |
| 72 | 24 | | | Avg = 1.091 | | | | | | | | 5.0 |
| Total = | | 38.430 | | Avg. gas temp. tm= | | 73 °F = 533 °R | | | | | | |

## ORSAT ANALYSIS FOR TEST

Date 3/13/85 Time _____ Run No. 2

Sampling Point Location M.A. SEGALL - STACK

| | Analysis 1 | Analysis 2 | Analysis 3 | Avg | x mole wt = | wt/mole (dry) |
|---|---|---|---|---|---|---|
| $CO_2$ ($V_{bf}$) % vol (dry) | AVERAGE OF 6 GRAB SAMPLES | | | 4.33 | 44/100 | 1.91 |
| CO ($V_{bg}$) % vol (dry) | ASSUME 0 | | | ~~0~~ | 28/100 | + 0 |
| $O_2$ ($V_{bh}$) % vol (dry) | AVERAGE OF 6 GRAB SAMPLES | | | 12.98 | 32/100 | + 4.15 |
| $N_2$ ($V_{bi}$) % vol (dry) | BY DIFFERENCE | | | 82.69 | 28/100 | + 23.15 |

$M_{bj}$ = Avg molecular wt of dry stack gas = 29.21

"SEE COVER PG. FOR MOISTURE DATA"

## IMPINGER $H_2O$ CONDENSATE

| Impinger No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Initial Volume | | | | |
| Final Volume | _____ | _____ | _____ | _____ |
| Volume Collected | | | | |

Total = _____

## SOURCE DESCRIPTION

Run No. 3

1. Name of Firm M.A. SEGALE
2. Location of Plant TACOMA, WASH.
3. Type of Source ASPHALT BATCH PLANT
4. Control Equipment SCRUBBER (VENTURI)
5. Sampling Point Location STACK
6. Load
7. Type of Fuel PROPANE
8. Pollutants Sampled PARTICULATE MATTER
9. Time of Test:

   Date 3-13-85, Begin 3:15, End 4:30
10. Filter No. X03
11. Filter Holder No. 3
12. Sampler No. 3
13. General Comments WHAT A DESK.

### IMPINGER $H_2O$ CONDENSATE

| Impinger No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Final Volume | 848.5 | 634.7 | 474.0 | 824.6 |
| Initial Volume | 570.6 | 609.7 | 470.5 | 815.5 |
| Volume Collected | 277.9 | 25.0 | 3.50 | 9.10 |

