1 coal-fired Kiln
controlled by baghouse
PM-filt, PM-cond., CO_2
← 6 runs → (3 runs)

EXHIBIT 2

TEST CONDUCTED AT

PLANT NO. 2

MAY 1977

REPORT ON THE PARTICULATE EMISSIONS FROM A LIME KILN BAGHOUSE

CONTENTS

I. INTRODUCTION

This report presents the results of a particulate emission test conducted on the No. 5 kiln baghouse at Plant No. 2.

One run of 2 hours and 12 minutes was made on each of the six No. 5 baghouse exit stacks. Particulate results for each run have been divided into evaluations of the probe and filter catch alone and the total catch (The probe and filter plus impingers). The total emission rate for the baghouse has been calculated from the sum of all six runs.

The test were performed in accordance with EPA Method 5 Procedures.

Plant No. 2 PARTICULATE

STACK TEST

#/ton feed (allowable = 0.3 #/ton)

	Run Number / Date	1 5-4-77	2 5-5-77	3 5-6-77	4 5-7-77	5 5-9-77	6 5-10-77	AVG	TOTAL
olume Gas Sampled SCFD		53.155	55.581	48.116	55.685	63.977	49.574	53.348	326,088
Moisture, Volume		11.4	15.5	12.3	15.1	9.9	11.8	12.67	
verage Stack Temp. °F		404.0	428.0	420.5	420.5	426.5	371.3	411.80	
CFM D		11,862	11,707	10,812	11,218	13,782	10,705	11,681	70,086
CFM		21,329	23,378	20,302	22,560	25,309	18,852	22,038	132,230
Isokinetic		97.1	102.4	96.0	103.4	100.1	99.9	99.82	
eed Rate T/hr (Limestone only)		43.9	42.5	43.5	44.0	42.1	41.1	42.85	192,700 M
oal Feed T/r		6.3	5.7	6.2	6.1	6.1	6.0	6.07	314,941 E
otal IWR		50.2	48.2	49.7	50.1	48.2	47.1	48.92	
articulates - Probe & Filter Catch									
g		56.9	93.9	174.7	114.1	74.7	106.7	103.5	621.0
r/DSCF		0.0165	0.0261	0.0560	0.0316	0.0180	0.0332	0.0302	
/hr		1.65	2.65	5.09	3.15	2.13	3.04	2.95	17.71
/ton feed	.41	0.0376	0.0624	0.1170	0.0716	0.0506	0.0740	0.0689	51.86 M
	1.17 MHL, .46 EPA	0.45		1.40					17.93 E
								AVG = 0.83	
articulates - Total Catch									
g		411.0	201.7	203.6	132.2	217.6	131.4	216.3	1297.5
r/DSCF		0.1192	0.0560	0.0652	0.0366	0.0524	0.0409	0.0617	
/hr		11.96	5.69	5.93	3.64	6.21	3.75	6.20	37.18
/ton feed		0.2724	0.1339	0.1363	0.0827	0.1475	0.0912	0.1440	
Impinger Catch		86.2	53.4	14.2	13.5	65.7	18.9	42.0	37.18 M
	Cond lb/h	10.31	3.84	0.84	0.49	4.05	0.71	3.25	17.93 E

Cond lb / ton prod 2.8 0.13 AVG = 0.89

PROCESS WEIGHT RATE CALCULATION

DATE: 5-4-77

TEST PERIOD: 10:15AM-1:52 PM

STONE FEED

	TIME	POIDOMETER READING
START	10:00 AM	3,493,661
FINISH	2:00 PM	3,511,240
TOTAL POIDOMETER UNITS		17,579
TOTAL TONS (@ 20#/POID. UNIT)		175.79
TONS/HOUR		43.94

COAL FEED

	TIME	POIDOMETER READING
START	10:00 AM	18,417
FINISH	2:00 PM	20,922
TOTAL POIDOMETER UNITS		2,505
TOTAL TONS (@ 20#/POID. UNIT)		25.05
TONS/HOUR		6.26

TOTAL PWR = 50.20

PROCESS WEIGHT RATE CALCULATION

DATE: 5-5-77

TEST PERIOD: 11:00 AM - 2:07 PM

STONE FEED

	TIME	POIDOMETER READING
START	11:00 AM	3,594,739
FINISH	2:00 PM	3,607,482
TOTAL POIDOMETER UNITS		12,743
TOTAL TONS (@ 20#/POID. UNIT)		127.43
TONS/HOUR		42.48

COAL FEED

	TIME	POIDOMETER READING
START	11:00 AM	32,852
FINISH	2:00 PM	34,569
TOTAL POIDOMETER UNITS		1,717
TOTAL TONS (@ 20#/POID. UNIT)		17.17
TONS/HOUR		5.72

TOTAL PWR = 48.20

PROCESS WEIGHT RATE CALCULATION

DATE: 5-6-77

TEST PERIOD: 10:40 AM — 1:42 PM

STONE FEED

	TIME	POIDOMETER READING
START	10:00 AM	3,693,944
FINISH	2:00 PM	3,711,355
TOTAL POIDOMETER UNITS		17,411
TOTAL TONS (@ 20#/POID. UNIT)		174.11
TONS/HOUR		43.53

COAL FEED

	TIME	POIDOMETER READING
START	10:00 AM	46,765
FINISH	2:00 PM	49,232
TOTAL POIDOMETER UNITS		2,467
TOTAL TONS (@ 20#/POID. UNIT)		24.67
TONS/HOUR		6.17

TOTAL PWR = 49.70

PROCESS WEIGHT RATE CALCULATION

DATE: 5-7-77

TEST PERIOD: 10:30AM — 1:27 PM

STONE FEED

	TIME	POIDOMETER READING
START	10:00 AM	3,797,376
FINISH	2:00 PM	3,814,980
TOTAL POIDOMETER UNITS		17,604
TOTAL TONS (@ 20#/POID. UNIT)		176.04
TONS/HOUR		44.01

COAL FEED

	TIME	POIDOMETER READING
START	10:00 AM	61,325
FINISH	2:00 PM	63,777
TOTAL POIDOMETER UNITS		2452
TOTAL TONS (@ 20#/POID. UNIT)		24.52
TONS/HOUR		6.13

TOTAL PWR = 50.14

PROCESS WEIGHT RATE CALCULATION

DATE: 5-9-77

TEST PERIOD: 10:30 AM - 1:32 PM

STONE FEED

	TIME	POIDOMETER READING
START	10:00 AM	4005258
FINISH	2:00 PM	4022115
TOTAL POIDOMETER UNITS		16,857
TOTAL TONS (@ 20#/POID. UNIT)		168.57
TONS/HOUR		42.14

COAL FEED

	TIME	POIDOMETER READING
START	10:00 AM	90402
FINISH	2:00 PM	92835
TOTAL POIDOMETER UNITS		2433
TOTAL TONS (@ 20#/POID. UNIT)		24.33
TONS/HOUR		6.08

TOTAL PWR = 48.22

PROCESS WEIGHT RATE CALCULATION

DATE: 5-10-77

TEST PERIOD: 10:00AM - 1:07PM

STONE FEED

	TIME	POIDOMETER READING
START	10:00AM	4107523
FINISH	1:00 PM	4119840
TOTAL POIDOMETER UNITS		12,317
TOTAL TONS (@ 20#/POID. UNIT)		123.17
TONS/HOUR		41.06

COAL FEED

	TIME	POIDOMETER READING
START	10:00AM	105070
FINISH	1:00 PM	106870
TOTAL POIDOMETER UNITS		1800
TOTAL TONS (@ 20#/POID. UNIT)		18.00
TONS/HOUR		6.00

TOTAL PWR = 47.06

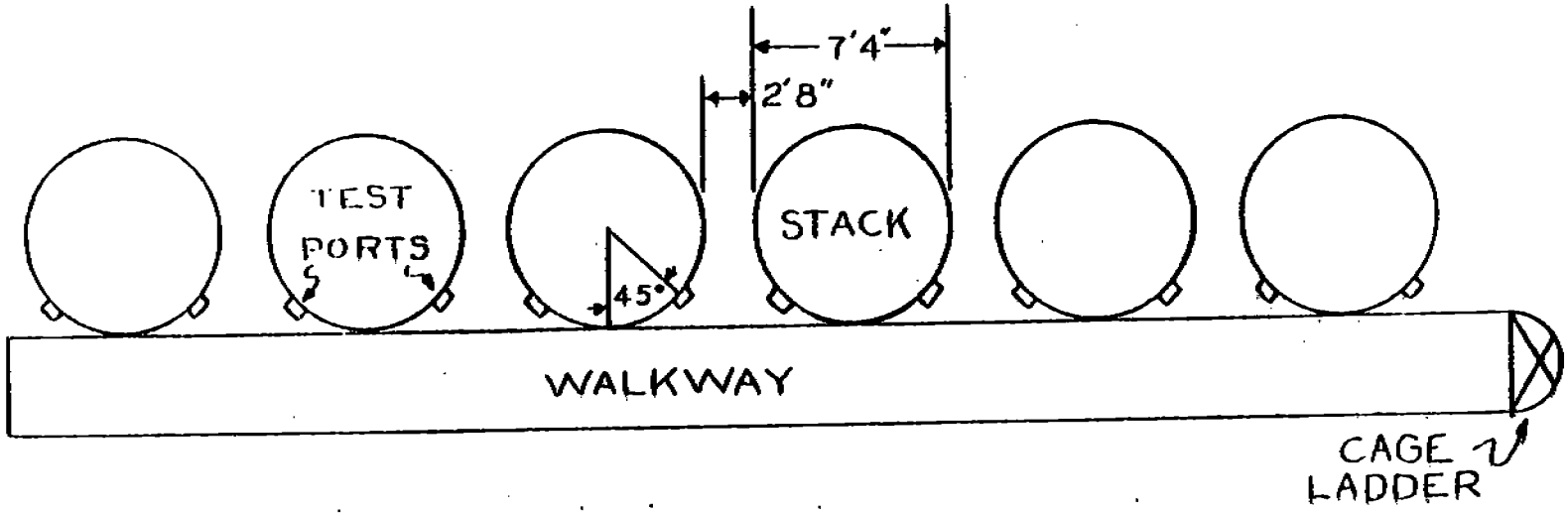
REVISIONS

DESTROY ALL PREVIOUS PRINTS

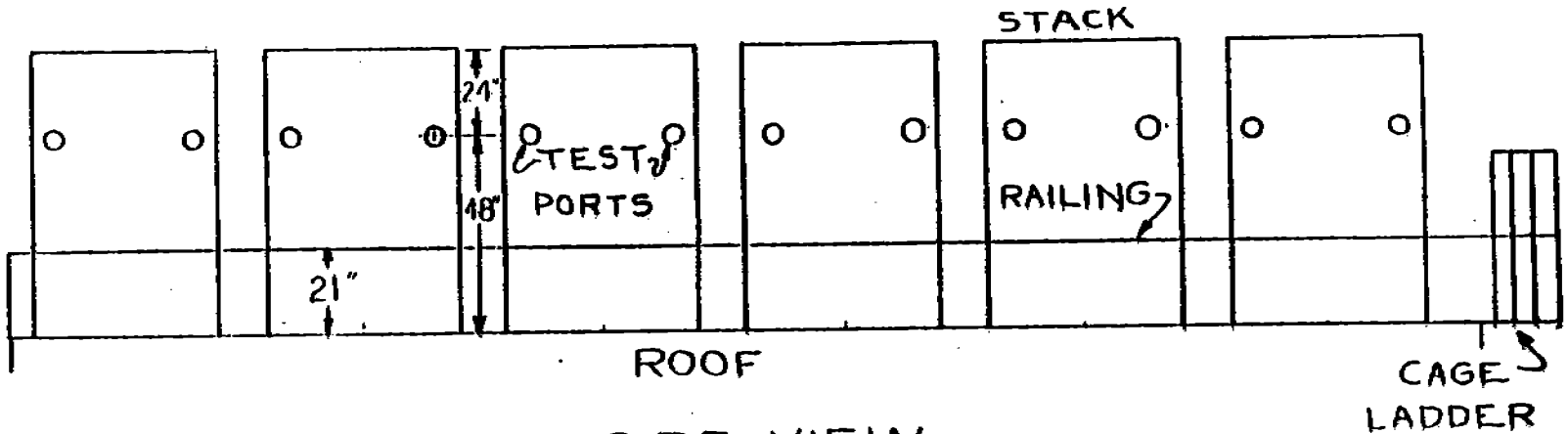
5	
4	
3	
2	
1	

DRAWN BY W. A. SCALE DATE 5-12-77

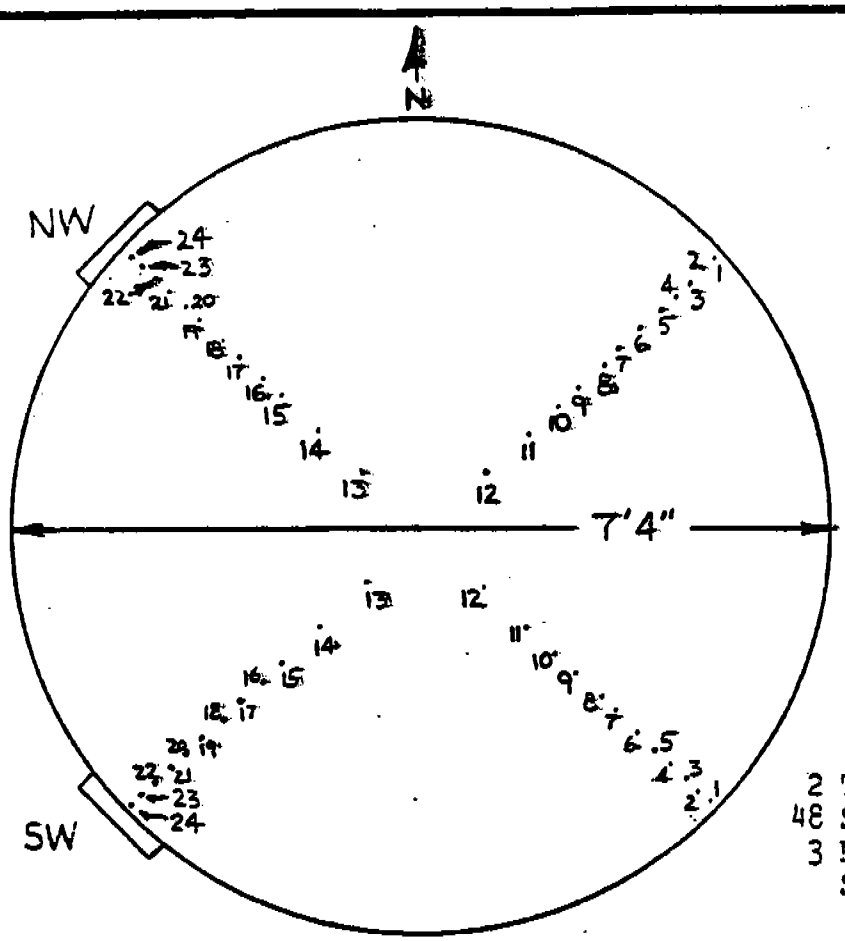
CHECKED BY APPROVED



TOP VIEW



SIDE VIEW



2 Traverses
48 Sampling Points
3 Minutes Per Sampling Point

TRAVERSE POINT	DISTANCE FROM INSIDE WALL, INCHES	TRAVERSE POINT	DISTANCE FROM INSIDE WALL, INCHES
1	87.05	13	35.02
2	85.14	14	28.45
3	83.16	15	23.91
4	81.03	16	20.24
5	78.76	17	17.06
6	76.41	18	14.21
7	73.77	19	11.62
8	70.94	20	9.22
9	67.76	21	6.97
10	64.09	22	4.85
11	59.55	23	2.85
12	52.98	24	.92

REVISIONS DESTROY ALL PREVIOUS PRINTS.	
1	
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4	DRAWN BY G. K. SCALE DATE 5-16-77
5	CHECKED BY APPROVED

desiccant dried glass fiber filter (MSA 1106 BH), preweighed silica gel and distilled water are used to prepare the particulate sampling train for the stack sampling. The equipment is taken to the test site, set up, and checked out for an acceptable leakage rate. The test is now ready to be performed. The stack gas velocity head measurements are made with a reverse-type or Type "S" pitot tube and an inclined-vertical manometer. Stack gas temperatures are sensed by a Type "K" thermocouple and indicated on a readout at the control unit. Traverse points are based on the division of stack cross sectional area into equal area zones.

