

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

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

PARTICULATE CHECKLIST

Name of Source: Appleton Asphalt Test Date: May 20, 91

1. Are the isokinetics per run between 90 and 110%?
If the %I for a run is outside the range, void the run. See 5. YES NO
 2. Is the sample volume per run \geq 30 DSCF?
If the sample volume for a run is $<$ 30 DSCF, void the run. See 5. YES NO
 3. Is the sample time per run \geq 60 min.?
If the sample time for a run is $<$ 60 min., void the run. See 5. YES NO
 4. Is the sample time per sample point \geq two min.?
If the sample time per point for a run is $<$ two min., void the run. See 5. YES NO
 5. A stack test shall consist of three valid runs or, at a minimum, two valid runs if one run is voided. Is this a valid test?
If no, inform the District or the source that the test is unacceptable and should be redone. Your review is over. YES NO
 6. Is the total particulate per run added correctly?
If an incorrect total is found, call the consultant and ask for a correction. YES NO
 7. Was the backhalf included in the total particulate?
NSPS sources are exempt from including the backhalf. All other sources must include the backhalf. If they don't, the test is invalid. See 5. YES NO
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- Eq. 1 $Gr/DSCF = 15.43 * g \text{ of part. / sample volume of run in DSCF}$
- Eq. 2 $Lb/DSCF = (Gr/DSCF) / 7000$
- Eq. 3 $Lb/Hr = 60 * DSCFM * (Lb/DSCF)$
- Eq. 4 $Lb/10^6 \text{ BTU} = (Lb/DSCF) * F \text{ Factor} * 20.9 / (20.9 - \text{Stack } O_2)$
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8. If the emission limit is in Gr/DSCF, Lb/DSCF, Lb/Hr, or Lb/10⁶ BTU, solve Eq. 1-4. Do your results match the consultant's?
If no, fix the problem or call the consultant for a correction. YES NO
 9. Is the three run (or two run) average correct?
If no, write in the correct average. YES NO
 10. Is the average result in compliance?
If no, the District should issue an NOV. YES NO
 11. Was the source operating at a level representative of full capacity?
If no, the permit release may need to provide conditions to cap the source at the test level until a stack test at a higher production level (showing compliance) is performed. If the test was not for permit release, other actions may be warranted. YES NO

SUMMARY

On May 20, 1991, Environmental Technology & Engineering Corporation personnel performed a stack emission test on the Appleton Asphalt, Inc. Green Bay asphalt plant located on Scray Hill in DePere, Wisconsin. The average of the three particulate tests show the emissions to be above the limit of 0.04 grains of particulate matter per dry standard cubic foot (gr/dscf) as specified by the State of Wisconsin Department of Natural Resources (DNR) by permit. The numerical test results are summarized below:

Test	Emissions	% of Allowable
1	.052 0.051 gr/dscf	128 %
2	.0482 0.047	117
3	.0414 0.040	100
AVG	<u>.0472</u> 0.046 gr/dscf	115 %

In addition, the permit also required testing for formaldehyde emissions. The following table presents the numerical results:

Test	LB/HR	LB/TON
1	0.11 lb/hr	0.0006 lb/ton
2	0.12	0.0007
3	0.10	0.0006
AVG	0.11 lb/hr	0.0006 lb/ton

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in = .3720
 STACK AREA, sq ft = 11.250
 SAMPLING TIME PER POINT, min = 2.50
 NUMBER OF POINTS = 25
 GAS METER VOLUME, acf = 46.45
 WATER COLLECTED, ml = 457.00
 PARTICULATE COLLECTED, grams = 0.1528
 CO₂ = 8.40 O₂ = 11.00 CO = 0.00 N₂ = 80.60

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	155	0.190	2.15	80	28.33
2	155	0.190	2.15	81	28.33
3	155	0.200	2.25	82	29.06
4	155	0.200	2.25	82	29.06
5	155	0.190	2.15	83	28.33
6	155	0.160	1.80	86	26.00
7	155	0.180	2.00	87	27.57
8	155	0.180	2.00	88	27.57
9	155	0.140	1.60	89	24.32
10	155	0.140	1.60	90	24.32
11	155	0.170	1.70	92	26.80
12	155	0.170	1.70	93	26.80
13	155	0.180	1.80	93	27.57
14	155	0.180	1.80	94	27.57
15	155	0.100	1.05	95	20.55
16	155	0.230	2.35	97	31.17
17	155	0.230	2.35	97	31.17
18	155	0.230	2.35	98	31.17
19	155	0.210	2.15	98	29.78
20	155	0.200	2.00	98	29.06
21	155	0.170	1.70	98	26.80
22	150	0.170	1.70	89	26.69
23	150	0.150	1.55	90	25.07
24	155	0.150	1.55	80	25.17
25	155	0.120	1.25	80	22.51
AVG VALUES	155		1.884	90	27.23

TOTAL GAS WITHDRAWN, scf = 67.84
 DRY GAS WITHDRAWN, scf = 46.33
 WATER VAPOR WITHDRAWN, scf = 21.51
 PERCENT WATER VAPOR = 31.71
 ACTUAL WET FLOW RATE, acfm = 18,380.90
 STANDARD DRY FLOW RATE, scfm = 10,594.07
 , m³/hr = 18,001.44
 PARTICULATE CONCENTRATION, grains/dscf = 0.051
 PARTICULATE EMISSIONS, lb/1000 lb wet gas = 0.075
 PARTICULATE EMISSION RATE, lb/hr = 4.72
 FORMALDEHYDE CONCENTRATION, mg/m³ = 2.77
 FORMALDEHYDE EMISSION RATE, lb/hr = 0.11
 PERCENT OF ISOKINETIC SAMPLING = 104.32

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in .3720
 STACK AREA, sq ft = 11.250
 SAMPLING TIME PER POINT, min = 2.50
 NUMBER OF POINTS = 25
 GAS METER VOLUME, acf = 45.60
 WATER COLLECTED, ml = 457.00
 PARTICULATE COLLECTED, grams = 0.1386
 CO₂ = 8.80 O₂ = 11.00 CO = 0.00 N₂ = 80.20