Total (Vw) = 315.5

# VELOCITY TRAVERSE DATA

Date MARCH 13, 1985 Time 3:15 Run No. 3

Sampling Point Location STACK PORTS

Stack I.D. 96 x 96 INCHES in

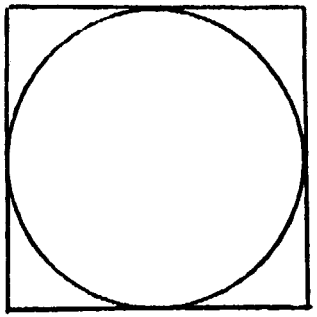
Wet Bulb Temperature ($T_{hj}$), °F 162

Dry Bulb Temperature ($T_{hk}$), °F 160

Barometric Pressure ($P_{hl}$), in Hg absolute = 20.29

Stack Pressure, in $H_2O$ 0.07 / 13.6 + 30.29 = 30.29

Thermocouple Reference Junction Temp N/A



Drawing of stack cross section

| Point No. | Distance from ref point, in. | Stack Temperature: Thermocouple m.v. | Stack Temperature: ($T_{hd}$), °F | Stack Temperature: ($T_{hd}$ + 460), °R | Velocity head ($V_a$), in $H_2O$ | $V_a$ x ($T_{hd}$ + 460) | $\sqrt{V_a \times (T_{hd} + 460)}$ |
|---|---|---|---|---|---|---|---|
| 1 2 | D.ITO | N/A | 158 158 | 618 618 | .10 .065 | 61.80 40.17 | 7.86 6.34 |
| 3 4 | | | 163 161 | 623 621 | .055 .05 | 34.27 31.05 | 5.85 5.57 |
| 5 6 | | | 165 163 | 625 623 | .025 .08 | 15.63 49.84 | 3.95 7.06 |
| 7 8 | | | 166 166 | 626 626 | .16 .08 | 100.16 50.08 | 10.01 7.08 |
| 9 10 | | | 166 166 | 626 626 | .045 .03 | 28.17 18.78 | 5.31 4.33 |
| 11 12 | | | 166 166 | 626 626 | .03 .06 | 18.78 37.56 | 4.33 6.13 |
| 13 14 | | | 166 167 | 626 627 | .16 .08 | 100.16 50.16 | 10.01 7.08 |
| 15 16 | | | 169 168 | 629 628 | .03 .025 | 18.87 15.70 | 4.34 3.96 |
| 17 18 | | | 166 167 | 626 627 | .03 .07 | 18.78 43.89 | 4.33 6.62 |
| 19 20 | | | 166 167 | 626 627 | .12 .15 | 75.12 94.05 | 8.67 9.70 |
| 21 22 | | | 167 166 | 627 626 | .11 .09 | 68.97 56.34 | 8.30 7.51 |
| 23 24 | | | 166 167 | 626 627 | .08 .05 | 50.08 31.35 | 7.08 5.60 |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | 165 | 625 | | | 6.54 |

RTI LAT OU SA LIN IEI DAT

Run No. 3
Plant M.A. Schools
Sampling Location Stackpoints
Date 3/13/65
Operator Foudt
Assistant Duvall

Ambient Temp. 50 °F
Bar Pressure, Po= 30.29 in. Hg
Begin Sampling Time 3:15
Sampling Time Interval 3 min.
Probe Heater Setting 70%
Stack Pressure 40.02 in. $H_2O$

**IMPORTANT**
Nozzle Dia., Dn= 3/8 in.
Heater Box Setting 250 °F
"C" Factor 10.41 @ 160 °F
Assumed Moisture 32 Vol.%

Leak Check at start 0.02 / 15" Hg
Leak Check at end 0.02 / 12" Hg

| Clock Time | Point No. | Dry Gas Meter Qm, $ft^3$ | Pitot P "$H_2O$" | Orifice, H in $H_2O$ Desired | Orifice, H in $H_2O$ Actual | Dry Gas Temp tm, °F Inlet | Dry Gas Temp tm, °F Outlet | Pump Vacuum "Wg | Stack Temp. Ts, °F | Filter Temp. °F | Impinger Temp. °F | Stack Opacity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3:15 :18 | 1 2 | 828.800 830.5 | .10 .065 | 1.04 .68 | 1.04 .68 | 58 58 | 60 65 | 5 3 1/2 | 158 158 | 220 | 60 | 11.8 5.0 |
| :21 :24 | 3 4 | 831.7 832.9 | .055 .05 | .57 .52 | .57 .52 | 59 60 | 70 74 | 3 3 | 163 161 | | | 12.3 |
| :27 :30 | 5 6 | 834.0 834.9 | .025 .08 | .26 .83 | .20 .83 | 60 61 | 75 78 | 2 4 | 165 163 | 240 | 52 | 12.8 5.2 |
| :33 | Port | | | | | | | | | | | |
| :36 :39 | 7 8 | 836.75 838.3 | .16 .08 | 1.65 .82 | 1.65 .82 | 61 63 | 77 78 | 7 4 | 166 166 | 225 | 50 | 12.0 5.2 |
| :42 :45 | 9 10 | 839.8 840.8 | .045 .03 | .46 .31 | .46 .31 | 64 65 | 85 86 | 3 2 | 166 166 | | | |
| :48 :51 | 11 12 | 841.75 842.6 | .03 .06 | .31 .62 | .31 .62 | 66 66 | 86 85 | 2 3 1/2 | 166 166 | 220 | 50 | 12.0 5.2 |
| :54 | Port | | | | | | | | | | | |
| :57 4:00 | 13 14 | 843.9 845.9 | 0.16 0.08 | 1.65 .82 | 1.65 .82 | 67 67 | 82 84 | 7 4 | 166 167 | 235 | 56 | 12.0 5.0 |
| :03 :06 | 15 16 | 847.4 848.4 | .03 .025 | .31 .26 | .31 .26 | 68 70 | 86 86 | 2 1/2 2 1/2 | 169 168 | 225 | | |
| :09 :12 | 17 18 | 849.0 850.1 | .03 .07 | .31 .72 | .31 .72 | 70 71 | 86 88 | 2 1/2 4 | 166 167 | 240 | 52 | 12.2 5.2 |
| :15 | Port | | | | | | | | | | | |
| 4:18 :21 | 19 20 | 851.4 853.2 | .12 .15 | 1.24 1.55 | 1.24 1.55 | 70 71 | 82 88 | 6 7 | 166 167 | 235 | 48 | 12.0 5.4 |
| :24 :27 | 21 22 | 855.2 857.1 | .11 .09 | 1.13 .95 | 1.13 .95 | 72 73 | 94 95 | 6 5 | 167 166 | 220 | | |
| :30 :39 | 23 24 | 858.6 860.0 | .08 .05 | .84 .53 | .84 .53 | 73 73 | 95 96 | 4 1/2 4 | 166 167 | 235 | 50 | 12.0 5.2 |
| 4:36 | END | 861.150 | | | | | | | | | | |
| | | | | | | | | | | | | |
| 72 | 24 | | | Avg = 0.766 | | | | | | | | 12.15 5.18 |
| Total = | | 32.350 | | | | Avg. gas temp. tm= | | 74°F = 534 | | | | |