The metering rate to establish isokinetic sampling of stack gas is determined by measuring gas conditions in the stack at the sampling point and gas conditions at the meter while sampling. Other necessary data to determine isokinetic metering rate is determined by preliminary test.

The probe with the pitot and thermocouple attachments, is inserted into the stack and continuous gas samples are withdrawn isokinetically at specific traverse points for specific intervals of time. The probe and filter holder are electrically heated to prevent condensation. The gas then passes through a series of four impingers containing distilled water and silica gel set in an ice bath to condense water vapor. The gas, then, passes through the pump, totalizing gas meter, orifice meter and finally to the atmosphere. Needle valves are used to control the flow rates in the sampling train.

At the end of the run, the probe is held in a vertical position, nozzle up, and tapped on the nozzle to cause any dust sticking to the inside of the nozzle to enter the filter.

REVISIONS

DESTROY ALL PREVIOUS PRINTS

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DRAWN BY

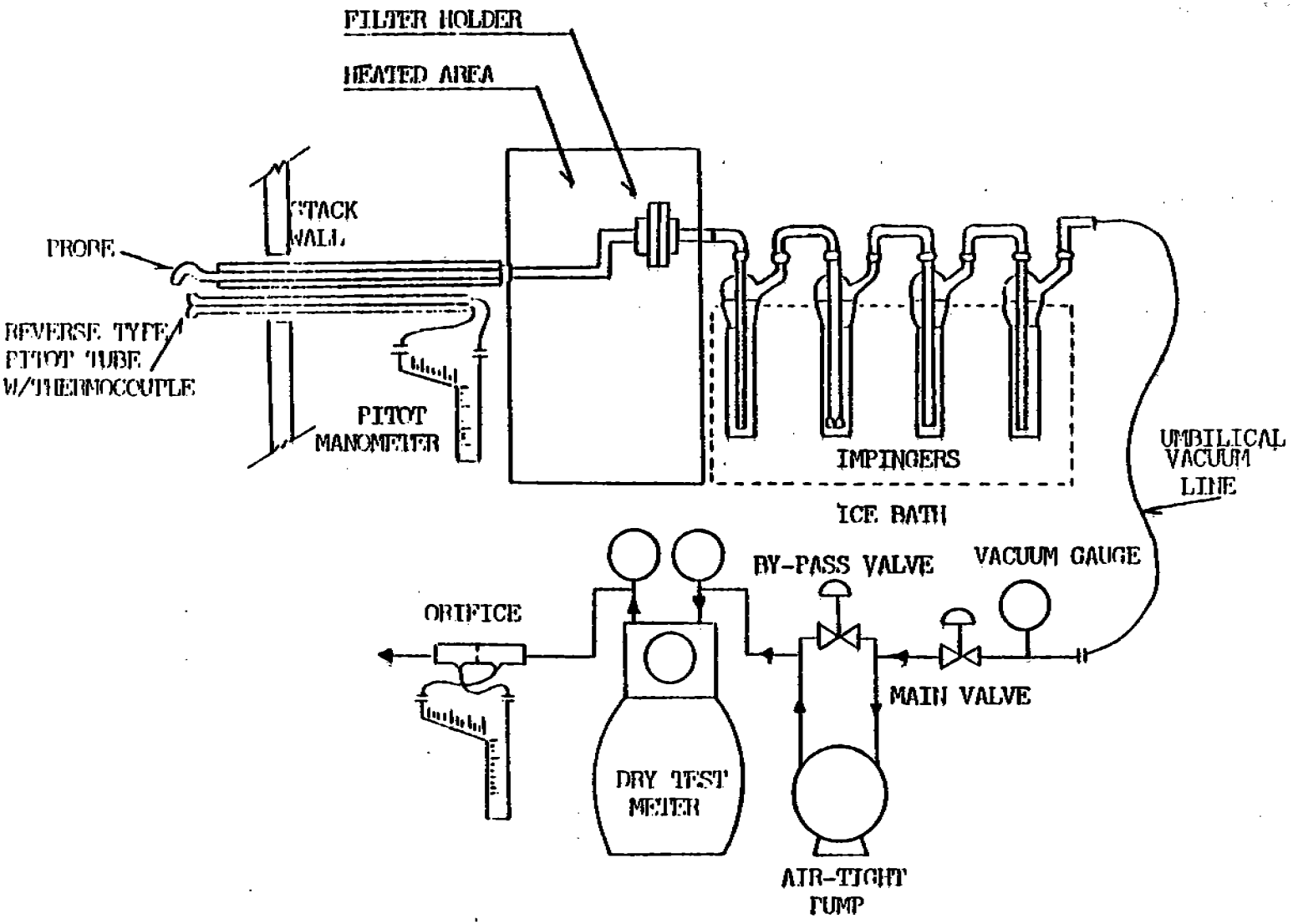
CHECKED BY

SCALE

DATE

APPROVED

EPA METHOD 5 SAMPLING TRAIN



PARTICULATE SAMPLING TRAIN

e basic equipment is manufactured by SCIENTIFIC GLASS & INSTRUMENTS, INC. The Model -5000 Modular Stac-C-Lator consists of the following equipment:

(1) 0.50" I.D. Button hook-type sampling probe tip, 316 SS

(2) 10 Ft. effective length pitobe with heated 316 SS inner Liner with

(a) 1/2" I.D., 5/8" O.D. inner liner, heated
(b) 3/8" O.D. 316 SS pitot tube
(c) Type "K" thermocouple in 1/4" O.D. jacket

(3) Four impingers in ice bath

(a) Absorber with 100 ml distilled water with 1/2" I.D. absorbent tube.
(b) Greenburgh-Smith impinger with 100 ml distilled water
(c) Absorber with 1/2" I.D. absorber tube, dry
(d) Absorber with 200 gms dry silica gel

(4) 50 LF umbilical cord to control case

(5) Vacuum gauge

(6) Needle control valves

(7) Thomas diaphragm pump, 4 SCFM at 0" Hg, 23" Hg. max.

(8) Dry gas meter rated at 0.1 ft.^{3}/rev.

(9) Calibrated orifice plate

EQUIPMENT TRAIN CHECKOUT

Prior to performing a run, the test equipment is thoroughly checked out:

(a) Teflon tape on all metal-to-metal joints.

(b) Silicone grease on all glass or metal ball joints.

(c) Plug vacuum line at the umbilical cord after impingers, turn on pump, open coarse valve and adjust vacuum to max. vacuum with fine valve. Gas meter should register no flow.

(d) Assemble entire train including probe, plug probe tip and adjust valves to 15" Hg. Leakage, if any, should not exceed 0.02 CFM at 15" Hg. or correction must be made.

(e) Check operation of all sensors, meters, and equipment orientation

APPENDIX A

Gravimetric Analysis

Plant No. 2

DATE: 5-4-77

RUN: 1

	WEIGHT of PARTICULATE COLLECTED grams		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTER CATCH	0.7063	0.6982	0.0081
ACETONE WASHINGS	138.6463	138.5975	0.0488
IMPINGER CATCH	133.7049	133.3508	0.3541
TOTAL PARTICULATE COLLECTED			0.4110

Plant No. 2

DATE 6-4-77

LOCATION #5 BAGHOUSE
RUN NO. STACK #1

MOISTURE CONTENT

Impinger No. 1	Gross	741.1
	Tare	635.8
	Net	105.3
Impinger No. 2	Gross	669.8
	Tare	650.5
	Net	19.3
Impinger No. 3	Gross	434.1
	Tare	430.9
	Net	3.2
Impinger No. 4	Gross	678.5
	Tare	664.8
	Net	13.7

No. 1	Net	105.3
No. 2	Net	19.5
No. 3	Net	3.2
No. 4	Net	13.7
	Total	141.5

Plant No. 2

DATE: 5-5-77

RUN: 2

	WEIGHT of PARTICULATE COLLECTED grams		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTER CATCH	0.7420	0.7079	0.0341
ACETONE WASHINGS	137.7246	137.6648	0.0598
IMPINGER CATCH	128.0191	127.9113	0.1078
TOTAL PARTICULATE COLLECTED			0.2017

Plant No 2

PLANT No. 2
DATE 2-5-77

LOCATION #5 Baghouse
RUN NO. Stack No 2

MOISTURE CONTENT

Impinger No. 1	Gross	806.1
	Tare	636.4
	Net	169.7
Impinger No. 2	Gross	675.2
	Tare	651.1
	Net	24.1
Impinger No. 3	Gross	433.1
	Tare	430.8
	Net	2.3
Impinger No. 4	Gross	681.9
	Tare	666.7
	Net	15.2

No. 1	Net	169.7
No. 2	Net	24.1
No. 3	Net	2.3
No. 4	Net	15.2
	Total	211.3

Plant No 2

DATE: 5-6-77

RUN: 3

	WEIGHT of PARTICULATE COLLECTED grams		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTER CATCH	0.7567	0.7220	0.0347
ACETONE WASHINGS	137.4323	137.2923	0.1400
IMPINGER CATCH	135.2126	135.1837	0.0289
TOTAL PARTICULATE COLLECTED			0.2036

Plant No. 2

PLANT No 2
DATE 5-6-77

LOCATION #5 BACKHOUSE
RUN NO. STACK

MOISTURE CONTENT

Impinger No. 1	Gross	749.7
	Tare	630.8
	Net	108.9
Impinger No. 2	Gross	670.9
	Tare	653.1
	Net	17.8
Impinger No. 3	Gross	437.4
	Tare	436.0
	Net	1.4
Impinger No. 4	Gross	675.2
	Tare	663.8
	Net	11.4

No. 1	Net	108.9
No. 2	Net	17.8
No. 3	Net	1.4
No. 4	Net	11.4
	Total	139.5

Plant No. 2

DATE: 5-7-77

RUN: 4

	WEIGHT of PARTICULATE COLLECTED grams		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTER CATCH	0.7820	0.7720	0.0100
ACETONE WASHINGS	133.4535	133.3494	0.1041
IMPINGER CATCH	134.0415	134.0234	0.0181
TOTAL PARTICULATE COLLECTED			0.1322

Plant No. 2

NT No 2
6-7-77

LOCATION #5 BOILER HOUSE
RUN NO. STACK # 4

MOISTURE CONTENT

Impinger No. 1	Gross	806.6
	Tare	636.3
	Net	170.3
Impinger No. 2	Gross	672.5
	Tare	653.7
	Net	18.8
Impinger No. 3	Gross	439.1
	Tare	436.1
	Net	3.0
Impinger No. 4	Gross	675.7
	Tare	663.1
	Net	12.6

No. 1	Net	170.3
No. 2	Net	18.8
No. 3	Net	3.0
No. 4	Net	12.6
	Total	204.7

Plant No. 2

DATE: 5-9-77

RUN: 5

	WEIGHT of PARTICULATE COLLECTED grams		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTER CATCH	0.7378	0.7123	0.0255
ACETONE WASHINGS	135.2330	135.1838	0.0492
TWINSIDE CATCH	138.7388	138.5959	0.1429
TOTAL PARTICULATE COLLECTED			0.2176

Plant No. 2

PLANT No. 2

LOCATION ES Precipitator

RUN NO. 2

MOISTURE CONTENT

Impinger No. 1	Gross	738.9
	Tare	633.6
	Net	105.3
Impinger No. 2	Gross	675.6
	Tare	665.0
	Net	10.6
Impinger No. 3	Gross	438.4
	Tare	434.0
	Net	4.4
Impinger No. 4	Gross	681.2
	Tare	666.9
	Net	14.3

No. 1	Net	105.3
No. 2	Net	10.6
No. 3	Net	4.4
No. 4	Net	14.3
	Total	134.6

Plant No. 2

DATE: 5-10-77

RUN: 6

	WEIGHT of PARTICULATE COLLECTED GRAMS		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
FILTER CATCH	0.8087	0.7730	0.0357
ACETONE WASHINGS	137.3638	137.2928	0.0710
IMPINGER CATCH	127.9355	127.9108	0.0247
TOTAL PARTICULATE COLLECTED			0.1314

Plant No. 2

PLANT No. 2
DATE 5-10-77

LOCATION #5 BAGHOUSE
RUN NO. #6 STACK

MOISTURE CONTENT

Impinger No. 1	Gross	740.2
	Tare	634.7
	Net	105.5
Impinger No. 2	Gross	670.8
	Tare	654.8
	Net	16.0
Impinger No. 3	Gross	438.0
	Tare	436.4
	Net	1.6
Impinger No. 4	Gross	679.1
	Tare	665.9
	Net	13.2

No. 1	Net	105.5
No. 2	Net	16.0
No. 3	Net	1.6
No. 4	Net	13.2
	Total	136.3

STACK GAS COMPOSITION

Stack: [illegible] - #5 Blower - Stack 3

Date: 5-3-77 Time: 10:00 AM

Method of Collection:

( ) Grab Sample ( ) Integrated Other _____

( ) Bomb (X) Bag ( ) Bottle Number _____

Analytical Method:

_____ for _____

_____ for _____

_____ for _____

Test No.	CO_2 Reading	%	O_2 Reading	%	CO Reading	%	Reading	
1								
2								
3								
4								
Avg.	16.6	16.6	27.1	10.5	27.1	0.0		

(AVERAGE OF 3 TRIALS)

Test No.	Reading		Reading		Reading		Reading	
1								
2								
3								
4								
Avg.								