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	155	0.170	1.75	82	26.80
2	155	0.160	1.65	83	26.00
3	155	0.150	1.55	84	25.17
4	155	0.150	1.55	84	25.17
5	155	0.120	1.25	84	22.51
6	155	0.240	2.50	88	31.84
7	155	0.240	2.50	90	31.84
8	155	0.240	2.50	91	31.84
9	155	0.230	2.40	91	31.17
10	155	0.230	2.40	91	31.17
11	155	0.170	1.75	95	26.80
12	155	0.160	1.65	96	26.00
13	155	0.150	1.55	97	25.17
14	155	0.150	1.55	98	25.17
15	155	0.110	1.15	100	21.56
16	155	0.230	2.40	102	31.17
17	150	0.180	1.85	82	27.46
18	150	0.180	1.85	96	27.46
19	155	0.160	1.65	97	26.00
20	155	0.160	1.65	98	26.00
21	155	0.240	2.50	101	31.84
22	155	0.230	2.40	102	31.17
23	155	0.230	2.40	102	31.17
24	155	0.230	2.40	103	31.17
25	155	0.200	2.05	103	29.07
AVG VALUES	155		1.954	94	28.03

TOTAL GAS WITHDRAWN, scf = 67.03
 DRY GAS WITHDRAWN, scf = 45.51
 WATER VAPOR WITHDRAWN, scf = 21.51
 PERCENT WATER VAPOR = 32.09
 ACTUAL WET FLOW RATE, acfm = 18,919.65
 STANDARD DRY FLOW RATE, scfm = 10,842.78
 , m³/hr = 18,424.04
 PARTICULATE CONCENTRATION, grains/dscf = 0.047
 PARTICULATE EMISSIONS, lb/1000 lb wet gas = 0.067
 PARTICULATE EMISSION RATE, lb/hr = 4.37
 FORMALDEHYDE CONCENTRATION, mg/m³ = 2.85
 FORMALDEHYDE EMISSION RATE, lb/hr = 0.12
 PERCENT OF ISOKINETIC SAMPLING = 100.12

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in .3720
 STACK AREA, sq ft = 11.250
 SAMPLING TIME PER POINT, min = 2.50
 NUMBER OF POINTS = 25
 GAS METER VOLUME, acf = 45.40
 WATER COLLECTED, ml = 454.00
 PARTICULATE COLLECTED, grams = 0.1177
 CO₂ = 8.60 O₂ = 11.40 CO = 0.00 N₂ = 80.00

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	150	0.220	2.25	102	30.36
2	155	0.240	2.50	105	31.84
3	155	0.240	2.50	105	31.84
4	155	0.230	2.40	105	31.17
5	155	0.190	1.95	105	28.33
6	155	0.160	1.65	108	26.00
7	155	0.160	1.65	108	26.00
8	155	0.180	1.85	109	27.58
9	155	0.180	1.85	109	27.58
10	155	0.140	1.45	110	24.32
11	155	0.160	1.65	110	26.00
12	155	0.170	1.75	110	26.80
13	150	0.170	1.75	110	26.69
14	155	0.160	1.65	110	26.00
15	155	0.130	1.35	110	23.43
16	155	0.230	2.40	110	31.17
17	155	0.240	2.50	110	31.84
18	155	0.240	2.50	110	31.84
19	155	0.220	2.25	110	30.49
20	155	0.210	2.15	110	29.79
21	155	0.180	1.85	110	27.58
22	155	0.160	1.65	110	26.00
23	155	0.150	1.55	110	25.17
24	155	0.140	1.45	110	24.32
25	155	0.120	1.25	110	22.52
AVG VALUES	155		1.910	109	27.79

TOTAL GAS WITHDRAWN, scf = 66.76
 DRY GAS WITHDRAWN, scf = 45.39
 WATER VAPOR WITHDRAWN, scf = 21.37
 PERCENT WATER VAPOR = 32.01
 ACTUAL WET FLOW RATE, acfm = 18,755.32
 STANDARD DRY FLOW RATE, scfm = 10,761.92
 , m³/hr = 18,286.66
 PARTICULATE CONCENTRATION, grains/dscf = 0.040
 PARTICULATE EMISSIONS, lb/1000 lb wet gas = 0.058
 PARTICULATE EMISSION RATE, lb/hr = 3.70
 FORMALDEHYDE CONCENTRATION, mg/m³ = 2.60
 FORMALDEHYDE EMISSION RATE, lb/hr = 0.10
 PERCENT OF ISOKINETIC SAMPLING = 100.60

May 20, 1991

STACK TEST LOG

ADM PLANT - GREEN BAY - 999818160

FUEL #2

APM

TEST #1

TIME	AGG TPH	ASPH. TPH	RECYCLE T.P.H.	
9:15	130	6.2	46	182.2
9:25	131	6.2	48	185.2
9:35	133	6.6	45	184.6
9:45	136	6.6	43	185.6
9:55	133	6.4	42	181.4
10:05	134	6.4	45	182.4
10:10	133	6.4	41	180.4
11:05	132	6.2	42	180.2
11:15				

TEST #2

12:15	128	6.0	40	179.0	
					AVG 181.8
12:45	115	5.8	52	172.8	
12:55	118	5.9	55	178.9	3 7/8
1:05	116	6.0	53	175	
1:15	114	5.8	54	175.8	3 2/8
1:25	114	5.9	55	174.9	
2:25	116	6.0	52	174	3 2/8
2:35	117	6.1	52	175.1	
2:45	115	5.9	53	173.9	3 2/8
2:55					AVG 175.1