## ORSAT ANALYSIS FOR TEST

Date 3/13/85 Time _____ Run No. 3

Sampling Point Location M.A. SEGALE - STACK

| | Analysis 1 | Analysis 2 | Analysis 3 | Avg | x = mole wt | wt/mole (dry) |
|---|---|---|---|---|---|---|
| $CO_2$ ($V_{bf}$) % vol (dry) | AVERAGE OF 8 GRAB | | SAMPLES | 5.18 | 44/100 | 2.28 |
| CO ($V_{bg}$) % vol (dry) | ASSUME Ø | | | Ø | 28/100 | + Ø |
| $O_2$ ($V_{bh}$) % vol (dry) | AVERAGE OF 9 GRAB | | SAMPLES | 12.06 | 32/100 | + 3.86 |
| $N_2$ ($V_{bi}$) % vol (dry) | BY DIFFERENCE | | | | 28/100 | + 23.17 |

$M_{bj}$ = Avg molecular wt of dry stack gas = 29.31

SEE CALC. SHEET FOR ISOKINETIC SAMPLE RUN

## IMPINGER $H_2O$ CONDENSATE

| Impinger No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Initial Volume | | | | |
| Final Volume | | | | |
| Volume Collected | | | | |

Total = _____

SUBJECT SEGALE

BY EBP DATE

SHEET NO. OF

PROJECT NO.

RUN #1

3/13/85

HOT BOX SETTING 300

PROBE HEAT 70%

| | | IMP. TEMP | BOX TEMP | $O_2$ | $CO_2$ |
|---|---|---|---|---|---|
| A-1 | 9:39 | 54 | 240 | | |
| A-2 | :42 | | 235 | 14.5 | 4.0 |
| A-3 | :45 | | 215 | | |
| A-4 | :48 | | 235 | | |
| A-5 | :51 | | — | | |
| A6 | | | — | | |
| B-1 | 10.00 | 50 | 235 | | |
| B-2 | :03 | 48 | 225 | | |
| B-3 | 6 | | 230 | | 3.8 |
| B-4 | 9 | | 235 | 12.5 | |
| B-5 | 12 | | 230 | | |
| B-6 | | | — | 13.0 | 2.6 |
| C-1 | | 44 | 245 | | |
| C-2 | | | 245 | 13.0 | 4.2 |
| C-3 | | | 240 | | |
| C-4 | | | 240 | 12.5 | 4.2 |
| C-5 | | | | | |
| C-6 | | | | | |
| D-2 | | 46 | | | |
| | | | AVG. | 12.5 | 4.2 |
| | | | | 13.00 | 3.83 |