APPENDIX B

Field Data and Calculation Sheets

E.P.A., EXTENDED NOMENCLATURE & SYMBOLS

DEC. 23, FED. REG.

1. A = Cross-sectional area stack, $ft.^2$
2. A_e = Inside area of stack at exit, square feet
3. A_n = Cross-sectional area nozzle, $ft.^2$
4. B_d = Proportion (by volume) of dry gas in gas stream, no dimensions
5. BTU = British thermal units
6. B_{wc} = Proportion (by volume) of water vapor in gas stream leaving condenser, no dimensions
7. B_{wi} = Approximate volumetric proportion of water vapor in gas stream leaving the impingers, 0.025
8. B_{wo} = Proportion (by volume) of water vapor in gas stream, no dimensions
9. C = Conc. NO_x as NO_2 dry basis, #/SCFDG
10. $C_{H_2SO_4}$ = Conc. of H_2SO_4 at std. cond., dry basis, #/SCFDG
11. C_p = Specific heat at constant pressure, BTU per lb., ^oF
12. $C_{P_{std.}}$ = Pitot tube coefficient standard type, ~ 0.99
13. $C_{P_{test}}$ = Pitot tube coefficient of type S pitot tube
14. C_s = Concentration particulate matter in stack gas, #/SCFDG
15. C'_s = Concentration particulate matter in stack gas, gr/SCFDG
16. C_{SO_2} = Concentration SO_2 at standard cond., dry basis. #/SCFDG
17. cal = Calorie(s)

19. cfm = Cubic feet per minute

19. D_e = Inside diameter of stack at exit, feet

20. DI = Deionized water

21. D_n = Inside diameter of nozzle in inches

22. D_s = Inside diameter of stack at sample port, feet

23. %EA = Percent excess air

24. ^oF = Degrees Fahrenheit

25. ft = Feet

26. gm = Gram(s)

27. gr = Grain(s)

28. H = Physical height of stack, feet

29. H_e = Effective height of stack, feet

30. Hg = Mercury

31. hr = Hour

32. $\triangle H$ = Average $\triangle p$ across orifice meter, inches H_2O

33. $\triangle H_@$ = $\triangle H$ for 0.75 SCFM, inches H_2O

34. in. = Inch(es), (")

35. K_m = Orifice meter coefficient

36. K_p = 85.48 ft/sec $\left(\frac{\#}{\# \text{ mole}, {}^oR}\right)^{\frac{1}{2}}$

37. K_p' = 4005 ft/min, air STP

38. l = Liter(s)

39. lb = Pound(s)

40. m = Mass of NO_2 in gas sample, μg

41. M_{CO} = MW CO, 28 #/# mole

42. M_{CO_2} = MW CO_2, 44#/# mole

43. M_d = MW dry stack gas, #/# mole

44. M_{H_2O} = MW H_2O, 18 #/# mole

45. M_m = MW of gas stream at meter, #/# mole

46. M_n = Total amount of particulate matter collected, mg

47. M_{N_2} = MW (N_2 + A), 28.2 #/# mole

48. M_{O_2} = MW O_2, 32 #/# mole

49. M_s = MW wet stack gas, #/# mole

50. mg = Milligram(s)

51. ml = Milliliter(s)

52. mm = Millimeter(s)

53. MW = Molecular weight

54. μ = Micron(s)

55. μg = Microgram(s)

56. N = Normality

57. nm = Nanometers, $m\mu = 10^{-9}$ meters

58. P_{bar} = Barometric pressure, "Hg

59. P_c = Absolute pressure gas stream leaving condenser, "Hg

60. P_f = Final abs. pressure flask, "Hg

61. P_i = Initial abs. pressure flask, "Hg

62. P_m = Absolute pressure at dry gas meter, "Hg

63. P_s = Absolute pressure in stack, "Hg

64. $P_{std.}$ = 29.92 "Hg

65. $\Delta_{p\ std.}$ = Velocity head, standard type pilot tube

66. $\Delta_{p\ test}$ = Velocity head, Type S pilot tube

67. $(\sqrt{\Delta p})_{avg.}$ = Average "H_2O, velocity head

68. pm = Pollutant mass, #

69. pmr_a = Pollutant mass rate based on area ratio, #/hr

70. pmr_c = Pollutant mass rate based on concentration, #/hr

71. ppm = Parts per million (volume per unit volume)

72. Q_M = Mass flow rate of stack, #/hr

73. Q_s = Stack volumetric flow rate dry basis, standard conditions, $ft.^3/hr$

74. Q_v = Stack volumetric flow rate, stack conditions, $ft.^3/hr$

75. q_v = Actual volumetric flow stack gas, $ft.^3/min$

76. Q_{vm} = Volumetric flow rate (meter conditions) through sampling train, $ft.^3/hr$

77. q_{vm} = Volumetric flow rate (meter conditions) $ft.^3/min$

78. R = 21.83 "Hg - cu. ft./# mole ^oR

79. ^oR = Degrees rankine

80. SCFDG = Standard Cubic Feet Dry Gas

81. SCFM = Standard Cubic Feet per Minute

82. sec = Second(s)

83. ρ_{H_2O} = Density H_2O, 1 g/ml

84. ρ_s = Density wet stack gas, $\#/ft.^3$

85. SG = Specific gravity (air = 1.0)

86. STP = Standard temperature and pressure, 530°R and 29.92 in. Hg

87. T = Ambient temperature, °R

88. T_c = Absolute temperature gas stream leaving condenser, °R

89. T_e = Temperature stack gas at exit, °R

90. T_f = Final abs. temperature flask, °R

91. T_i = Initial abs. temperature flask, °R

92. T_m = Absolute temperature at meter, °R

93. $T_{std.}$ = 530 °R

94. T_s = Absolute temperature of stack gas at sample point, °R

95. $(T_s)_{avg}$ = Average absolute temperature of stack from traverses, °R

96. t_d = Temperature of dry bulb, °F

97. t_w = Temperature of wet bulb, °F

98. ~~θ~~ = Total sampling time, min.

99. V_a = Volume of sample aliquot titrated, ml (SO_x)

100. V_a' = Volume of absorbing solution, 25 ml (NO_x)

101. V_c = Volume water vapor through meter at meter conditions, $ft.^3$

102. V_e = Velocity of stack gas at stack exit, ft/sec

103. V_f = Final volume of impinger contents, ml

104. V_i = Initial volume of impinger content, ml

105. V_{lc} = Total volume of liquid impinger + silica gel, ml

106. V_m = Volume by dry gas meter, ft.^{3} (wet)

107. V_{mc} = Dry gas volume through meter at std. cond., ft.^{3}

108. V_{md} = Dry gas volume through meter at meter conditions, ft.^{3}

109. V_{ms} = Sample volume at stack conditions, including the water vapor, cubic ft.

110. $V_{m_{std.}}$ = V_{mc}

111. V_n = Gas velocity in the nozzle actual, ft/sec

112. V_p = Partial pressure due to water vapor, "Hg

113. V_{ps} = Partial pressure for water at saturation, "Hg

114. V_s = Stack velocity, ft/sec

115. $(V_s)_{avg}$ = Stack gas velocity, ft/sec

116. V_{sc} = Sample vol. std. cond. (dry basis), ml

117. $V_{soln.}$ = Total volume of solution from which aliquot taken

118. V_t = Volume of flask and valve, ml (NO_x)

119. V_t' = Volume of titrant, ml (SO_x)

120. V_{tb}' = Volume of titrant for blank, ml (SO_x)

121. V_{wc} = Volume of water vapor collected, ft.^{3} std. cond. (Method 4)

122. $V_{w\ std.}$ = Volume of water vapor in gas sample, std. cond., ft.^{3} (Method 5)

STACK # 1

CALCULATION WORK SHEET

1. VOLUME OF GAS SAMPLE (DRY, STP) $V_{m_{std}}$:

$$V_{m_{std}} = V_{mc}$$
$$= V_{m_1}$$
$$= 53.155 \text{ SCFDG}$$

2. WATER CALCULATION:

A. Water Vapor Through Meter (SCF):

$$V_{c_{std}} = \left(\frac{B_{wc}}{1-B_{wc}}\right) V_{m_{std}}$$
$$= \left(\frac{0.003}{1-0.003}\right) (53.155)$$
$$= 0.1595 \text{ SCF}$$

B. Collected Water (Impingers + Silica Gel)

V_{l_c}

141.5 ml

C. Water Fraction Gas Stream, B_{wc} =

$$B_{wc} = \frac{(V_{c_{std}} + 0.0474\, V_{l_c})}{(V_{c_{std}} + 0.0474\, V_{l_c}) + V_{m_{std}}}$$
$$= \frac{(0.159) + 0.0474\,(141.5)}{(0.159) + 0.0474\,(141.5) + (53.155)}$$
$$= 0.0044$$

D. Dry Gas Fraction, F_d :

$$F_d = 1 - B_{wc}$$
$$= 0.9956$$

E. MOLECULAR WEIGHT CALCULATION:

$$M_d = \frac{1}{100}\left[(\%CO_2)(M_{CO_2}) + (\%O_2)(M_{O_2}) + (\%N_2)(M_{N_2}) + (\%CO)(M_{CO})\right]$$

3. MOLECULAR WEIGHT CALCULATIONS: (cont'd)

$$= \frac{I}{100}\left[(16.6)\ (44) + (10.5)\ (32) + (0)\ (28) + (72.9)\ (28)\right]$$

$$= (7.30) + (3.36) + (0) + (20.41)$$

$$= \underline{31.07}$$

$$M_s = (M_d)\ (B_d) + 18\ B_{wo}$$

$$= (31.07)\ (0.8856) + 18\ (0.1144)$$

$$= \underline{29.57}$$

4. VELOCITY CALCULATIONS:

$$V_s = 85.48\ (C_{p\ test})\ (\sqrt{\Delta P_{avg}})\ \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_s = (85.48)\ (.812)\ (0.25)\ \sqrt{\frac{864}{(29.93)(29.57)}}$$

$$V_s = \underline{8.573}\ \text{fps}$$

5. VOLUMETRIC FLOW IN STACK (STP), Q_s :

$$Q_s = 3600\ (V_s)\ (A)\ (B_d)\ \frac{T_{std}}{T_{s\ avg}}\ \frac{P_{s\ avg}}{P_{std}}$$

$$Q_s = 3600\ (8.573)\ (42.37)\ (0.8856)\ \left(\frac{530}{864}\right)\ \left(\frac{29.93}{29.92}\right)$$

$$Q_s = \underline{71,745}\ \text{SCFDC}$$

6. PARTICULATE MASS RATE, pmr

a. Area Ratio Method, pmr_a

$$pmr_a = 60\ \frac{(p_m)\ (A)}{(\%)\ (A_n)} = 60\ \frac{(0.00023)\ (42.37)}{(.86)\ (0.00386)}$$

$$= \underline{1.625}\ \#/\text{hr}$$

Total Catch $P_m = 0.00023$

$\therefore pmr_a = 1.625$

b. Concentration Method, pmr_c

$$pmr_c = \frac{(p_m)\ (Q_s)}{V_{m\ std}} = \frac{(0.00023)\ (71745)}{(53.155)}$$

$$= \underline{1.674}\ \#/\text{hr}$$

$pmr_c = 1.674$

CALCULATION WORK SHEET - 3

c. Average pmr $= \frac{pmr_a + pmr_c}{2}$

$= \frac{(1.625) + (1.674)}{2} = 1.65$ #/hr

7. ISOKINETIC RATIO, I_r:

TOTAL CATCH = $\frac{11.778 + 12.133}{2} = 11.956$ #

$I_r = \frac{pmr_a}{pmr_c} = \frac{(1.625)}{1.674}$

$= .9707$

8. ISOKINETIC VARIATION CHECK, I%:

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

$= \frac{100\ (53.155)\ (864)\ (29.02)}{60\ (.144)\ (0.00136)\ (0.8856)\ (530)\ (3.573)\ (29.03)}$

$= 97.10\ \%$

9. PARTICULATE LOADING, c'_s:

$c'_s = (0.01542)\ \frac{(\text{Total Particulate Catch, mg})}{V_{m_{std}}}$

$= (0.01542)\ \left(\frac{56.9}{53.155}\right)$

$= 0.0165$ gr/SCFDG

TOTAL LOADING $\frac{(0.01542)(411.6)}{53.155} = 0.1195$

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{ps}	P_c	$P_c - V_{ps}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.880						.877	528.0	29.95	.881
2	.01	.100	.888						.885	527.5	29.95	.890
3	.01	.100	.890						.887	527.5	29.95	.892
4	.01	.100	.887						.884	529.0	29.95	.886
5	.01	.100	.880						.877	529.0	29.95	.879
6	.01	.100	.885						.882	529.0	29.95	.884
7	.01	.100	.875						.872	528.5	29.95	.875
8	.01	.100	.880						.877	529.5	29.95	.879
9	.01	.100	.870						.867	528.0	29.95	.871
10	.01	.100	.886						.882	528.5	29.95	.889
11	.02	.141	1.240						1.236	528.0	29.96	1.242
12	.02	.141	1.250						1.246	526.5	29.96	1.256
13	.02	.141	1.245						1.241	527.0	29.96	1.249
14	.02	.141	1.250						1.246	526.5	29.96	1.256
15	.02	.141	1.255						1.251	526.5	29.96	1.261
16	.02	.141	1.255						1.251	526.0	29.96	1.262
17	.02	.141	1.250						1.246	526.5	29.96	1.256
18	.02	.141	1.255						1.251	526.5	29.96	1.261
19	.02	.141	1.245						1.241	526.5	29.96	1.251
20	.02	.141	1.250						1.246	527.0	29.96	1.255
21	.02	.141	1.245						1.241	527.0	29.96	1.249
22	.01	.100	.890						.887	526.0	29.95	.894
23	.01	.100	.880						.877	526.0	29.95	.884
24	.01	.100	.885						.882	526.0	29.95	.889
Tot.	.35	2.851	25.215						25.132	12654.5	718.91	25.291
Avg.	.01	.119	1.051						1.047	527.3	29.95	1.054
Std. Dev.	.18	6.003	52.196						52.825	2532.5	1437.93	53.155
Abs.	.02	.125	1.104						1.10	527.3	29.96	1.107

Name; Plan No. 2
Source; #5 BAGHOUSE
Date; 5-4-77

Run No, 1 - SW TRVS

P_{bar} = 29.93 "H

V_1 = _____ in

V_c = _____ n

$(t_s)_{avg}$ = _____ o

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ -mi

D_n = _____ in

$$V = \left(\frac{V_{ps}}{P_c}\right) V_m$$

$V_{md} = V_m - V_c$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

NO.	Δp	√Δp	V_m	t_c	V_{pa}	P_c	$P_c - V_{ps}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.02	.141	1.240						1,236	525.0	29.96	1.249
2	.01	.100	.885						.882	524.5	29.95	.892
3	.03	.173	1.490						1.486	526.0	29.98	1.500
4	.03	.173	1.500						1.496	525.5	29.98	1.512
5	.02	.141	1.255						1.251	525.5	29.96	1.263
6	.02	.141	1.250						1.246	527.0	29.96	1.254
7	.02	.141	1.255						1.251	526.5	29.96	1.261
8	.02	.141	1.245						1.241	526.5	29.96	1.251
9	.02	.141	1.240						1.236	528.0	29.96	1.242
10	.02	.141	1.250						1.246	527.0	29.96	1.254
11	.02	.141	1.245						1.241	528.0	29.96	1.247
12	.02	.141	1.250						1.246	528.0	29.96	1.252
13	.02	.141	1.255						1.251	528.5	29.96	1.256
14	.03	.173	1.490						1.486	527.5	29.98	1.496
15	.02	.141	1.250						1.246	528.0	29.96	1.252
16	.02	.141	1.255						1.251	528.5	29.96	1.256
17	.02	.141	1.250						1.246	528.5	29.96	1.251
18	.01	.100	.895						.892	528.5	29.95	.895
19	.01	.100	.880						.877	529.0	29.95	.879
20	.01	.100	.891						.888	528.0	29.95	.892
21	.01	.100	.875						.872	528.0	29.95	.876
22	.01	.100	.880						.877	529.0	29.95	.879
23	.01	.100	.875						.872	528.5	29.95	.875
24	.01	.100	.880						.877	528.5	29.95	.880
Tot.	.43	3.152	27.781						27.693	12658.0	719.02	27.864
Avg.	.02	.131	1.158						1.154	527.4	29.96	1.161

Name: Plant No 2
Source: #5 BAGHOUSE
Date: 5-4-77

Run No. 1 - NW TRVS.