TEST #3

<u>TIME</u>	<u>AGG.</u> <u>TPH</u>	<u>Asph</u> <u>TPH</u>	<u>Recycle</u> <u>TPH</u>		
3:30	116	3.7	52	173.9	3 $\frac{2}{F}$
3:40	117	5.9	51	173.9	
3:50	115	6.0	53	174	3 $\frac{2}{F}$
4:00	115	6.1	54	175.1	
4:10	116	6.0	53	175	3 $\frac{2}{F}$
4:50	117	6.0	53	176	
5:00	113	5.4	51	169.7	3 $\frac{2}{F}$
5:10	115	5.9	54	174.9	
5:20	114	5.8	53	172.8	3 $\frac{2}{F}$
5:30	116	5.9	52	173.9	
			Avg.	173.9	

GREEN BAY ASPHALT FORMALDEHYDE CALCULATIONS

TEST 1 $V_M = 2.50 \text{ ft}^3$ $Z = 1.070$
181.8 TPH $T_M = 79^\circ\text{F}$

$$V_{M \text{ std}} = 2.50 \times 1.070 \times \frac{528}{538} = \frac{79.4}{29.92}$$

$$= 2.46 \text{ scf} = .07832 \cdot .070 \text{ m}^3$$

$$C = \frac{.194 \text{ mg}}{.070 \text{ m}^3} = 2.77 \text{ mg/m}^3$$

$$\text{ER} = 0.11 \text{ lb/hr.}$$

$$= .0006 \text{ lb/ton}$$

TEST 2 $V_M = 2.50$
175.1 TPH $T_M = 84^\circ\text{F}$

$$V_{M \text{ std}} = 2.43 \text{ scf} = .069 \text{ m}^3$$

$$C = \frac{.197}{.069} = 2.85 \text{ mg/m}^3$$

$$\text{ER} = 0.12 \text{ lb/hr.}$$

$$= .0007 \text{ lb/ton}$$

TEST 3 $V_M = 2.00$
173.9 TPH $T_M = 84^\circ\text{F}$

$$V_{M \text{ std}} = 1.95 \text{ scf} = .055 \text{ m}^3$$

$$C = \frac{.143}{.055} = 2.60 \text{ mg/m}^3$$

$$\text{ER} = 0.10 \text{ lb/hr.}$$

$$= .0006 \text{ TPH}$$

CALCULATION OF PARTICULATE CONCENTRATION
AND EMISSION RATE RESULTS WITH EPA METHOD 5 DATA

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Run Number: 1
Test Site: Appleton Asphalt
Test Date: 5/20/91

	DATA
All data are in: 1=metric, 2=English:	2
Area of stack (ft2 or m2):	11.25
Pitot tube calibration coefficient (Cp):	0.85
Barometric pressure (in. Hg or mm Hg):	29.4
Nozzle diameter (ft or m):	0.031
Dry stack gas molecular weight:	29.784
Initial Dry Gas Meter reading (ft3 or m3):	0
Final Dry Gas Meter reading (ft3 or m3):	46.33
Dry Gas Meter calibration factor (Y):	1.032
Total run time (min):	62.5

	DATA
Particulate weight in probe rinse (mg):	0
Particulate weight in filter catch (mg):	152.8
Particulate weight in impinger catch (mg):	0
Volume of Water Vapor Condensed (ml):	404
Water Vapor Collected in Silica Gel (mg):	0
Percent Oxygen in Stack by Volume (dry):	11
Percent Carbon Dioxide in Stack by Volume (dry):	8.4
Leak Rate Correction Factor Used? 1=yes, 2=no:	2
Heat Input(mmBtu/hr):	0

MEASURED DATA FROM TEST RUN no: 1

Run Time (min)	Pitot Delta p (in H2O, mm H2O)	Orifice Delta H (in H2O, mm H2O)	Average DGM Temp (F,C)	Static Pressure (in H2O, mm H2O)	Stack Temp (F,C)
2.5	0.19	2.15	90	-0.1	155
2.5	0.19	2.15	90	-0.1	155
2.5	0.2	2.25	90	-0.1	155
2.5	0.2	2.25	90	-0.1	155
2.5	0.19	2.15	90	-0.1	155
2.5	0.16	1.8	90	-0.1	155
2.5	0.18	2	90	-0.1	155
2.5	0.18	2	90	-0.1	155
2.5	0.14	1.6	90	-0.1	155
2.5	0.14	1.6	90	-0.1	155
2.5	0.17	1.7	90	-0.1	155
2.5	0.17	1.7	90	-0.1	155
2.5	0.18	1.8	90	-0.1	155
2.5	0.18	1.8	90	-0.1	155
2.5	0.1	1.05	90	-0.1	155
2.5	0.23	2.35	90	-0.1	155
2.5	0.23	2.35	90	-0.1	155
2.5	0.23	2.35	90	-0.1	155
2.5	0.23	2.35	90	-0.1	155
2.5	0.21	2.15	90	-0.1	155
2.5	0.2	2.05	90	-0.1	155
2.5	0.17	1.75	90	-0.1	155
2.5	0.17	1.75	90	-0.1	155
2.5	0.15	1.55	90	-0.1	155
2.5	0.15	1.55	90	-0.1	155
2.5	0.12	1.25	90	-0.1	155

Average
Values

SR(VP)=
0.4222

OP=
1.9104

TS(R')=
615

RESULTS

Percent moisture in stack gas (%) :	29.52
Wet Stack Gas Molecular Weight (Ms) :	26.3
Average Stack Pressure (Ps) (in Hg, mm Hg) :	29.39
Average Stack Gas Temperature (Ts) (R, K) :	615
Average Stack Velocity (Vs-avg) (ft/sec, m/sec) :	27.36
Actual Volumetric Flow Rate (Q) (acfm, acmm) :	18467.6
Standard Volumetric Flow Rate (Qstd) (scfm, scmm, dry) :	10977.3
Standard Volume Metered on DGM (Vmstd) (scf, scm, dry) :	45.315