FORM 3B

SUBJECT Run #2

BY _____ DATE _____

SHEET NO. _____ OF _____

PROJECT NO. _____

| Point # | Time | $O_2$ | $CO_2$ | Hot Box Temp. | Imping Temp. |
|---|---|---|---|---|---|
| A-1 | 12:40 | | | 220 | 50 |
| A-2 | 43 | 13.0 | 4.4 | 250 | 44 |
| -3 | 12:46 | | | 235 | 42 |
| -4 | 49 | | | | |
| -5 | | 13.3 | 4.0 | | |
| -6 | | | | | |
| B-1 | 1:02 | | | 225 | 56 |
| 2 | | | | 230 | 58 |
| 3 | | | | | |
| 4 | | 12.8 | 3.8 | | |
| 5 | | | | | |
| 6 | | | | | |
| C 1 | | | | 220 | 56 |
| 2 | | 13.0 | 4.4 | 225 | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | 12.8 | 4.4 | ~230 | |
| 6 | | | | | |
| D 1 | 1:47 | | | 240 | 55 |
| 2 | | | | | |
| 3 | | 13.0 | 5.0 | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | Avg 12.98 | 4.33 | | |

CH2M

SUBJECT Run 3

BY _____ DATE _____

SHEET NO. _____ OF _____

PROJECT NO. _____

| Point | Time | $O_2$ | $CO_2$ | IMP Temp | Box Temp |
|---|---|---|---|---|---|
| A-1 | 3:14 | | | 60 | 220 |
| 2 | 17 | 11.8 | | 52 | 240 |
| 3 | 20 | | | | |
| 4 | 23 | | 5.0 | | |
| 5 | 24 | 12.3 | | | |
| 6 | | 12.2 | 5.2 | | |
| B 1 | | | | 50 | 225 |
| 2 | :37 | | 5.2 | 50 | 220 |
| 3 | :44 | 12.0 | | | |
| 4 | | | | | |
| 5 | | 12.0 | | | |
| 6 | | | 5.2 | | |
| C 1 | | | | 52 | 235 |
| 2 | | 12.0 | | 52 | 235 |
| 3 | | | 5.0 | | 240 |
| 4 | | 12.2 | | | 235 |
| 5 | | | | | |
| 6 | | | 5.2 | | |
| D 1 | 4:17 | | | 48 | 220 |
| 2 | | | 5.4 | 50 | 235 |
| 3 | | 12.0 | | | |
| 4 | | | | | |
| 5 | | 12.0 | 5.2 | | |
| 6 | | | | | |
| Avg | | 12.06 | 5.18 | | |

FORM 3B

# CHAIN OF CUSTODY RECORD

| PROJECT NUMBER | PROJECT NAME |
|---|---|
| 519456.A6 | AIR Sampling/Analysis (M.A. Segale) |

LABORATORY: CH2M-Hill Northwest, Inc.

| STA. NO. | DATE | TIME | COMP | GRAB | SAMPLE IDENTIFICATION | NUMBER OF CONTAINERS | Filter (TSP) | Probe Wash (TSP) | Impinger Water (TSP) | Total & dissolved solids | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3/13/85 | 940 | | X | Sample Run 1 | 3 | X | X | X | | |
| 1 | " | 1243 | | X | Sample Run 2 | 3 | X | X | X | | |
| 1 | " | 315 | | X | Sample Run 3 | 3 | X | X | X | | |
| 2 | 3/13 | 4pm | | X | Pond Water Sample | 1 | | | | X | |
| 2 | 3/13 | 5pm | | X | Pond Water Sample | 1 | | | | X | |

| SAMPLED BY AND TITLE (SIGNATURE) | DATE/TIME | RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|---|
| W.R. Faught, Project Manager | 3/13 \| 5:30p | | | |
| **RELINQUISHED BY: (SIGNATURE)** | **DATE/TIME** | **RECEIVED BY: (SIGNATURE)** | **RELINQUISHED BY: (SIGNATURE)** | **DATE/TIME** / **RECEIVED BY LAB: (SIGNATURE)** |
| W.R. Faught | 3/14 \| 450p | | | Earl Littlefield |

REMARKS: Samples transported by W. Faught in company truck.