P_{bar} = 29.93 "H

V_1 = _____ m

V_f = _____ n

$(t_s)_{avg}$ = _____ o

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ mi

D_n = _____ in

$$V = \left(\frac{V_{pa}}{P_c}\right) V_m$$

$$V_{md} = V_m - V_c$$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V_{md}$$

PARTICULATE FIELD DATA

PLANT No. 2

RUN NO. STACK No. 1

LOCATION SW TRAVERSE

DATE 5-4-77

OPERATOR D.C. - R.M

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 56°

BAR. PRESS. IN. Hg 29.93

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10' REF.

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_g STACK PRESS IN. H_2O	t_s STACK TEMP. °F
	10:15	479.680										
1	1	80.560	.01	.22		68	68	1.5	250	63	.01	396
2	2	81.448	.01	.23		68	67	1.6	254	63	.01	397
3	3	82.338	.01	.22		68	67	1.6	260	64	.01	407
4	4	83.225	.01	.22		70	68	1.7	257	64	.01	419
5	5	84.105	.01	.22		70	68	1.7	265	64	.01	422
6	6	84.990	.01	.22		70	68	1.7	267	64	.01	422
7	7	85.865	.01	.22		70	67	1.7	268	64	.01	423
8	8	86.745	.01	.22		[illegible]	68	1.7	273	63	.01	409
9	9	87.615	.01	.22		69	67	1.7	275	64	.01	406
10	10	88.500	.01	.22		67	66	1.8	277	63	.01	409
11	11	89.740	.02	.44		69	67	4.9	280	63	.02	404
12	12	90.990	.02	.44		67	66	4.9	281	64	.02	404
13	13	92.235	.02	.44		67	67	4.0	280	65	.02	407
14	14	93.485	.02	.44		66	67	4.9	282	63	.02	403
15	15	94.740	.02	.44		66	67	4.9	284	62	.02	407
16	16	95.995	.02	.44		66	66	4.9	284	61	.02	406
17	17	97.245	.02	.44		66	67	4.9	285	60	.02	404
18	18	98.500	.02	.44		66	67	4.9	286	60	.02	402
19	19	99.745	.02	.44		67	66	4.9	283	59	.02	400
20	20	800.995	.02	.44		67	67	4.9	282	58	.02	372
21	21	2.240	.02	.44		67	67	4.9	281	58	.02	402
22	22	3.130	.01	.22		66	66	2.0	279	57	.02	372
23	23	4.010	.01	.22		60	60	1.9	283	56	.01	381
24	24	4.895	.01	.22		66	66	1.9	285	56	.01	360
TOTAL				7.70		Avg. 68	Avg. 67				.16	9622
Average				.32		Avg. 67					.02	401

PARTICULATE FIELD DATA

PLANT No. 2

RUN NO. STACK No. 1

LOCATION N&W TRAVERSE

DATE 5-4-77

OPERATOR D.C. R.M

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 66°

BAR. PRESS. IN. Hg 29.03

ASSUMED MOISTURE % 15

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10 FEET

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN. H_2O	t_s STACK TEMP °F
	12:40	504.895										
1	1	6.135	.02	.44		65	65	4.1	267	64	.02	385
2	2	7.020	.01	.22		65	64	2.5	271	64	.02	412
3	3	8.510	.03	.65		66	66	6.1	276	65	.03	412
4	4	10.010	.03	.65		66	65	6.1	277	65	.04	418
5	5	11.265	.02	.44		66	65	4.2	280	65	.03	422
6	6	12.515	.02	.44		67	67	4.2	283	64	.04	424
7	7	13.770	.02	.44		67	66	4.2	282	64	.03	423
8	8	15.015	.02	.44		67	66	4.2	281	64	.03	416
9	9	16.255	.02	.44		69	67	4.2	281	66	.03	417
10	10	17.505	.02	.44		67	67	4.2	281	69	.03	398
11	11	18.750	.02	.44		68	68	4.2	285	69	.02	422
12	12	20.000	.02	.44		68	69	4.3	285	69	.02	421
13	13	21.255	.02	.44		68	67	4.4	284	70	.02	424
14	14	22.745	.03	.65		68	68	4.5	283	71	.02	424
15	15	23.995	.02	.44		68	68	4.5	285	72	.01	421
16	16	25.250	.02	.44		68	69	4.5	284	73	.02	423
17	17	26.500	.02	.44		69	68	4.5	286	72	.02	421
18	18	27.395	.01	.22		68	69	2.7	281	73	.02	419
19	19	28.275	.01	.22		69	69	2.7	281	73	.01	421
20	20	29.160	.01	.22		68	68	2.7	279	73	.01	416
21	21	30.035	.01	.22		68	68	2.7	281	73	.01	416
22	22	30.915	.01	.22		68	68	3.2	284	73	.01	416
23	23	31.790	.01	.22		69	69	2.9	281	73	.01	417
24	24	532.670	.01	.22		69	68	2.9	277	73	.01	419
TOTAL				9.43		Avg. 68	Avg. 67				9.776	419

STACK #2

CALCULATION WORK SHEET

1. VOLUME OF GAS SAMPLE (DRY, STP) $V_{m_{std}}$:

$$V_{m_{std}} = V_{mc}$$
$$= V_{m_{c_t}}$$
$$= 55.58 \text{ SCFDG}$$

2. WATER CALCULATION:

A. Water Vapor Through Meter (SCF):

$$V_{c_{std}} = \left(\frac{B_{wc}}{1-B_{wc}}\right) V_{m_{std}}$$
$$= \left(\frac{0.003}{1-0.003}\right) (55.58)$$
$$= 0.1667 \text{ SCF}$$

B. Collected Water (Impingers + Silica Gel)

V_{l_c}

$$211.3 \text{ ml}$$

C. Water Fraction Gas Stream, B_{wo} =

$$B_{wo} = \frac{(V_{c_{std}} + 0.0474\ V_{l_c})}{(V_{c_{std}} + 0.0474\ V_{l_c}) + V_{m_{std}}}$$
$$= \frac{(0.1667) + 0.0474\ (211.3)}{(0.1667) + 0.0474\ (211.3)} + (55.58)$$
$$= 0.1548$$

D. Dry Gas Fraction, B_d :

$$B_d = 1 - B_{wo}$$
$$= 0.8452$$

3. MOLECULAR WEIGHT CALCULATION:

$$M_d = \frac{1}{100} (\%\ CO_2)(M_{CO_2}) + (\%\ O_2)(M_{O_2}) + (\%\ CO)(M_{CO}) + (\%\ N_2)(M_{N_2})$$

3. MOLECULAR WEIGHT CALCULATIONS (cont'd)

$$= \frac{1}{100}\left[(6.6)\ (44) + (10.5)\ (32) + (0)\ (28) + (72.9)\ (28)\right]$$

$$= (7.30) + (3.36) + (0) + (20.4)$$

$$= 31.07$$

$$M_s = (M_d)\ (B_d) + 18\ B_{wo}$$

$$= (31.07)\ (0.8452) + 18\ (0.1548)$$

$$= 29.05$$

4. VELOCITY CALCULATIONS:

$$V_s = 85.48\ (C_{p\ test})\ (\sqrt{\Delta P_{avg}})\ \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_s = (85.48)\ (0.82)\ (0.131)\ \sqrt{\frac{888}{(29.70)(29.05)}}$$

$$V_s = 9.225 \text{ fps}$$

5. VOLUMETRIC FLOW IN STACK (STP), Q_s:

$$Q_s = 3600\ (V_s)\ (A)\ (B_d)\left(\frac{T_{std.}}{T_{s\ avg}}\right)\left(\frac{P_{s\ avg}}{P_{std}}\right)$$

$$Q_s = 3600\ (9.225)\ (42.237)\ (0.8452)\ \left(\frac{530}{888}\right)\ \left(\frac{29.70}{29.92}\right)$$

$$Q_s = 702,391 \text{ SCFM}$$

6. PARTICULATE RATE, pmr

a. Isokinetic Method, pmr_a

$$pmr_a = 60\ \frac{(p_m)\ (A)}{(t_m)} = 60\ \frac{(0.00020\#)\ (42.237)}{(144)\ (0.00136)}$$

$$= 2.679 \text{ \#/hr}$$

TOTAL CATCH $p_m = 0.00044\#$

$pmr_a = 5.759$ #/hr

b. Concentration Method, pmr_c

$$pmr_c = \frac{(p_m)\ (Q_s)}{V_{std}} = \frac{(0.00020\#)\ (702,391)}{(55.581)}$$

$$= 2.616 \text{ \#/hr}$$

$pmr_c = 5.624$ #/hr

CALCULATION WORK SHEET - 3

c. Average pmr = $\frac{pmr_a + pmr_c}{2}$

= $\frac{(2.679) + (2.616)}{2}$ = 2.65 #/hr

TOTAL CATCH =

7. ISOKINETIC RATIO, I_r: $\frac{5.759 + 5.624}{2} = 5.69$ #/hr.

$I_r = \frac{pmr_a}{pmr_c} = \frac{(2.679)}{2.616}$

= 1.0241

8. ISOKINETIC VARIATION CHECK, I%:

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

$= \frac{100\ (55.581)\ (888)\ (29.92)}{60\ (.144)\ (0.00136)\ (0.8452)\ (9.225)\ (530)\ (29.7}$

= 102.40 %

9. PARTICULATE LOADING, c'_s:

$c'_s = (0.01542)\ \frac{(\text{Total Particulate Catch, mg})}{V_{m_{std}}}$

TOTAL CATCH = 20.7

$= (0.01542)\ \frac{93.9}{55.581}$ $\frac{(0.01542)(20.7)}{55.581}$

= 0.0261 gr/SCFDG

TOTAL CATCH = 0.0560 gr/SCFDG

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{pa}	P_c	$P_c - V_{pa}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.910						.907	533.5	29.72	.895
2	.01	.100	.900						.897	533.5	29.72	.885
3	.02	.141	1.250						1.246	534.0	29.74	1.230
4	.02	.141	1.230						1.226	534.5	29.74	1.208
5	.02	.141	1.245						1.241	534.5	29.74	1.223
6	.02	.141	1.245						1.241	534.0	29.74	1.224
7	.02	.141	1.235						1.231	533.5	29.74	1.215
8	.03	.173	1.535						1.530	534.5	29.76	1.509
9	.03	.173	1.540						1.535	533.5	29.76	1.516
10	.03	.173	1.545						1.540	533.5	29.76	1.521
11	.03	.173	1.540						1.535	533.5	29.76	1.516
12	.02	.141	1.245						1.241	533.5	29.74	1.225
13	.02	.141	1.240						1.236	533.5	29.74	1.220
14	.02	.141	1.235						1.231	533.5	29.74	1.215
15	.01	.100	.915						.912	534.0	29.72	.899
16	.01	.100	.910						.907	534.5	29.72	.893
17	.01	.100	.915						.912	534.5	29.72	.899
18	.01	.100	.910						.907	534.5	29.72	.893
19	.01	.100	.905						.902	534.0	29.72	.889
20	.01	.100	.910						.907	534.5	29.72	.893
21	.01	.100	.905						.902	534.0	29.72	.889
22	.01	.100	.910						.907	534.5	29.72	.893
23	.01	.100	.905						.902	534.5	29.72	.888
24	.01	.100	.910						.910	534.0	29.72	.897
Tot.	.40	3.020	26.990						26.905	12816.0	713.60	27.130
Avg.	.02	.126	1.125						1.121	534.0	29.73	1.130
	.86	6.286	55.700						55.721	25618.5	1427.12	55.581
	.02	.131	1.165						1.161	533.7	29.74	1.158

Name: Plant No 2
Source: #5 BAGHOUS
Date: 5-5-77

Run No. 2 - SW TR

P_{bar} = 29.70 "

V_t = _____

V_f = _____

$(t_s)_{avg}$ = _____

$(P_s)_{avg}$ = _____ "

A = _____ ft

θ = _____ min

P_n = _____ in

$$V = \left(\frac{V_{pa}}{P_c}\right) V_m$$

$V_{md} = V_m - V_c$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{pa}	P_c	$P_c - V_{pa}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.905						.902	533.5	29.72	.890
2	.01	.100	.900						.897	534.0	29.72	.884
3	.01	.100	.910						.907	534.0	29.72	.894
4	.01	.100	.925						.922	534.0	29.72	.909
5	.01	.100	.920						.917	534.0	29.72	.904
6	.02	.141	1.225						1.221	534.0	29.74	1.209
7	.02	.141	1.240						1.236	534.0	29.74	1.219
8	.02	.141	1.230						1.226	534.0	29.74	1.209
9	.02	.141	1.240						1.236	534.0	29.74	1.219
10	.03	.173	1.455						1.450	534.0	29.76	1.431
11	.02	.141	1.300						1.296	534.5	29.74	1.277
12	.03	.173	1.540						1.535	533.5	29.76	1.516
13	.03	.173	1.490						1.485	533.5	29.76	1.467
14	.03	.173	1.545						1.540	534.0	29.76	1.519
15	.02	.141	1.265						1.261	533.5	29.74	1.245
16	.02	.141	1.240						1.236	534.0	29.74	1.219
17	.02	.141	1.225						1.221	532.5	29.74	1.208
18	.02	.141	1.245						1.241	533.5	29.74	1.225
19	.02	.141	1.235						1.231	532.5	29.74	1.218
20	.02	.141	1.240						1.236	532.5	29.74	1.223
21	.02	.141	1.245						1.241	531.5	29.74	1.230
22	.02	.141	1.230						1.226	534.5	29.74	1.208
23	.02	.141	1.245						1.241	531.5	29.74	1.230
24	.01	.100	.915						.912	531.5	29.72	.903
Tot.	.46	3.266	28.910						28.816	12802.5	713.72	28451
Avr.	.02	.136	1.205						1.201	533.4	29.74	1.185

Name: Plant Dp2
Source: #5 BAGHOUSE
Date: 5-5.77

Run No. 2 - Null Trv.