CALCULATION OF PARTICULATE CONCENTRATION
AND EMISSION RATE RESULTS WITH EPA METHOD 5 DATA

RESULTS	PMRA Pollutant Mass Rate (lbs/hr) :	4.8211
	PMRC Pollutant Mass Rate (lbs/hr) :	4.90
	PMRA-PMRC Ave. Pollutant Mass Rate (lbs/hr) :	4.86
	Dry Catch Pollutant Mass Rate (g/hr) :	2220.91
	Total Catch Pollutant Mass Rate (g/hr) :	2220.91
	Dry Catch Concentration (grains/dscf, g/dscm) :	5.20E-02
	Total Catch Concentration (grains/dscf, g/dscm) :	5.20E-02
	Isokinetic Check (% I) :	98.4
	Oxygen-Based Emission Rate (ng/J, lb/million Btu) :	0.00E+00
	Carbon Dioxide-Based Emission Rate (ng/J, lb/million Btu) :	0.00E+00
	Emission Concentration, standard conditions dry (mmBtu/hr) :	0.00

CALCULATION OF PARTICULATE CONCENTRATION
AND EMISSION RATE RESULTS WITH EPA METHOD 5 DATA

Run Number: . 2
Test Site: Appleton Asphalt
Test Date: 5/20/91

	DATA
All data are in: 1=metric, 2=English:	2
Area of stack (ft2 or m2):	11.25
Pitot tube calibration coefficient (Cp):	0.85
Barometric pressure (in. Hg or mm Hg):	29.4
Nozzle diameter (ft or m):	0.031
Dry stack gas molecular weight:	29.848
Initial Dry Gas Meter reading (ft3 or m3):	0
Final Dry Gas Meter reading (ft3 or m3):	45.51
Dry Gas Meter calibration factor (Y):	1.037
Total run time (min):	62.5

	DATA
Particulate weight in probe rinse (mg):	0
Particulate weight in filter catch (mg):	138.6
Particulate weight in impinger catch (mg):	0
Volume of Water Vapor Condensed (ml):	397
Water Vapor Collected in Silica Gel (mg):	0
Percent Oxygen in Stack by Volume (dry):	11
Percent Carbon Dioxide in Stack by Volume (dry):	8.8
Leak Rate Correction Factor Used? 1=yes, 2=no:	2
Heat Input (mmBtu/hr):	0

MEASURED DATA FROM TEST RUN no: 2

Run Time (min)	Pitot Delta p (in H2O, mm H2O)	Orifice Delta H (in H2O, mm H2O)	Average DGM Temp (F,C)	Static Pressure (in H2O, mm H2O)	Stack Temp (F,C)
2.5	0.17	1.75	94	-0.1	155
2.5	0.16	1.65	94	-0.1	155
2.5	0.15	1.55	94	-0.1	155
2.5	0.15	1.55	94	-0.1	155
2.5	0.12	1.25	94	-0.1	155
2.5	0.24	2.5	94	-0.1	155
2.5	0.24	2.5	94	-0.1	155
2.5	0.24	2.5	94	-0.1	155
2.5	0.23	2.4	94	-0.1	155
2.5	0.23	2.4	94	-0.1	155
2.5	0.17	1.75	94	-0.1	155
2.5	0.16	1.65	94	-0.1	155
2.5	0.15	1.55	94	-0.1	155
2.5	0.15	1.55	94	-0.1	155
2.5	0.11	1.15	94	-0.1	155
2.5	0.23	2.4	94	-0.1	155
2.5	0.18	1.85	94	-0.1	155
2.5	0.18	1.85	94	-0.1	155
2.5	0.16	1.65	94	-0.1	155
2.5	0.16	1.65	94	-0.1	155
2.5	0.24	2.5	94	-0.1	155
2.5	0.23	2.04	94	-0.1	155
2.5	0.23	2.04	94	-0.1	155
2.5	0.23	2.04	94	-0.1	155
2.5	0.2	2.05	94	-0.1	155

Average
Values

SR(VP)=
0.4307

OP=
1.9050

TS(R')=
615

RESULTS

Percent moisture in stack gas (%) :	29.58
Wet Stack Gas Molecular Weight (Ms) :	26.3
Average Stack Pressure (Ps) (in Hg, mm Hg) :	29.39
Average Stack Gas Temperature (Ts) (R, K) :	615
Average Stack Velocity (Vs-avg) (ft/sec, m/sec) :	27.89
Actual Volumetric Flow Rate (Q) (acfm, acmm) :	18828.9
Standard Volumetric Flow Rate (Qstd) (scfm, scmm, dry) :	11183.0
Standard Volume Metered on DGM (Vmstd) (scf, scm, dry) :	44.408

CALCULATION OF PARTICULATE CONCENTRATION
AND EMISSION RATE RESULTS WITH EPA METHOD 5 DATA

RESULTS	PMRA Pollutant Mass Rate (lbs/hr) :	4.3731
	PMRC Pollutant Mass Rate (lbs/hr) :	4.62
	PMRA-PMRC Ave. Pollutant Mass Rate (lbs/hr) :	4.50
	Dry Catch Pollutant Mass Rate (g/hr) :	2094.16
	Total Catch Pollutant Mass Rate (g/hr) :	2094.16
	Dry Catch Concentration (grains/dscf, g/dscm) :	4.82E-02
	Total Catch Concentration (grains/dscf, g/dscm) :	4.82E-02
	Isokinetic Check (% I) :	94.7
	Oxygen-Based Emission Rate (ng/J, lb/million Btu) :	0.00E+00
	Carbon Dioxide-Based Emission Rate (ng/J, lb/million Btu) :	0.00E+00
	Emission Concentration, standard conditions dry (mmBtu/hr) :	0.00

CALCULATION OF PARTICULATE CONCENTRATION
AND EMISSION RATE RESULTS WITH EPA METHOD 5 DATA

Run Number: 3
Test Site: Appleton Asphalt
Test Date: 5/20/91

	DATA
All data are in: 1=metric, 2=English:	2
Area of stack (ft2 or m2):	11.25
Pitot tube calibration coefficient (Cp):	0.85
Barometric pressure (in. Hg or mm Hg):	29.4
Nozzle diameter (ft or m):	0.031
Dry stack gas molecular weight:	29.832
Initial Dry Gas Meter reading (ft3 or m3):	0
Final Dry Gas Meter reading (ft3 or m3):	45.39
Dry Gas Meter calibration factor (Y):	1.055
Total run time (min):	62.5