SAMPLE SHIPPED VIA: ☐ UPS ☐ BUS ☐ FEDERAL EXPRESS

AIR BUS BILL NUMBER: X

DISTRIBUTION: WHITE — ORIGINAL ACCOMPANIES SHIPMENT, PINK — COPY TO COORDINATOR FIELD FILES, YELLOW — CLIENT

FORM 240

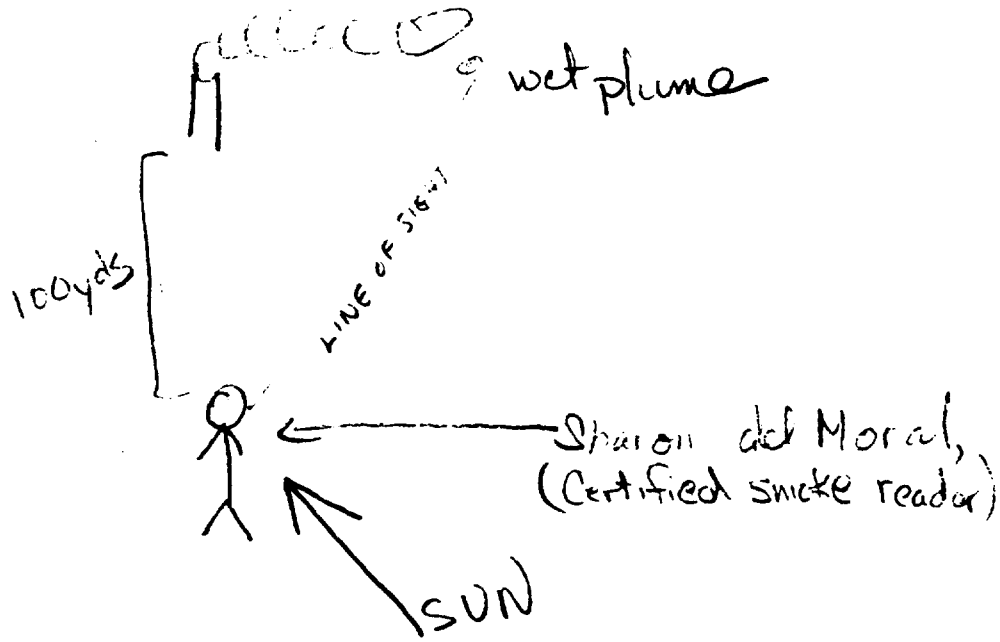
M. A. Segale source test Port of Tacoma

3/13/85 50°F sunny

Wind 5-10 mph

| | 0sec | 15sec | 30sec | 45sec | | |
|---|---|---|---|---|---|---|
| 13:32 START | 05 | 05 | 0 | 10 | 13 | 5 |
| 01 | 0 | 10 | 05 | 0 | 3 | 10 |
| 02 | 0 | 0 | 05 | 0 | | |
| 03 | 0 | 05 | 0 | 05 | | |
| 04 | 05 | 0 | 0 | 05 | | |
| 05 | 0 | 0 | 0 | 05 | | |
| 06 | 0 | 05 | 05 | 0 | | |
| 07 | 0 | 0 | 0 | 05 | | |
| 08 | 05 | 0 | 10 | 0 | | |
| 09 | 0 | 0 | 0 | 0 | | |

1 :42 END



## SOLIDS (Residue)

| | | | | | | |
|---|---|---|---|---|---|---|
| TYPE — TOTAL | X | X | | | | |
| TYPE — DISSOLVED | | | | | | |
| TYPE — SUSPENDED | | | X | X | | |
| A. SAMPLE IDENTITY | Separate Pond Water #2 | | Separate Pond Water #2 | | | |
| B. TARE NUMBER | Pearl 100 | WRFT | D-4 | D5 | | |
| C. SAMPLE VOL., mls | 100 | 100 | 30 | 30 | | |
| D. TARE + SOLIDS, gms | 77.1374 | 76.4912 | 1.5192 | 1.5166 | | |
| E. TARE, gms | 77.0991 | 76.4517 | 1.5110 | 1.5083 | | |
| F. SOLIDS, gms | 0.0383 | 0.0395 | 0.0082 | 0.0083 | | |
| G. mg/l SOLIDS | 383 | 395 | 273 | 277 | | |
| | 389 | | 275 | | | |