P_{bar} = 29.70 "Hg
V_t = _____ m
V_f = _____ n
$(t_s)_{avg}$ = _____ s
$(P_s)_{avg}$ = _____ "H
A = _____ ft
θ = _____ ml
D_n = _____ in

$$V = \left(\frac{V_{pa}}{P_c}\right) V_m$$

$$V_{md} = V_m - V_c$$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

PARTICULATE FIELD DATA

PLANT Plant No. 2

RUN NO. 2

LOCATION NW Traverse

DATE 5-5-77

OPERATOR D.C. - R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 70

BAR. PRESS. IN. Hg 29.70

ASSUMED MOISTURE % 14

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10' EFF.

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN. H_2O	t_s STACK TEMP F
	12:55	54.430										
1		55.335	.01	.29		73	74	4.2	265	73	.03	401
2		56.235	.01	.29		74	74	4.2	273	74	.03	407
3		57.145	.01	.29		74	74	4.2	272	74	.03	412
4		58.070	.01	.29		74	74	4.2	274	74	.02	416
5		56.990	.01	.29		74	74	4.2	275	75	.01	416
6		60.215	.02	.36		74	74	7.8	277	75	.01	417
7		61.455	.02	.56		74	74	7.8	283	75	.06	422
8		62.685	.02	.56		74	74	7.8	279	74	.03	428
9		63.925	.02	.56		74	74	7.9	276	72	.02	431
10		65.380	.03	.86		74	74	13.6	275	73	.02	434
11		66.680	.02	.56		75	74	8.0	279	73	.03	437
12		68.220	.03	.86		74	73	13.2	285	72	.02	436
13		69.710	.03	.86		74	73	13.2	277	72	.03	436
14		71.255	.03	.86		74	74	13.3	279	72	.04	433
15		72.520	.02	.56		74	73	8.0	285	72	.03	431
16		73.760	.02	.56		75	73	7.9	277	72	.02	434
17		74.985	.02	.56		73	72	7.9	287	73	.01	422
18		76.230	.02	.56		74	73	7.9	279	74	.04	432
19		77.465	.02	.56		73	72	7.9	280	74	.05	425
20		78.705	.02	.56		73	72	7.8	279	73	.06	419
21		79.950	.02	.56		72	71	7.9	280	69	.07	402
22		81.160	.02	.56		74	74	7.9	268	75	.04	412
23		82.425	.02	.56		72	71	7.9	278	72	.03	377
24		83.640	.01	.29		72	71	4.6	278	69	.02	377
TOTAL				13.02		Avg. 74	Avg. 73				.73	10,106
Average				.54		Avg. 73					.03	419

PARTICULATE FIELD DATA

PLANT Sw 2

RUN NO. 2

LOCATION SW TRAVERSE

DATE 5-5-77

OPERATOR D.C.-R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 70

BAR. PRESS. IN. Hg. 29.70

ASSUMED MOISTURE % 14

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10 FEET

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN. H_2O	ST TE
	11:00	27.440										
1		28.350	.01	.29		74	73	4.0	255	72	.04	4
2		29.250	.01	.29		74	73	4.0	281	71	.01	4
3		30.500	.02	.56		74	74	7.3	283	72	.02	4
4		31.730	.02	.56		75	74	7.3	284	72	.03	4
5		32.975	.02	.56		75	74	7.4	285	72	.03	4
6		34.220	.02	.56		75	73	7.4	282	72	.03	4
7		35.455	.02	.56		74	73	7.4	282	73	.03	4
8		36.490	.03	.86		75	74	13.0	281	73	.03	4
9		38.530	.03	.86		74	73	13.1	281	72	.04	4
10		40.075	.03	.86		74	73	13.2	282	72	.03	4
11		41.615	.03	.86		74	73	13.0	282	72	.03	4
12		42.860	.02	.56		74	73	7.8	280	73	.02	4
13		44.100	.02	.56		74	73	7.8	276	72	.02	4
14		45.335	.02	.56		74	73	7.9	276	74	.02	4
15		46.250	.01	.29		74	74	4.2	278	74	.01	4
16		47.160	.01	.29		75	74	4.2	280	75	.01	4
17		48.075	.01	.29		75	74	4.2	279	74	.01	4
18		48.985	.01	.29		75	74	4.2	282	75	.01	4
19		49.870	.01	.29		74	74	4.2	283	75	.01	4
20		50.800	.01	.29		75	74	4.2	281	74	.01	4
21		51.705	.01	.29		74	74	4.2	280	75	.01	4
22		52.615	.01	.29		75	74	4.2	281	74	.01	4
23		53.520	.01	.29		75	74	4.2	281	74	.01	4
24		54.430	.01	.29		74	74	4.2	281	75	.01	4
				11.40		Avg 74	Avg 74				.17	96

Test # 3

CALCULATION WORK SHEET

1. VOLUME OF GAS SAMPLE (DRY, STP) $V_{m_{std}}$:

$$V_{m_{std}} = V_{mc}$$
$$= V_{mc_t}$$
$$= 48.116 \text{ SCFDG}$$

2. WATER CALCULATION:

A. Water Vapor Through Meter (SCF):

$$V_{c_{std}} = \left(\frac{B_{wc}}{1-B_{wc}}\right) V_{m_{std}}$$
$$= \left(\frac{0.003}{1-0.003}\right) (48.116)$$
$$= 0.1443 \text{ SCF}$$

B. Collected Water (Impingers + Silica Gel)

V_{l_c}

$$139.5 \text{ ml}$$

C. Water Fraction Gas Stream, B_{wo} =

$$B_{wo} = \frac{(V_{c_{std}} + 0.0474\ V_{l_c})}{(V_{c_{std}} + 0.0474\ V_{l_c}) + V_{m_{std}}}$$
$$= \frac{(0.1443) + 0.0474\ (139.5)}{(0.1443 + 0.0474\ (139.5)) + (48.116)}$$
$$= 0.1231$$

D. Dry Gas Fraction, B_d :

$$B_d = 1 - B_{wo}$$
$$= 0.8769$$

3. MOLECULAR WEIGHT CALCULATION:

$$M_d = \frac{1}{100} (\%\ CO_2)(M_{CO_2}) + (\%\ O_2)(M_{O_2}) + (\%\ CO) \ldots$$
$$+ (\%\ N_2)(M_{N_2})$$

3. MOLECULAR WEIGHT CALCULATIONS: (cont'd)

$$= \frac{1}{100}\left[(16.6)\ (44) + (12.5)\ (32) + (0)\ (28) + (72.9)\ (28)\right]$$

$$= (7.30) + (3.36) + (0.) + (20.4)$$

$$= 31.07$$

$$M_s = (M_d)\ (B_d) + 18\ B_{wo}$$

$$= (31.07)\ (0.8769) + 18\ (0.1231)$$

$$= 29.46$$

4. VELOCITY CALCULATIONS:

$$V_s = 85.48\ (C_{p\ test})\ (\sqrt{\Delta P_{avg}})\ \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_s = (85.48)\ (0.812)\ (0.116)\ \sqrt{\frac{871.5}{(29.88)(29.46)}}$$

$$V_s = 8.011 \text{ fps}$$

5. VOLUMETRIC FLOW IN STACK (STP), Q_s :

$$Q_s = 3600\ (V_s)\ (A)\ (B_d)\left(\frac{T_{std}}{T_{s\ avg}}\right)\left(\frac{P_{s\ avg}}{P_{std}}\right)$$

$$Q_s = 3600\ (8.011)\ (42.237)\ (0.8769)\ \left(\frac{530}{871.5}\right)\left(\frac{29.88}{29.92}\right)$$

$$Q_s = 645,724 \text{ SCFHD}$$

6. POLLUTANT MASS RATE, pmr

a. Area Ratio Method, pmr_a

$$pmr_a = 60\ \frac{(pm)\ (A)}{(B)\ (An)} = 60\ \frac{(0.000585)\ (42.237)}{(1)\ (0.2036)}$$

$$= 4.982 \text{ #/hr}$$

TOTAL CATCH = 2.93 g
pm = 0.000585 g

$\therefore pmr_a = 5.8 \times 10^{-4}$ #/hr

b. Concentration Method, pmr_c

$$pmr_c = \frac{(pm)\ (Q_s)}{V_{m\ std}} = \frac{(0.000585)\ (645.724)}{(43.116)}$$

$$= 5.91 \text{ #/hr}$$

$pmr_c = 6.05 \times 10^{-4}$ #/hr

CALCULATION WORK SHEET - 3

c. Average pmr = $\frac{pmr_a + pmr_c}{2}$

= $\frac{(4.982) + (5.191)}{2}$ = 5.087 #/hr

TOTAL CATCH = $\frac{5.810 + 6.054}{2}$ = 5.932 #/hr

7. ISOKINETIC RATIO, I_r:

$I_r = \frac{pmr_a}{pmr_c} = \frac{(4.982)}{5.191}$

= 0.9597

8. ISOKINETIC VARIATION CHECK, I%:

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

$= \frac{100\ (48.116)\ (87.5)\ (29.92)}{60\ (.144)\ (0.00136)\ (0.8769)\ (5.011)\ (530)\ (29.53)}$

= 95.98 %

9. PARTICULATE LOADING, c'_s:

$c'_s = (0.01542)\ \frac{(\text{Total Particulate Catch, mg})}{V_{m_{std}}}$ TOTAL CATCH = 203.6 mg

$= (0.01542)\ \frac{(174.7)}{48.116}$ $\frac{(0.01542)(203.6)}{48.116} = 0.0652$

= 0.0560 gr/SCFDG

TOTAL CATCH = 0.0652 gr/SCFDG

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{pn}	P_c	$P_c - V_{pn}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.910						.907	531.0	29.90	.904
2	.01	.100	.890						.887	533.0	29.90	.881
3	.01	.100	.890						.887	531.5	29.90	.884
4	.01	.100	.855						.852	533.0	29.90	.846
5	.01	.100	.895						.892	532.0	29.90	.888
6	.01	.100	.905						.902	530.5	29.90	.900
7	.02	.141	1.225						1.221	531.5	29.92	1.217
8	.02	.141	1.270						1.266	532.0	29.92	1.261
9	.01	.100	.940						.937	532.0	29.90	.933
10	.01	.100	.890						.887	532.0	29.90	.883
11	.01	.100	.880						.877	532.0	29.90	.873
12	.01	.100	.880						.877	531.0	29.90	.875
13	.01	.100	.920						.917	530.5	29.90	.915
14	.01	.100	.910						.907	530.5	29.90	.905
15	.01	.100	.930						.927	530.5	29.90	.925
16	.01	.100	.900						.897	528.0	29.90	.900
17	.01	.100	.910						.907	527.5	29.90	.910
18	.01	.100	.885						.882	527.5	29.90	.885
19	.01	.100	.900						.897	527.5	29.90	.900
20	.01	.100	.910						.907	527.0	29.90	.911
21	.01	.100	.890						.887	528.5	29.90	.889
22	.01	.100	.885						.882	528.0	29.90	.885
23	.01	.100	.870						.867	528.0	29.90	.870
24	.01	.100	.885						.882	528.5	29.90	.884
Tot.	.26	2.682	22.225						22.151	12,723.5	717.64	22,124
Avr.	.01	.112	.926						.923	530.1	29.90	.922

Name: PORT No. 2
Source: #5 BAGHOUSE
Date: 5-6-77

Run No. 5-SU TRI

P_{bar} = 29.88 "Hg

V_t = _____ ml

V_c = _____ ml

$(t_s)_{avg}$ = _____ °F

$(P_s)_{avg}$ = _____ "Hg

A = _____ ft²

θ = _____ min

P_n = _____ in

$$V = \left(\frac{V_{pn}}{P_c}\right) V_m$$

$V_{md} = V_m - V_c$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_o	V_{pn}	P_c	$P_c - V_{pn}$	V_o	V_{md}	T_m	P_m	V_{mc}
1	.02	.141	1.375						1.371	532.0	29.92	1.366
2	.02	.141	1.240						1.236	531.5	29.92	1.232
3	.01	.100	.930						.927	532.0	29.90	.923
4	.01	.100	.860						.857	532.0	29.90	.853
5	.01	.100	.880						.877	530.5	29.90	.875
6	.02	.141	1.205						1.201	531.0	29.92	1.198
7	.02	.141	1.290						1.286	531.0	29.92	1.283
8	.02	.141	1.270						1.266	531.0	29.92	1.263
9	.02	.141	1.315						1.311	531.0	29.92	1.308
10	.02	.141	1.270						1.266	530.0	29.92	1.266
11	.01	.100	.885						.882	530.5	29.90	.880
12	.02	.141	1.200						1.196	531.5	29.92	1.192
13	.02	.141	1.275						1.271	531.0	29.92	1.268
14	.02	.141	1.265						1.261	531.0	29.92	1.258
15	.02	.141	1.285						1.281	532.0	29.92	1.276
16	.02	.141	1.305						1.301	531.0	29.92	1.298
17	.01	.100	.930						.927	531.0	29.90	.924
18	.01	.100	.895						.892	531.0	29.90	.890
19	.01	.100	.890						.887	530.5	29.90	.885
20	.01	.100	.900						.897	531.5	29.90	.894
21	.01	.100	.910						.907	531.0	29.90	.904
22	.01	.100	.925						.922	531.5	29.90	.919
23	.01	.100	.905						.902	531.0	29.90	.900
24	.01	.100	.940						.937	529.5	29.90	.937
Tot.	.36	2.812	26.145						26.061	12,746.0	717.84	25.992
Avg.	.015	.121	1.089						1.086	531.1	29.91	1.083
Tot.	.62	5.514	48.330						48.212	25478.5	1435.48	48.116