	DATA
Particulate weight in probe rinse (mg):	0
Particulate weight in filter catch (mg):	117.7
Particulate weight in impinger catch (mg):	0
Volume of Water Vapor Condensed (ml):	396
Water Vapor Collected in Silica Gel (mg):	0
Percent Oxygen in Stack by Volume (dry):	11.4
Percent Carbon Dioxide in Stack by Volume (dry):	8.6
Leak Rate Correction Factor Used? 1=yes, 2=no:	2
Heat Input(mmBtu/hr):	0

MEASURED DATA FROM TEST RUN no: 3

Run Time (min)	Pitot Delta p (in H2O, mm H2O)	Orifice Delta H (in H2O, mm H2O)	Average DGM Temp (F,C)	Static Pressure (in H2O, mm H2O)	Stack Temp (F,C)
2.5	0.22	2.25	109	-0.1	155
2.5	0.24	2.5	109	-0.1	155
2.5	0.24	2.5	109	-0.1	155
2.5	0.23	2.4	109	-0.1	155
2.5	0.19	1.95	109	-0.1	155
2.5	0.16	1.65	109	-0.1	155
2.5	0.16	1.65	109	-0.1	155
2.5	0.18	1.85	109	-0.1	155
2.5	0.18	1.85	109	-0.1	155
2.5	0.14	1.45	109	-0.1	155
2.5	0.16	1.65	109	-0.1	155
2.5	0.17	1.75	109	-0.1	155
2.5	0.17	1.75	109	-0.1	155
2.5	0.16	1.65	109	-0.1	155
2.5	0.13	1.35	109	-0.1	155
2.5	0.23	2.4	109	-0.1	155
2.5	0.24	2.5	109	-0.1	155
2.5	0.24	2.5	109	-0.1	155
2.5	0.22	2.25	109	-0.1	155
2.5	0.21	2.15	109	-0.1	155
2.5	0.18	1.85	109	-0.1	155
2.5	0.16	1.65	109	-0.1	155
2.5	0.15	1.55	109	-0.1	155
2.5	0.14	1.45	109	-0.1	155
2.5	0.12	1.25	109	-0.1	155

Average
Values

SR(VP)=
0.4310

OP=
1.9375

TS(R')=
615

RESULTS

Percent moisture in stack gas (%) :	29.78
Wet Stack Gas Molecular Weight (Ms) :	26.3
Average Stack Pressure (Ps) (in Hg, mm Hg) :	29.39
Average Stack Gas Temperature (Ts) (R, K) :	615
Average Stack Velocity (Vs-avg) (ft/sec, m/sec) :	27.93
Actual Volumetric Flow Rate (Q) (acfm, acmm) :	18854.3
Standard Volumetric Flow Rate (Qstd) (scfm, scmm, dry) :	11166.2
Standard Volume Metered on DGM (Vmstd) (scf, scm, dry) :	43.872

CALCULATION OF PARTICULATE CONCENTRATION
AND EMISSION RATE RESULTS WITH EPA METHOD 5 DATA

RESULTS	PMRA Pollutant Mass Rate (lbs/hr) :	3.7136
	PMRC Pollutant Mass Rate (lbs/hr) :	3.96
	PMRA-PMRC Ave. Pollutant Mass Rate (lbs/hr) :	3.84
	Dry Catch Pollutant Mass Rate (g/hr) :	1797.40
	Total Catch Pollutant Mass Rate (g/hr) :	1797.40
	Dry Catch Concentration (grains/dscf, g/dscm) :	4.14E-02
	Total Catch Concentration (grains/dscf, g/dscm) :	4.14E-02
	Isokinetic Check (% I) :	93.7
	Oxygen-Based Emission Rate (ng/J, lb/million Btu) :	0.00E+00
	Carbon Dioxide-Based Emission Rate (ng/J, lb/million Btu) :	0.00E+00
	Emission Concentration, standard conditions dry (mmBtu/hr) :	0.00

Date: June 18, 1991

File Ref: 4530

To: ~~Joe~~ Joe Perez - AM/10
Joydeb Bhattacharyya - AM/10

From: Dennis J. Verhaagh - LMD

Subject: Modification/Alteration of Permit No. 85 RV 012 issued
to Appleton Asphalt, Inc.
FID No. 999818160
Presently located at 2048 Scray Hill Road, Brown County
200 TPH @ 5% moisture removal ADM plant S/N DM116-85

Attached are the results of the stack testing of this plant on
May 20, 1991 for your review. I note that formaldehyde was not
included. I'd appreciate your comments.

RECEIVED

JUN 20 1991

BUREAU OF
AIR MANAGEMENT

SUMMARY

On May 20, 1991, Environmental Technology & Engineering Corporation personnel performed a stack emission test on the Appleton Asphalt, Inc. Green Bay asphalt plant located on Scray Hill in DePere, Wisconsin. The average of the three particulate tests show the emissions to be above the limit of 0.04 grains of particulate matter per dry standard cubic foot (gr/dscf) as specified by the State of Wisconsin Department of Natural Resources (DNR) by permit. The numerical test results are summarized below:

Test	Emissions	% of Allowable
1	0.051 gr/dscf	128 %
2	0.047	117
3	0.040	100
	-----	-----
AVG	0.046 gr/dscf	115 %

In addition, the permit also required testing for formaldehyde emissions. The following table presents the numerical results:

Test	LB/HR	LB/TON
1	0.11 lb/hr	0.0006 lb/ton
2	0.12	0.0007
3	0.10	0.0006
	-----	-----
AVG	0.11 lb/hr	0.0006 lb/ton

1.0 GENERAL

On Monday, May 20, 1991, Environmental Technology and Engineering Corporation personnel performed a stack emission test on the Appleton Asphalt, Inc. Green Asphalt drum mix asphalt plant located on Scray Hill Road in DePere, Wisconsin. The State of Wisconsin Department of Natural Resources (DNR) has established a particulate emission limit of 0.04 grains per dry standard cubic foot (gr/dscf). The purpose of this test was to demonstrate the compliance status of this plant with the particulate limits set by the DNR. In addition, the permit also required a test to determine the formaldehyde emissions.