### VOLATILE SOLIDS

| | | | | | | |
|---|---|---|---|---|---|---|
| H. TARE + SOLIDS, gms (D) | | | | | | |
| I. IGNITED TARE + SOLIDS, gms | | | | | | |
| J. LOSS ON IGNITION, gms | | | | | | |
| k. MG/L VOLATILE | | | | | | |

### CALCULATION:

$$\text{mg/l} = \frac{\text{WEIGHT, gms (LOST OR GAINED)} \times 10^6}{\text{ml OF SAMPLE}}$$

### COMMENTS:

CH2M HILL

BY Jaynes

DATE 3/21/85

SHEET NO. ___ OF ___

PROJECT NO. ___

SUBJECT M.P. Square

SOLIDS (Residue)

CORVALLIS, OREGON

RAC Sample Box NO. "C"

# CALIBRATION SHEET

Figure 5-4

Orifice C Gas Meter C Date 8/21/84 Barometric Pressure $P_b$: 30.05

| Orifice Manometer ΔH In. $H_2O$ | GAS VOLUME Wet Test Meter $V_w$, cf | GAS VOLUME Dry Gas Meter $V_d$, cf | TEMPERATURE Wet Test Meter $t_w$, °F | TEMPERATURE Dry Gas Meter Inlet $t_{di}$, °F | TEMPERATURE Dry Gas Meter Outlet $t_{do}$, °F | TEMPERATURE Dry Gas Meter Average $t_d$, °F | TIME θ, min. | RESULTS Y | RESULTS ΔH@ |
|---|---|---|---|---|---|---|---|---|---|
| 0.50 | 0.794 | 0.781 | 70 | 75 | 77 | 76 | 2 | 1.027 | 1.76 |
| | | | | | | | | | |
| 0.60 | 0.8455 | 0.847 | 70 | 75 | 77 | 76 | 2 | 1.008 | 1.856 |
| | | | | | | | | | |
| 0.75 | 0.943 | 0.952 | 70 | 75 | 77 | 76 | 2 | 1.00 | 1.87 |
| | | | | | | | | | |
| 1.00 | 1.006 | 1.0240 | 70 | 75 | 77 | 76 | 2 | .9916 | 2.185 |
| | | | | | | | | | |
| | | | | | | | | Average | 1.007 / 1.97 |

$$Y = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)} \qquad \Delta H@ = \frac{0.0317\ \Delta H}{P_b (t_{do} + 460)} \left[\frac{(t_w + 460)\theta^2}{V_w}\right]$$

Probe Nozzle Date

| | $D_n$, In. | $D_n$, In. | $D_n$, In. | |
|---|---|---|---|---|
| 3/8 | .3748 | .3748 | .3753 | AVG = 0.3750 |
| | | | | |
| 5/16 | .3124 | .3126 | .3124 | = 0.3125 |
| | | | | |
| 1/4 | .2510 | .2449 | .2507 | = 0.2489 |
| | | | | |
| 3/16 | .1875 | .1876 | .1874 | = 0.1875 |
| | | | | |
| | | | | Averages |

Pitot Tube 5' Date 10'

| Forward $\Delta P_s$ | Forward $\Delta P_{std}$ | Forward $C_p$ | Reverse $\Delta P_s$ | Reverse $\Delta P_{std}$ | Reverse $C_p$ |
|---|---|---|---|---|---|
| 1.39 | 1.03 | 0.852 | | | |
| 1.75 | 1.30 | 0.853 | | | |
| 1.15 | 0.84 | 0.846 | | | |
| 0.68 | 0.50 | 0.849 | | | |
| 0.32 | 0.23 | 0.839 | | | |
| 0.18 | 0.13 | 0.841 | | | |
| | | | | | |
| 0913 | 0.672 | 0.847 | | | Average |

$$C_p = 0.99 \left[\frac{\Delta P_{std}}{\Delta P_s}\right]^{\frac{1}{2}}$$