Name: P.P. No 2
Source; #5 BAGHOUSE
Date: 5-6-77

Run No, 3 - NW TRAIN

P_{bar} = 29.88 "Hg

V_l = _____ ml

V_f = _____ ml

$(t_s)_{avg}$ = _____ °F

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ min

D_n = _____ in

$V = \left(\frac{V_{pn}}{P_c}\right) V_m$

$V_{md} = V_m - V_o$

$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$

PARTICULATE FIELD DATA

PLANT No. 2

RUN NO. 3

LOCATION NW TRAVERSE

DATE 5-6-77

OPERATOR D.C-R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F _____

BAR. PRESS. IN. Hg _____

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. .625

PROBE LENGTH 10' ONE

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN H_2O	t_s STACK TEMP. °F
	12:30	10,225										
1		11.600	.02	.54		72	72	8.1	260	113	.01	412
2		12.840	.02	.54		73	70	8.1	319	113	.01	410
3		13.770	.01	.27		72	72	4.1	302	114	.01	422
4		14.630	.01	.27		72	72	4.1	281	112	.01	429
5		15.510	.01 .02	.27		71	70	4.1	256	110	.01	393
6		16.715	.02	.54		72	70	8.2	253	113	.02	399
7		18.005	.02	.54		72	70	8.2	256	112	.02	415
8		19.275	.02	.54		72	70	8.0	260	114	.01	415
9		20.590	.02	.54		72	70	8.0	261	110	.01	420
10		21.860	.02	.54		71	69	8.0	262	101	.01	423
11		23.745	.01	.27		71	70	3.2	267	99	.01	384
12		23.945	.02	.54		72	71	7.0	268	99	.01	382
13		25.220	.02	.54		72	70	6.9	269	104	.02	317
14		26.485	.02	.54		72	70	6.8	266	97	.02	391
15		27.770	.02	.54		73	71	6.8	258	96	.02	413
16		29.015	.02	.54		72	70	6.8	253	91	.02	402
17		30.005	.01	.27		72	70	3.2	251	83	.02	415
18		30.900	.01	.27		72	70	3.2	260	80	.01	415
19		31.790	.01	.27		71	70	3.2	261	78	.01	412
20		32.690	.01	.27		72	71	3.2	263	78	.01	407
21		33.600	.01	.27		71	71	3.2	263	76	.01	393
22		34.525	.01	.27		71	72	3.2	265	82	.01	380
23		35.430	.01	.27		71	71	3.0	261	80	.01	350
24		36.370	.01	.27		69	70	3.0	255	68	.01	379
TOTAL				9.72		Avg. 72	Avg. 70					

PARTICULATE FIELD DATA

PLANT No. 2

RUN NO. 3

LOCATION SW TRAVERSE

DATE 5-6-77

OPERATOR D.C. - R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 65

BAR. PRESS. IN. Hg 29.53

ASSUMED MOISTURE % 15

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10' ea.

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN. H_2O	t_s STACK TEMP. °F
	10:40	588.000										
1		88.910	.01	.27		69	73	3.2	256	66	.01	366
2		89.800	.01	.27		73	73	3.2	268	76	.01	401
3		90.690	.01	.27		71	72	3.2	272	76	.01	408
4		91.545	.01	.27		73	73	4.2	277	77	.01	394
5		92.440	.01	.27		72	72	3.4	283	77	.01	395
6		93.345	.01	.27		71	70	3.3	265	74	.01	416
7		94.570	.02	.54		71	72	6.0	279	75	.01	434
8		95.840	.02	.54		72	72	6.2	281	75	.01	436
9		96.780	.01	.27		72	72	3.3	282	75	.01	436
10		97.670	.01	.27		72	72	3.3	283	77	.01	431
11		98.550	.01	.27		72	72	3.3	284	72	.01	433
12		99.430	.01	.27		71	71	3.3	280	70	.01	444
13		600.350	.01	.27		70	71	3.3	277	69	.01	444
14		1.260	.01	.27		70	71	3.3	280	69	.01	444
15		2.190	.01	.27		69	72	3.3	270	67	.01	444
16		3.040	.01	.27		66	70	3.3	267	66	.01	440
17		3.900	.01	.27		65	70	3.3	271	66	.01	436
18		4.885	.01	.27		65	70	3.3	271	65	.01	435
19		5.785	.01	.27		65	70	3.3	273	66	.01	434
20		6.695	.01	.27		64	70	3.3	275	65	.01	435
21		7.585	.01	.27		67	70	3.3	289	65	.01	443
22		8.470	.01	.27		67	69	3.3	295	66	.01	431
23		9.310	.01	.27		67	69	3.3	297	67	.01	441
24		10.225	.01	.27		68	69	3.3	300	67	.01	445
				1.02		Avg. 69	Avg. 71				.174	111.14

CALCULATION WORK SHEET

1. VOLUME OF GAS SAMPLE (DRY, STP) $V_{m_{std}}$:

$$V_{m_{std}} = V_{mc}$$
$$= V_{mc_1}$$
$$= 55.685 \text{ SCFDG}$$

2. WATER CALCULATION:

A. Water Vapor Through Meter (SCF):

$$V_{c_{std}} = \left(\frac{B_{wc}}{1-B_{wc}}\right) V_{m_{std}}$$
$$= \left(\frac{0.003}{1-0.003}\right) (55.685)$$
$$= 0.1671 \text{ SCF}$$

B. Collected Water (Impingers + Silica Gel)

V_{l_c}

$$204.7 \text{ ml}$$

C. Water Fraction Gas Stream, B_{wo} =

$$B_{wo} = \frac{(V_{c_{std}} + 0.0474\, V_{l_c})}{(V_{c_{std}} + 0.0474\, V_{l_c}) + V_{m_{std}}}$$
$$= \frac{(0.1671) + 0.0474\ (204.7)}{(0.1671) + 0.0474\ (204.7)} + (55.685)$$
$$= 0.1506$$

D. Dry Gas Fraction, B_d :

$$B_d = 1 - B_{wo}$$
$$= 0.8494$$

3. MOLECULAR WEIGHT CALCULATION:

$$M_d = \frac{1}{100} (\%\, CO_2)(M_{CO_2}) + (\%\, O_2)(M_{O_2}) + (\%\, CO)(M_{CO}) + (\%\, N_2)(M_{N_2})$$

CALCULATION WORK SHEET - 3

c. Average pmr = $\frac{pmr_a + pmr_c}{2}$

= $\frac{(3.261) + (3.046)}{2}$ = 3.15 #/hr

TOTAL CATCH = $\frac{3.766 + 3.517}{2}$ = 3.64 #/hr

7. ISOKINETIC RATIO, I_r:

$I_r = \frac{pmr_a}{pmr_c} = \frac{(3.261)}{3.046}$

= 1.0706

8. ISOKINETIC VARIATION CHECK, I%:

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

$= \frac{100\ (55.685)\ (880.5)\ (29.92)}{60\ (.144)\ (.00136)\ (0.8494)\ (8.902)\ (530)\ (30.1}$

= 103.36 %

9. PARTICULATE LOADING, c'_s:

$c'_s = (0.01542)\ \frac{(\text{Total Particulate Catch, mg})}{V_{m_{std}}}$

= (0.01542) $\left(\frac{1141}{55.685}\right)$

= 0.0316 gr/SCFDG

TOTAL CATCH = 1322 mg

$\frac{(.01542 \times 1322)}{55.685}$

TOTAL CATCH = 0.0366 gr/SCFDG

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{ps}	P_c	$P_c - V_{ps}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.910						.907	533.5	30.16	.908
2	.01	.100	.900						.897	533.5	30.18	.899
3	.02	.141	1.250						1.246	534.0	30.18	1.247
4	.02	.141	1.230						1.226	534.5	30.18	1.226
5	.02	.141	1.245						1.241	534.5	30.18	1.241
6	.02	.141	1.245						1.241	534.0	30.18	1.242
7	.02	.141	1.235						1.231	533.5	30.18	1.233
8	.03	.173	1.535						1.530	534.5	30.18	1.529
9	.03	.173	1.540						1.535	533.5	30.18	1.538
10	.03	.173	1.545						1.540	533.5	30.18	1.543
11	.03	.173	1.540						1.535	533.5	30.18	1.538
12	.02	.141	1.245						1.241	533.5	30.18	1.243
13	.02	.141	1.240						1.236	533.5	30.18	1.238
14	.02	.141	1.235						1.231	533.5	30.16	1.232
15	.01	.100	.915						.912	534.0	30.16	.912
16	.01	.100	.910						.907	534.5	30.16	.906
17	.01	.100	.915						.912	534.5	30.16	.911
18	.01	.100	.910						.907	534.5	30.16	.906
19	.01	.100	.905						.902	534.0	30.16	.902
20	.01	.100	.910						.907	534.5	30.16	.906
21	.01	.100	.905						.902	534.0	30.16	.902
22	.01	.100	.910						.907	534.5	30.16	.906
23	.01	.100	.905						.902	534.5	30.16	.901
24	.01	.100	.910						.907	534.0	30.16	.907
Tot.	.40	3.020	26.990						26.902	128.160	724.08	26.916
Avg.	.02	.176	1.125						1.121	534.0	30.17	1.121
Tot.	.82	6.158	51.760						54.582	25155.5	1448.28	55.685
Ave.	.02	.128	1.141						1.137	524.1	30.17	1.160

Name: [illegible] 120.2
Source: #5 RAGHOUSE
Date: 5-7-77

Run No. 4 - NW TRVS

P_{bar} = 30.14 "H

V_1 = _____ m

V_f = _____ n

$(t_s)_{avg}$ = _____ g

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ mi

D_n = _____ in

$V = \left(\frac{V_{ps}}{P_c}\right) V_m$

$V_{md} = V_m - V_c$

$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V_m$

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_o	V_{pa}	P_c	$P_c - V_{pa}$	V_o	V_{md}	T_m	P_m	V_{mc}
1	.02	.141	1.250						1.246	515.5	30.18	1.292
2	.02	.141	1.250						1.246	515.0	30.18	1.293
3	.02	.141	1.225						1.221	515.0	30.18	1.267
4	.02	.141	1.190						1.186	515.0	30.18	1.231
5	.02	.141	1.195						1.191	515.0	30.18	1.236
6	.02	.141	1.250						1.246	514.0	30.18	1.296
7	.02	.141	1.245						1.241	514.5	30.18	1.289
8	.02	.141	1.235						1.231	515.0	30.18	1.278
9	.02	.141	1.255						1.251	515.0	30.18	1.298
10	.02	.141	1.250						1.246	515.0	30.18	1.293
11	.02	.141	1.255						1.251	514.5	30.18	1.300
12	.02	.141	1.260						1.256	514.0	30.18	1.306
13	.02	.141	1.250						1.246	514.0	30.18	1.296
14	.02	.141	1.230						1.226	514.0	30.18	1.275
15	.02	.141	1.265						1.261	514.0	30.18	1.311
16	.02	.141	1.265						1.261	513.5	30.18	1.312
17	.02	.141	1.255						1.251	513.5	30.18	1.302
18	.02	.141	1.265						1.261	513.0	30.18	1.314
19	.01	.100	.910						.907	513.0	30.16	.944
20	.01	.100	.920						.917	513.0	30.16	.955
21	.01	.100	.885						.882	514.0	30.16	.917
22	.01	.100	.895						.892	513.0	30.16	.929
23	.01	.100	.890						.887	513.0	30.16	.924
24	.01	.100	.880						.877	514.0	30.16	.911
Tot.	.42	3.138	27.770						27.680	12339.5	724.20	28.769
Avg.	.02	.131	1.157						1.153	514.1	30.17	1.199

Name: Run No 2
Source: #5 BAGHOUSE
Date: 5-7-77

Run No. #4 - SWITRIS

P_{bar} = _____ "H

V_t = _____ m

V_f = _____ n

$(t_p)_{avg}$ = _____ g

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ ml

D_n = _____ in

$$V = \left(\frac{V_{pn}}{P_g}\right) V_m$$

$V_{md} = V_m - V_c$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V_t$$

PARTICU[illegible] FIELD DATA

PLANT Plant No. 2

RUN NO. #4

LOCATION SW TRAVERSE

DATE 5-7-77

OPERATOR D.C.-R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 44

BAR. PRESS. IN. Hg 30.14

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. _____

PROBE LENGTH _____

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN H_2O	t_s STACK TEMP. °F
	10:30	36.600										
1		37.850	.02	.54		53	58	4.9	254	48	.04	411
2		39.100	.02	.54		52	58	4.8	253	47	.03	414
3		40.325	.02	.54		52	58	5.0	251	48	.03	414
4		41.515	.02	.54		52	58	5.9	250	47	.04	416
5		42.710	.02	.54		52	58	4.9	240	47	.03	417
6		43.960	.02	.54		51	57	4.9	252	47	.03	418
7		45.205	.02	.54		52	57	4.9	253	47	.03	420
8		46.440	.02	.54		52	58	4.9	250	47	.03	428
9		47.695	.02	.54		52	58	4.9	252	47	.04	431
10		48.945	.02	.54		52	58	4.9	251	47	.04	436
11		50.200	.02	.54		52	57	4.9	256	47	.05	435
12		51.460	.02	.54		51	57	4.9	258	46	.05	436
13		52.710	.02	.54		51	57	4.9	252	46	.04	435
14		53.940	.02	.54		51	57	4.9	256	46	.04	434
15		55.205	.02	.54		51	57	4.9	258	46	.04	432
16		56.470	.02	.54		50	57	5.0	251	46	.04	431
17		57.729	.02	.54		50	57	5.0	252	46	.03	429
18		58.970	.02	.54		50	56	5.0	251	46	.04	428
19		59.900	.01	.27		50	56	3.0	255	46	.03	425
20		60.820	.01	.27		50	56	3.1	259	45	.04	423
21		61.705	.01	.27		51	57	3.1	256	45	.04	418
22		62.600	.01	.27		50	56	3.1	257	44	.04	417
23		63.410	.01	.27		50	56	3.1	269	44	.03	414
24		64.370	.01	.27		51	57	3.1	250	44	.03	405
TAL				11.34		Avg. 51	Avg. 57				.98	1015
				11.7								