The plant tested was an ADM drum mix asphalt plant equipped with a scrubber for particulate control. During the test period, the plant production rate was approximately 175 tons per hour and the mix was composed of approximately 70 % virgin material and 30 % recycled material. The plant was fired with no. 2 fuel oil. The field tests, corresponding laboratory analysis and report preparation were coordinated by Bill Dick of ETE Corp. The test procedures, plant operating conditions, and stack opacity were witnessed by Tom Erickson of the Wisconsin DNR Green Bay District Office.

The following sections of this report document the activities and results of the test program. The report presents all of the relevant data collected and discussions on the interpretation of the data are provided where appropriate. The report, therefore, includes much necessary detail. The results, however, have been summarized in the SUMMARY section at the beginning of this report for those readers not wishing to be burdened by the details.

2.0 RESULTS

2.1 Particulate Emissions

Isokinetic sampling for particulate matter was performed in accordance with the procedures outlined in EPA Method 5 - "Determination of Particulate Emissions from Stationary Sources" - as published in the Federal Register. A brief summary of this method is included in section 3.0 of this report. The tests were performed in the final discharge stack at the location shown in Figure 2-1. This same figure also depicts the location of the exact test points relative to the stack wall. The stack flow parameters recorded during testing and the weights of particulate collected were used to compute the emissions for each test of the three-test sequence. These data were then entered into a computer and printouts showing detailed results are included as Tables 2-1, 2-2, and 2-3.

The results of each of the three individual tests show the emissions to be above the limit of 0.04 grains of particulate matter per dry standard cubic foot (gr/dscf) as specified by the State of Wisconsin Department of Natural Resources (DNR). The numerical test results are summarized below:

Test	Emissions	% of Allowable
1	0.051 gr/dscf	128 %
2	0.047	117
3	0.040	100
	-----	-----
AVG	0.046 gr/dscf	115 %

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in .3720
 STACK AREA, sq ft = 11.250
 SAMPLING TIME PER POINT, min = 2.50
 NUMBER OF POINTS = 25
 GAS METER VOLUME, acf = 46.45
 WATER COLLECTED, ml = 457.00
 PARTICULATE COLLECTED, grams = 0.1528
 CO₂ = 8.40 O₂ = 11.00 CO = 0.00 N₂ = 80.60

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	155	0.190	2.15	80	28.33
2	155	0.190	2.15	81	28.33
3	155	0.200	2.25	82	29.06
4	155	0.200	2.25	82	29.06
5	155	0.190	2.15	83	28.33
6	155	0.160	1.80	86	26.00
7	155	0.180	2.00	87	27.57
8	155	0.180	2.00	88	27.57
9	155	0.140	1.60	89	24.32
10	155	0.140	1.60	90	24.32
11	155	0.170	1.70	92	26.80
12	155	0.170	1.70	93	26.80
13	155	0.180	1.80	93	27.57
14	155	0.180	1.80	94	27.57
15	155	0.100	1.05	95	20.55
16	155	0.230	2.35	97	31.17
17	155	0.230	2.35	97	31.17
18	155	0.230	2.35	98	31.17
19	155	0.210	2.15	98	29.78
20	155	0.200	2.00	98	29.06
21	155	0.170	1.70	98	26.80
22	150	0.170	1.70	89	26.69
23	150	0.150	1.55	90	25.07
24	155	0.150	1.55	80	25.17
25	155	0.120	1.25	80	22.51
AVG VALUES	155		1.884	90	27.23

TOTAL GAS WITHDRAWN, scf = 67.84
 DRY GAS WITHDRAWN, scf = 46.33
 WATER VAPOR WITHDRAWN, scf = 21.51
 PERCENT WATER VAPOR = 31.71
 ACTUAL WET FLOW RATE, acfm = 18,380.90
 STANDARD DRY FLOW RATE, scfm = 10,594.07
 , m³/hr = 18,001.44
 PARTICULATE CONCENTRATION, grains/dscf = 0.051
 PARTICULATE EMISSIONS, lb/1000 lb wet gas = 0.075
 PARTICULATE EMISSION RATE, lb/hr = 4.72
 FORMALDEHYDE CONCENTRATION, mg/m³ = 2.77
 FORMALDEHYDE EMISSION RATE, lb/hr = 0.11
 PERCENT OF ISOKINETIC SAMPLING = 104.32

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in = .3720
 STACK AREA, sq ft = 11.250
 SAMPLING TIME PER POINT, min = 2.50
 NUMBER OF POINTS = 25
 GAS METER VOLUME, acf = 45.60
 WATER COLLECTED, ml = 457.00
 PARTICULATE COLLECTED, grams = 0.1386
 CO₂ = 8.80 O₂ = 11.00 CO = 0.00 N₂ = 80.20

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	155	0.170	1.75	82	26.80
2	155	0.160	1.65	83	26.00
3	155	0.150	1.55	84	25.17
4	155	0.150	1.55	84	25.17
5	155	0.120	1.25	84	22.51
6	155	0.240	2.50	88	31.84
7	155	0.240	2.50	90	31.84
8	155	0.240	2.50	91	31.84
9	155	0.230	2.40	91	31.17
10	155	0.230	2.40	91	31.17
11	155	0.170	1.75	95	26.80
12	155	0.160	1.65	96	26.00
13	155	0.150	1.55	97	25.17
14	155	0.150	1.55	98	25.17
15	155	0.110	1.15	100	21.56
16	155	0.230	2.40	102	31.17
17	150	0.180	1.85	82	27.46
18	150	0.180	1.85	96	27.46
19	155	0.160	1.65	97	26.00
20	155	0.160	1.65	98	26.00
21	155	0.240	2.50	101	31.84
22	155	0.230	2.40	102	31.17
23	155	0.230	2.40	102	31.17
24	155	0.230	2.40	103	31.17
25	155	0.200	2.05	103	29.07
AVG VALUES	155		1.954	94	28.03

TOTAL GAS WITHDRAWN, scf = 67.03
 DRY GAS WITHDRAWN, scf = 45.51
 WATER VAPOR WITHDRAWN, scf = 21.51
 PERCENT WATER VAPOR = 32.09
 ACTUAL WET FLOW RATE, acfm = 18,919.65
 STANDARD DRY FLOW RATE, scfm = 10,842.78
 , m³/hr = 18,424.04
 PARTICULATE CONCENTRATION, grains/dscf = 0.047
 PARTICULATE EMISSIONS, lb/1000 lb wet gas = 0.067
 PARTICULATE EMISSION RATE, lb/hr = 4.37
 FORMALDEHYDE CONCENTRATION, mg/m³ = 2.85
 FORMALDEHYDE EMISSION RATE, lb/hr = 0.12
 PERCENT OF ISOKINETIC SAMPLING = 100.12

2.2 Formaldehyde Emissions

The formaldehyde emissions were determined concurrently with the particulate and opacity observations using NIOSH Method 3500. A brief description of the method is included in section 3.0 of this report. The numerical results are presented below:

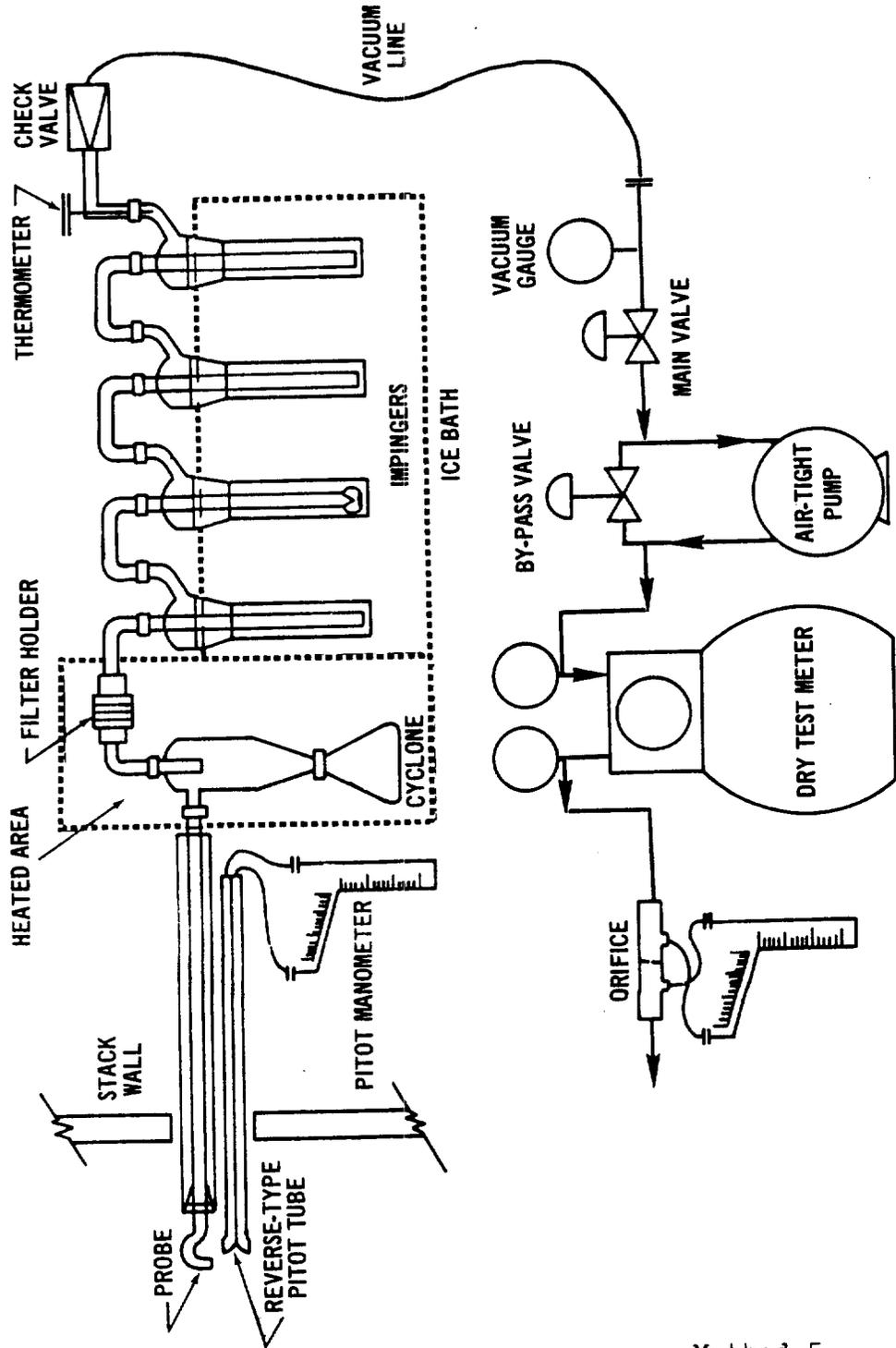
Test	LB/HR	LB/TON
1	0.11 lb/hr	0.0006 lb/ton
2	0.12	0.0007
3	0.10	0.0006
	-----	-----
AVG	0.11 lb/hr	0.0006 lb/ton

3.0 METHOD OF TEST

3.1 Particulate Matter

The equipment used to sample was the Western Precipitation Division of the Joy Manufacturing Company Emission Parameter Analyzer. Samples were collected and analyzed in accordance with procedures outlined in 40 CFR 60 Appendix A, Method 5 - Determination of Particulate Emissions from Stationary Sources.