PARTICU[illegible] FIELD DATA

PLANT Plant No. 2

RUN NO. 4

LOCATION NW Traverse

DATE 5-7-77

OPERATOR D.C. - R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 44°

BAR. PRESS. IN. Hg _____

ASSUMED MOISTURE % 12

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10' Elec

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN H_2O	t_s STACK TEMP. °F
	12:15	64.370										
1		65.265	.01	.27		50	57	2.9	256	46	.03	416
2		66.490	.02	.54		51	57	4.9	260	46	.03	416
3		67.755	.02	.54		52	57	4.9	265	46	.04	426
4		69.010	.02	.54		52	58	4.8	254	46	.04	425
5		70.260	.02	.54		52	58	4.8	264	46	.04	423
6		71.515	.02	.54		52	58	4.8	267	46	.04	429
7		72.775	.02	.54		53	58	4.8	272	46	.04	426
8		74.035	.02	.54		53	58	4.8	263	46	.04	431
9		75.250	.02	.54		53	58	4.8	260	46	.04	433
10		76.525	.02	.54		54	59	4.8	257	45	.04	423
11		77.790	.02	.54		54	59	4.8	258	45	.04	438
12		79.055	.02	.54		54	59	4.8	257	45	.04	432
13		80.320	.02	.54		53	59	4.8	258	45	.04	434
14		81.270	.01	.27		53	59	2.8	256	45	.04	424
15		82.160	.01	.27		55	60	3.0	253	45	.03	420
16		83.050	.01	.27		53	58	3.0	250	44	.03	415
17		83.940	.01	.27		52	58	3.0	245	43	.02	416
18		84.810	.01	.27		53	59	3.0	292	44	.02	415
19		85.600	.01	.27		52	59	3.1	260	44	.03	414
20		86.410	.01	.27		52	59	3.0	266	44	.02	414
21		87.320	.01	.27		52	59	4.1	271	44	.02	402
22		88.210	.01	.27		52	59	3.0	246	44	.02	408
23		89.130	.01	.27		53	59	2.9	251	45	.03	392
24		90.025	.01	.27		53	59	2.9	266	44	.03	398
TOTAL				9.72		Avg. 53	Avg. 58				.78	10,013
				.405		Avg.						417

STACK #5

CALCULATION WORK SHEET

1. VOLUME OF GAS SAMPLE (DRY, STP) $V_{m_{std}}$:

$$V_{m_{std}} = V_{mc}$$
$$= V_{mc_1}$$
$$= \underline{63.977} \text{ SCFDG}$$

2. WATER CALCULATION:

A. Water Vapor Through Meter (SCF):

$$V_{c_{std}} = \left(\frac{B_{wc}}{1-B_{wc}}\right) V_{m_{std}}$$
$$= \left(\frac{0.003}{1-0.003}\right) (63.977)$$
$$= \underline{0.1919} \text{ SCF}$$

B. Collected Water (Impingers + Silica Gel)

$$V_{l_c}$$
$$\underline{143.5} \text{ ml}$$

C. Water Fraction Gas Stream, B_{wo} =

$$B_{wo} = \frac{(V_{c_{std}} + 0.0474\, V_{l_c})}{(V_{c_{std}} + 0.0474\, V_{l_c}) + V_{m_{std}}}$$
$$= \frac{(0.1919) + 0.0474\,(143.5)}{(0.1919) + 0.0474\,(143.5) + (63.977)}$$
$$= \underline{0.0935}$$

D. Dry Gas Fraction, B_d :

$$B_d = 1 - B_{wo}$$
$$= \underline{0.9015}$$

3. MOLECULAR WEIGHT CALCULATION:

$$M_d = \frac{1}{100} (\%\, CO_2)(M_{CO_2}) + (\%\, O_2)(M_{O_2}) + (\%\, CO)(M_{CO}) + (\%\, N_2)(M_{N_2})$$

CALCULATION WORK SHEET - 2

3. MOLECULAR WEIGHT CALCULATIONS:(cont'd)

$$= \frac{1}{100}\left[(16.6)\ (44) + (10.5)\ (32) + (\ 0\ )\ (28) + (72.9)\ (28)\right]$$

$$= (7.30) + (3.36) + (0.) + (20.4)$$

$$= \underline{31.07}$$

$$M_s = (M_d)\ (B_d) + 18\ B_{wo}$$

$$= (31.07)\ (0.9015) + 18\ (0.0985)$$

$$= \underline{29.78}$$

4. VELOCITY CALCULATIONS:

$$V_s = 85.48\ (C_p \text{ test})\ (\sqrt{\Delta p_{avg}})\ \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_s = (85.48)\ (0.812)\ (0.145)\ \sqrt{\frac{886.5}{(30.23)(29.78)}}$$

$$V_s = \underline{9.987} \text{ fps}$$

5. VOLUMETRIC FLOW IN STACK (STP), Q_s :

$$Q_s = 3600\ (V_s)\ (A)\ (B_d)\left(\frac{T_{std}}{T_{s\ avg}}\right)\left(\frac{P_{s\ avg}}{P_{std}}\right)$$

$$Q_s = 3600\ (9.987)\ (47.237)\ (0.9015)\ \left(\frac{530}{886.5}\right)\ \left(\frac{30.23}{29.92}\right)$$

$$Q_s = \underline{826,932} \text{ SCFHDG}$$

6. POLLUTANT MASS RATE, pmr

a. Area Ratio Method, pmr_a

$$pmr_a = 60\ \frac{(pm)\ (A)}{(\cancel{p})\ (A_n)} = 60\ \frac{(0.000165)\ (42.237)}{(1.44)\ (0.00136)}$$

TOTAL CATCH = 217.6 mg
pm = 0.000165 g

$$= \underline{2.135} \text{ \#/hr}$$

$\therefore pmr_a = 6.211$ #/hr

b. Concentration Method, pmr_c

$$pmr_c = \frac{(pm)\ (Q_s)}{V_{m\ std}} = \frac{(0.000165)\ (826,932)}{(63.977)}$$

$$= \underline{2.133} \text{ \#/hr}$$

$pmr_c = 6.205$ #/hr

CALCULATION WORK SHEET - 3

c. Average pmr = $\frac{pmr_a + pmr_c}{2}$

= $\frac{(2.135) + (2.133)}{2}$ = 2.134 #/hr

TOTAL CATCH = $\frac{6.211 + 6.205}{2}$ = 6.208 #/hr

7. ISOKINETIC RATIO, I_r:

$I_r = \frac{pmr_a}{pmr_c} = \frac{(2.135)}{2.133}$

= 1.0009

8. ISOKINETIC VARIATION CHECK, I%:

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

= $\frac{100\ (63.977)\ (886.5)\ (29.92)}{60\ (.144)\ (0.00136)\ (0.9015)\ (9.987)\ (530)\ (32.23}$

= 100.11 %

9. PARTICULATE LOADING, c'_s:

$c'_s = (0.01542)\ \frac{(\text{Total Particulate Catch, mg})}{V_{m_{std}}}$

TOTAL CATCH = 2.176 gr

= (0.01542) $\frac{74.7}{63.977}$ $\frac{(0.01542)(2176}{63.977}$ =

= 0.0180 gr/SCFDG

0.0524

TOTAL CATCH = 0.0524 gr/SCFDG

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{pn}	P_c	$P_c - V_{ps}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.915						.912	522.5	30.25	.935
2	.02	.141	1.235						1.231	518.0	30.27	1.274
3	.02	.141	1.250						1.246	517.5	30.27	1.291
4	.02	.141	1.255						1.251	518.0	30.27	1.295
5	.02	.141	1.235						1.231	518.5	30.27	1.273
6	.02	.141	1.265						1.261	517.5	30.27	1.306
7	.02	.141	1.265						1.261	518.0	30.27	1.305
8	.02	.141	1.245						1.241	517.0	30.27	1.287
9	.02	.141	1.260						1.256	518.0	30.27	1.300
10	.03	.173	1.525						1.520	518.0	30.29	1.574
11	.03	.173	1.555						1.550	518.5	30.29	1.604
12	.03	.173	1.555						1.550	518.0	30.29	1.605
13	.03	.173	1.570						1.565	518.5	30.29	1.619
14	.03	.173	1.555						1.550	518.5	30.29	1.604
15	.03	.173	1.590						1.585	517.5	30.29	1.643
16	.04	.200	1.805						1.800	518.5	30.31	1.863
17	.03	.173	1.575						1.570	518.5	30.29	1.624
18	.03	.173	1.585						1.580	518.5	30.29	1.635
19	.03	.173	1.585						1.580	518.5	30.29	1.635
20	.03	.173	1.585						1.580	518.5	30.29	1.635
21	.02	.141	1.265						1.261	518.5	30.27	1.304
22	.02	.141	1.270						1.266	518.5	30.27	1.309
23	.02	.141	1.280						1.276	520.5	30.27	1.314
24	.02	.141	1.265						1.261	520.5	30.27	1.299
Tot.	.59	3.722	33.490						33.3841	12444.5	726.70	34.533
Avg.	.02	.155	1.395						1.391	518.5	30.28	1.439
	1.04	6.956	62.470						62.271	25071.5	1453.12	63.977

Name: 1) 10.2
Source: TS FAGHOUSE
Date: 5-9-77

Run No. 5 - SWTRVS,

P_{bar} = 30.23 "H

V_1 = _____ m

V_c = _____ n

$(t_s)_{avg}$ = _____ o

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ mi

D_n = _____ in

$$V = \left(\frac{V_{ps}}{P_c}\right) V_m$$

$V_{md} = V_m - V_c$

$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V_{md}$

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{pn}	P_c	$P_c - V_{pn}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.02	.141	1.245						1.241	519.5	30.27	1.281
2	.02	.141	1.250						1.246	523.5	30.27	1.276
3	.02	.141	1.245						1.241	523.5	30.27	1.271
4	.02	.141	1.250						1.246	524.0	30.27	1.275
5	.03	.173	1.515						1.510	524.5	30.29	1.544
6	.02	.141	1.280						1.276	525.5	30.27	1.302
7	.03	.173	1.530						1.525	525.5	30.29	1.557
8	.03	.173	1.535						1.530	524.5	30.29	1.565
9	.02	.141	1.265						1.261	525.5	30.27	1.286
10	.02	.141	1.255						1.251	526.0	30.27	1.275
11	.02	.141	1.260						1.256	526.5	30.27	1.279
12	.02	.141	1.260						1.256	526.5	30.27	1.279
13	.02	.141	1.260						1.256	526.5	30.27	1.279
14	.02	.141	1.270						1.266	527.0	30.27	1.288
15	.02	.141	1.265						1.261	526.5	30.27	1.284
16	.02	.141	1.270						1.266	526.5	30.27	1.289
17	.02	.141	1.270						1.266	527.5	30.27	1.287
18	.02	.141	1.270						1.266	528.0	30.27	1.285
19	.01	.100	.980						.977	528.0	30.25	.991
20	.01	.100	.905						.902	528 0	30.25	.915
21	.01	.100	.905						.902	528.5	30.25	.914
22	.01	.100	.900						.897	528.5	30.25	.909
23	.01	.100	.900						.897	528.5	30.25	.909
24	.01	.100	.895						.892	528.5	30.25	.904
Tot.	.45	3.234	29.980						28.887	12627.0	726.42	29.444
Avr.	.02	.135	1.207						1.204	526.1	30.26	1.227

Name: 102
Source: #5 BAGHOUSE
Date: 5-9-77

Run No, 5-NW

P_{bar} = 30.25 "H

V_t = ____ m

V_r = ____ n

$(t_s)_{avg}$ = ____ o

$(P_s)_{avg}$ = ____ "H

A = ____ ft

θ = ____ mt

D_n = ____ in

$$V = \left(\frac{V_{pn}}{P_c}\right) V_m$$

$V_{md} = V_m - V_c$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

PARTICULATE FIELD DATA

PLANT No 2

RUN NO. 5

LOCATION Al Tennessee

DATE 5-4-77

OPERATOR D.C. - R.W.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 74

BAR. PRESS. IN. Hg 30.23

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. _____

PROBE LENGTH _____

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS in H_2O	t_s STACK TEMP. °F
	12:20	22.655										
1		25.100	.54	.54		59	60	4.2	254	45	.02	413
2		26.350	.02	.54		64	62	4.2	257	43	.03	423
3		27.590	.02	.54		64	63	4.2	254	43	.03	425
4		28.845	.02	.54		65	63	4.2	253	42	.04	430
5		30.360	.03	.82		65	64	6.1	264	42	.04	433
6		31.640	.02	.54		66	65	4.3	271	42	.04	433
7		33.170	.03	.82		66	65	6.1	282	42	.03	435
8		34.705	.03	.82		65	64	6.2	276	43	.03	437
9		35.970	.02	.54		66	65	4.3	262	42	.03	434
10		37.225	.02	.54		67	65	4.3	266	41	.02	443
11		38.485	.02	.54		67	66	4.3	291	41	.03	440
12		39.745	.02	.54		67	66	4.3	265	41	.03	441
13		41.005	.02	.54		67	66	4.4	257	41	.03	440
14		42.275	.02	.54		68	66	4.4	286	41	.03	438
15		43.540	.02	.54		67	66	4.4	285	43	.03	434
16		44.810	.02	.54		67	66	4.4	278	40	.02	436
17		46.080	.02	.54		68	67	4.4	288	42	.02	435
18		47.350	.02	.54		67	67	4.4	281	40	.02	433
19		48.330	.01	.27		69	67	2.7	281	42	.02	431
20		49.235	.01	.27		69	67	2.7	277	42	.01	423
21		50.140	.01	.27		69	68	2.7	275	40	.01	423
22		51.040	.01	.27		69	68	2.7	262	41	.01	415
23		51.940	.01	.27		69	68	2.7	259	41	.01	414
24		52.835	.01	.27		69	68		253	41	.01	413
				12.18		67	Avg. 66				.60	10,278
						66					.025	1177

PARTICULATE FIELD DATA

PLAN No 2

RUN NO. 5

LOCATION Silo Warehouse

DATE 5-9-77

OPERATOR D.C.-R.W.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 44

BAR. PRESS. IN. Hg 30.33

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. _____

PROBE LENGTH _____

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN H_2O	t_s STACK TEMP. °F
	10:30	690.335										
1		91.250	.01	.27		62	63	2.7	259	62	.03	409
2		92.485	.02	.54		57	59	4.5	278	61	.03	402
3		93.735	.02	.54		57	58	4.5	274	63	.03	406
4		94.990	.02	.54		57	59	4.5	262	61	.03	408
5		96.255	.02	.54		58	59	4.5	260	60	.03	412
6		97.520	.02	.54		57	58	4.5	254	60	.02	412
7		98.765	.02	.54		58	58	4.6	267	57	.02	415
8		100.020	.02	.54		57	57	4.7	284	62	.03	421
9		101.290	.02	.54		58	58	4.7	277	57	.03	425
10		2.815	.03	.82		58	58	6.9	272	57	.04	427
11		4.310	.03	.82		57	58	7.0	274	58	.04	426
12		5.925	.03	.82		58	58	7.0	275	62	.04	427
13		7.495	.03	.82		59	58	7.0	282	63	.04	431
14		9.050	.03	.82		59	58	7.0	279	62	.04	434
15		10.640	.03	.82		58	57	7.1	272	59	.04	435
16		12.445	.04	1.09		59	56	9.0	269	58	.04	437
17		14.020	.03	.82		59	58	7.0	264	59	.04	438
18		15.605	.03	.82		59	59	7.0	263	52	.04	439
19		17.190	.03	.82		59	58	7.0	266	52	.04	439
20		18.775	.03	.82		59	58	7.0	265	52	.04	439
21		20.040	.02	.54		59	58	4.5	263	51	.04	436
22		21.310	.02	.54		59	58	4.5	264	52	.03	431
23		22.590	.02	.54		61	60	4.5	267	[illegible]	[illegible]	[illegible]
24		23.855	.02	.54		61	60		261	[illegible]	[illegible]	[illegible]
				16.04		Avg. 59	58				.11	10177
				.67			59 52				.03	1171

STACK #6

CALCULATION WORK SHEET

1. VOLUME OF GAS SAMPLE (DRY, STP) $V_{m_{std}}$:

$$V_{m_{std}} = V_{mc}$$
$$= V_{mc_f}$$
$$= 49.574 \text{ SCFDG}$$

2. WATER CALCULATION:

A. Water Vapor Through Meter (SCF):

$$V_{c_{std}} = \left(\frac{B_{wc}}{1-B_{wc}}\right) V_{m_{std}}$$
$$= \left(\frac{0.003}{1-0.003}\right) (49.574)$$
$$= 0.1492 \text{ SCF}$$

B. Collected Water (Impingers + Silica Gel)

V_{l_c}

$$136.3 \text{ ml}$$

C. Water Fraction Gas Stream, B_{wc} =

$$B_{wc} = \frac{(V_{c_{std}} + 0.0474\, V_{l_c})}{(V_{c_{std}} + 0.0474\, V_{l_c}) + V_{m_{std}}}$$
$$= \frac{(0.1492 + 0.0474\,(136.3))}{(0.1492 + 0.0474\,(136.3)) + 49.574}$$
$$= 0.1176$$

D. Dry Gas Fraction, F_d:

$$F_d = 1 - B_{wc}$$
$$= 0.8824$$

E. MOLECULAR WEIGHT CALCULATION:

$$M_d = \frac{1}{100}\left[(\%CO_2)(M_{CO_2}) + (\%O_2)(M_{O_2}) + (\%N_2)(M_{N_2})\right]$$

3. MOLECULAR WEIGHT CALCULATIONS: (cont'd)

$$= \frac{I}{100}\left[(16.6)\ (44) + (10.5)\ (32) + (\ 0\ )\ (28) + (72.9)\ (28)\right]$$

$$= (7.30) + (3.36) + (0) + (20.41)$$

$$= 31.07$$

$$M_s = (M_d)\ (B_d) + 18\ B_{wo}$$

$$= (31.07)\ (0.8824) + 18\ (0.1176)$$

$$= 29.53$$

4. VELOCITY CALCULATIONS:

$$V_s = 85.48\ (C_p\ test)\ (\sqrt{\Delta P_{avg}})\ \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_s = (85.48)\ (0.812)\ (0.111)\ \sqrt{\frac{831.3}{(30.20)(29.53)}}$$

$$V_s = 7.439 \text{ fps}$$

5. VOLUMETRIC FLOW IN STACK (STP), Q_s :

$$Q_s = 3600\ (V_s)\ (A)\ (B_d)\ \frac{T_{std}}{T_{s\ avg}}\ \frac{P_{s\ avg}}{P_{std}}$$

$$Q_s = 3600\ (7.439)\ (42.237)\ (0.8824)\ \left(\frac{530}{831.3}\right)\ \left(\frac{30.20}{29.92}\right)$$

$$Q_s = 642,302 \text{ SCFHDG}$$

6. POLLUTANT MASS RATE, pmr

a. Area Ratio Method, pmr_a

$$pmr_a = 60\ \frac{(pm)\ (A)}{(B)\ (An)} = 60\ \frac{(0.000239)\ (42.237)}{(144)\ (0.00136)}$$

$$= 3.041 \text{ \#/hr}$$

Total Catch
pm = 0.000239
pmr_a = 3.745 #/hr

b. Concentration Method, pmr_c

$$pmr_c = \frac{(pm)\ (Q_s)}{V_{m\ std}} = \frac{(0.000255)\ (642,302)}{(49.574)}$$

$$= 3.045 \text{ \#/hr}$$

pmr_c = 3.750 #/hr.

CALCULATION WORK SHEET - 3

c. Average pmr = $\frac{pmr_a + pmr_c}{2}$

= $\frac{(3041) + (3.045)}{2}$ = 3.043 #/hr

TOTAL CATCH = $\frac{3.745 + 3.750}{2}$ = 3.748 #/hr

7. ISOKINETIC RATIO, I_r:

$I_r = \frac{pmr_a}{pmr_c} = \frac{(3.041)}{3.045}$

= 0.9987

8. ISOKINETIC VARIATION CHECK, I%:

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

$= \frac{100\ (49.574)\ (831.3)\ (29.92)}{60\ (.144)\ (0.00136)\ (0.8824)\ (7.439)\ (530)\ 5[illegible]}$

= 99.88 %

9. PARTICULATE LOADING, c'_s:

$c'_s = (0.01542)\ \frac{(\text{Total Particulate Catch, mg})}{V_{m_{std}}}$

= (0.01542) $\left(\frac{0.1667}{49.574}\right)$

= 0.0332 gr/SCFDG

TOTAL CATCH = [illegible]

$\frac{(0.01542)(131.4)}{49.574}$ [illegible]

TOTAL CATCH = 0.0409 gr/SCFDG

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{ps}	P_c	$P_c - V_{ps}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.920						.917	526.5	30.22	.932
2	.01	.100	.925						.922	526.5	30.22	.937
3	.01	.100	.920						.917	527.0	30.22	.931
4	.01	.100	.915						.912	526.5	30.22	.927
5	.01	.100	.910						.907	527.0	30.22	.921
6	.01	.100	.925						.922	527.0	30.22	.936
7	.01	.100	.915						.912	528.0	30.22	.924
8	.01	.100	.920						.917	528.0	30.22	.929
9	.01	.100	1.020						1.017	528.0	30.22	1.030
10	.02	.141	1.105						1.102	528.5	30.24	1.117
11	.01	.100	.975						.972	529.0	30.22	.983
12	.01	.100	.848						.845	528.5	30.22	.856
13	.01	.100	.905						.902	529.5	30.22	.912
14	.01	.100	.905						.902	529.5	30.22	.912
15	.02	.141	1.235						1.231	530.0	30.24	1.244
16	.01	.100	.975						.972	530.5	30.22	.981
17	.02	.141	1.265						1.261	530.5	30.24	1.273
18	.02	.141	1.270						1.266	530.5	30.24	1.278
19	.02	.141	1.285						1.281	530.5	30.24	1.293
20	.02	.141	1.280						1.276	530.5	30.24	1.288
21	.01	.100	.945						.942	530.5	30.22	.950
22	.01	.100	.950						.947	530.0	30.22	.956
23	.01	.100	.920						.917	530.0	30.22	.926
24	.01	.100	.920						.917	529.0	30.22	.928
Tot.	.30	2.646	24.153						24.076	12691.5	725.40	24.364
Avg.	.0125	.110	1.006						1.003	528.8	30.22	1.015

Name: 2
Source: FS BAGHOUSE
Date: 5-10-77

Run No. 6 - NW TRVS.

P_{bar} = 30.20 "H

V_1 = _____ m

V_f = _____ n

$(t_s)_{avg}$ = _____ 9

$(P_s)_{avg}$ = _____ "H

A = _____ ft

Θ = _____ mi

D_n = _____ in

$$V = \left(\frac{V_{ps}}{P_c}\right) V_m$$

$V_{md} = V_m - V_c$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

NO.	Δp	$\sqrt{\Delta p}$	V_m	t_c	V_{pn}	P_c	$P_c - V_{po}$	V_c	V_{md}	T_m	P_m	V_{mc}
1	.01	.100	.955						.952	516.0	30.22	.987
2	.01	.100	.915						.912	520.5	30.22	.938
3	.01	.100	.920						.917	521.0	30.22	.942
4	.01	.100	.910						.907	521.5	30.22	.931
5	.01	.100	.930						.927	522.0	30.22	.950
6	.01	.100	.930						.927	520.5	30.22	.953
7	.01	.100	.930						.927	521.5	30.22	.951
8	.01	.100	.920						.917	521.5	30.22	.941
9	.01	.100	.930						.927	521.5	30.22	.951
10	.02	.141	1.255						1.251	521.5	30.24	1.285
11	.02	.141	1.270						1.266	521.5	30.24	1.300
12	.02	.141	1.275						1.271	521.5	30.24	1.305
13	.02	.141	1.275						1.271	522.0	30.24	1.304
14	.02	.141	1.280						1.276	522.5	30.24	1.308
15	.02	.141	1.270						1.266	523.0	30.24	1.296
16	.02	.141	1.270						1.266	523.5	30.24	1.295
17	.01	.100	.935						.932	524.0	30.22	.952
18	.01	.100	.930						.927	524.5	30.22	.946
19	.01	.100	.935						.932	525.0	30.22	.950
20	.01	.100	.920						.917	525.5	30.22	.934
21	.01	.100	.935						.932	525.5	30.22	.949
22	.01	.100	.930						.927	526.0	30.22	.943
23	.01	.100	.935						.932	526.5	30.22	.947
24	.01	.100	.940						.937	526.5	30.22	.952
Tot.	.31	2.687	24.695						24.616	12545.0	725.42	25.210
Avr.	.01	.112	1.029						1.026	522.7	30.23	1.050
Tot.	.61	5.333	48.848						48.692	25236.5	1450.82	49.574

Name: [illegible] 2
Source: #5 BAGHOUSE
Date: 5-10-77

Run No. 6 - SW TPVS

P_{bar} = 30.20 "H

V_1 = _____ m

V_f = _____ n

$(t_s)_{avg}$ = _____ a

$(P_s)_{avg}$ = _____ "H

A = _____ ft

θ = _____ mi

D_n = _____ in

$$V = \left(\frac{V_{pn}}{P_c}\right) V_m$$

$$V_{md} = V_m - V_c$$

$$V_{mc} = 17.71 \left(\frac{P_m}{T_m}\right) V$$

PARTICULATE FIELD DATA

PLANT AH 2

RUN NO. 6

LOCATION SW TRAVERSE

DATE 5-10-77

OPERATOR D.C. - R.M.

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 48

BAR. PRESS. IN. Hg 30.20

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10' EA

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN H_2O	t_s STACK TEMP. °F
	10:00	75:3.015										
1	1	53.970	.01	.28		57	60	2.6	264	54	.03	362
2	2	54.885	.01	.28		58	63	2.6	254	50	.03	361
3	3	55.805	.01	.28		59	63	2.5	270	50	.03	363
4	4	56.715	.01	.28		60	63	2.6	285	49	.03	364
5	5	57.615	.01	.28		61	63	2.6	296	47	.03	366
6	6	58.515	.01	.28		60	61	2.6	288	47	.03	365
7	7	59.505	.01	.28		61	62	2.6	284	47	.03	364
8	8	60.425	.01	.28		61	62	2.6	282	47	.03	364
9	9	61.355	.01	.28		62	61	2.7	279	46	.03	368
10	10	62.610	.02	.56		62	61	4.2	267	46	.03	371
11	11	63.860	.02	.56		62	61	4.2	264	46	.03	371
12	12	65.155	.02	.56		62	61	4.2	269	46	.04	372
13	13	66.430	.02	.56		63	61	4.3	270	45	.04	372
14	14	67.710	.02	.56		63	62	4.5	272	45	.04	381
15	15	68.980	.02	.56		64	62	4.5	278	45	.04	385
16	16	70.250	.02	.56		64	63	4.6	272	45	.04	383
17	17	71.185	.01	.28		65	63	2.9	274	45	.04	386
18	18	72.115	.01	.28		65	64	2.9	265	45	.03	386
19	19	73.050	.01	.28		66	64	2.9	283	45	.03	385
20	20	73.990	.01	.28		66	65	2.9	272	43	.03	385
21	21	74.905	.01	.28		66	65	2.9	286	44	.03	384
22	22	75.835	.01	.28		67	65	2.9	282	45	.03	382
23	23	76.770	.01	.28		67	66	2.9	290	45	.03	377
24	24	77.710	.01	.28		67	66	2.9	276	44	.03	376
				8.68		Avg. 63	Avg. 63				.75	8715

PARTICU[illegible] FIELD DATA

PLAN: No. 2

RUN NO. 6

LOCATION NW TRAVERSE

DATE 4/10/71

OPERATOR D.C. R.M

SAMPLE BOX NO. _____

METER BOX NO. _____

AMBIENT TEMP. °F 45

BAR. PRESS. IN. Hg 30.20

ASSUMED MOISTURE % _____

HEATER BOX SETTING °F _____

PROBE TIP DIA., IN. 0.50

PROBE LENGTH 10 FEET

PROBE HEATER SETTING _____

POINT	θ CLOCK TIME	V_m DRY GAS METER, Ft³	Δp test PITOT IN. H_2O	ΔH ORIFICE IN. H_2O REQUIRED	ΔH ORIFICE IN. H_2O ACTUAL	t_m DRY GAS TEMP. °F INLET	t_m DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	t_c IMPINGER TEMP °F	P_s STACK PRESS IN. H_2O	t_s STACK TEMP. °F
	11:55	777.710										
1	1	78.630	.01	.28		65	68	2.5	253	46	.03	368
2	2	79.555	.01	.28		65	68	2.6	260	47	.03	368
3	3	80.475	.01	.28		66	68	2.7	260	47	.03	365
4	4	81.390	.01	.28		65	68	2.5	275	47	.03	366
5	5	82.300	.01	.28		66	68	2.5	289	47	.03	365
6	6	83.225	.01	.28		66	68	2.5	297	46	.03	369
7	7	84.140	.01	.28		67	69	2.5	297	46	.03	37[illegible]
8	8	85.060	.01	.28		67	69	2.6	307	46	.03	37[illegible]
9	9	86.000	.01	.28		67	69	2.6	298	45	.03	375
10	10	87.185	.02	.56		68	69	4.2	280	45	.03	379
11	11	88.160	.01	.28		68	70	2.6	267	45	.03	378
12	12	89.085	.01	.28		68	69	2.6	272	45	.03	378
13	13	89.990	.01	.28		69	70	2.6	290	45	.03	382
14	14	90.895	.01	.28		69	70	2.5	299	45	.03	38[illegible]
15	15	92.130	.02	.56		70	70	4.1	292	44	.03	381
16	16	93.105	.01	.28		70	71	2.4	306	43	.02	38
17	17	94.370	.02	.56		70	71	3.8	300	43	.02	38
18	18	95.640	.02	.56		70	71	3.9	306	43	.03	37
19	19	96.925	.02	.56		70	71	4.0	308	42	.03	35
20	20	98.205	.02	.56		70	71	4.0	313	43	.03	37
21	21	99.150	.01	.28		70	71	4.0	295	42	.03	37
22	22	8.00.100	.01	.28		69	71	3.5	278	41	.03	34
23	23	1.02	.01	.28		69	71	3.7	260	41	.03	34
24	24	1.940	.01	.28		67	71	3.6	241	41	.03	33
TOTAL				8.40		Avg. 68	Avg. 70				0.78	361