The sampling train consisted of a stainless steel probe tip, a heated stainless steel lined probe, a glass cyclone and flask, and a heated 125 millimeter Whatman 934-AH fiberglass filter. A series of four impingers followed in an ice bath. The first was a modified Greenburg-Smith impinger with 100 ml of distilled water; the second was a Greenburg-Smith impinger with 100 ml water; the third was a modified Greenburg-Smith impinger dry; the fourth was also a modified Greenburg-Smith impinger containing a tared quantity of silica gel. The gas then passed through a vacuum pump, calibrated dry gas meter, and a calibrated orifice. A schematic drawing of the sampling train is included.



Method 5

Particulate sampling train.

The temperatures at strategic locations within the sampling devices, were monitored by RTDs and read directly from a gauge on the control unit.

The initial gas stream velocity was obtained from a preliminary traverse using an "S" type pitot tube. The initial moisture was estimated from previous tests of similar processes. This data, along with the stack temperature, was used to set a nomograph so that rapid calculations of isokinetic sampling conditions could be made.

The principle of the method was to collect the sample representative of the exhaust by adjusting the sample collection velocity to match the exhaust gas stream velocity at the point of collection. The velocity at the point of collection was measured with an "S" type pitot tube attached to the probe and the collection velocity was matched to the stack gas velocity by adjusting the flow as indicated by the calibrated orifice.

To determine the molecular weight of the stack gas, samples were drawn into an Orsat analyzer and analyzed for percentage CO₂, O₂, CO, and N₂.

At the completion of the test, the probe tip preceding the filter was washed with acetone which was placed in a tared beaker and evaporated to dryness at room temperature. The filter and beaker were then desiccated to the tared humidity conditions and weighed. The impinger contents were measured and weighed for determination of the actual moisture content of the exhaust gas stream.

The combined weight of the filter catch and the probe tip washing residue was used to determine the particulate emission rates.

A computer was used to calculate the stack velocities, emission concentrations, emission rates and volumetric flow rates using the field and laboratory data.

3.2 Formaldehyde

The sampling and analysis were performed using procedures outlined in NIOSH Method 3500, the method accepted by the Wisconsin Department of Natural Resources for determining formaldehyde emissions.

Sampling was performed by drawing a known quantity of stack exhaust through appropriate sampling media by means of a battery operated pump. The media consisted of a train of three midget impingers; each contained 15 milliliters of a one percent sodium bisulfite solution and were followed by a water trap. The impingers were set in an ice water bath to accommodate the temperature of the gas stream sampled. The sampling volumes were determined through the use of a calibrated dry gas meter.

Following the sampling, the samples were sealed and brought back to the lab for analysis. The samples were analyzed via colorimetric methods as described in the NIOSH procedures. Each impinger was analyzed separately to insure the complete absorption of all formaldehyde in the solution.

4.0 CALIBRATIONS

The probe tip, pitot tube, dry gas meter, and orifice were calibrated prior to the test according to procedures outlined in the Maintenance, Calibration, and Operation of Kinetic Source Sampling Equipment as published by the EPA. The values obtained were:

Probe tip diameter	d = 0.372"
Pitot tube coeff.	Cp = 0.85
Orifice coeff.	dHQ = 1.712

The dry gas meter presently installed in the control box is a temperature compensating meter. The correction factor for this dry gas meter is represented by:

$$\text{Gama} = 1.008 + (\text{Td} - 70) \times .00012$$

where: Td = Dry Gas Meter Temperature

The most recent calibration was performed May 13, 1991.

APPENDIX A

FIELD & LABORATORY DATA SHEETS

May 20, 1991

STACK TEST LOG

ADM PLANT - GREEN BAY - 999818160

FUEL #2

J.P.M.

TEST #1

TIME	AGG TPH	ASPH. TPH	RECYCLE T.P.H.	
915	130	6.2	46	182.2
925	131	6.2	48	186.2
935	133	6.6	45	184.6
945	136	6.6	43	185.6
955	133	6.4	42	181.4
1005	134	6.4	45	182.4
1010	133	6.4	41	180.4
1105	132	6.2	42	180.2

~~1115~~

TEST #2

1215	128	6.0	40	174.0	AVG 181.8
1245	115	5.8	52	172.8	
1255	118	5.9	55	178.9	3 3/8
105	116	6.0	53	175	
115	114	5.8	54	175.8	3 3/8
125	114	5.9	55	174.9	
225	116	6.0	52	174	3 3/8
235	117	6.1	52	175.1	
245	115	5.9	53	178.9	3 1/2
255			AVG	175.1	

TEST #3

<u>TIME</u>	<u>AGG.</u> <u>TPH</u>	<u>Asph</u> <u>TPH</u>	<u>Recycle</u> <u>TPH</u>		
3:30	116	5.7	52	173.9	3 $\frac{2}{F}$
340	117	5.9	51	173.9	
350	115	6.0	53	174	3 $\frac{2}{F}$
400	115	6.1	54	175.1	
410	116	6.0	53	175	3 $\frac{2}{F}$
450	117	6.0	53	176	
500	113	5.8	51	169.7	3 $\frac{2}{F}$
510	115	5.9	54	174.9	
520	114	5.8	53	172.8	3 $\frac{2}{F}$
530	116	5.9	52	<u>173.9</u>	
			Avg	173.9	

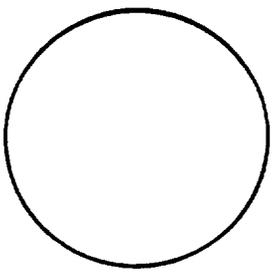
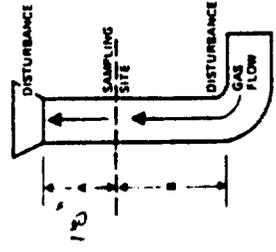
ROD
DRY
PROBE - BINDER

ELEVATION 1005-1100

Sp. 0.85 }
1.008 } 5-13-91
METER ΔH: 1.712

PARTICULATE FIELD DATA

PLANT SILICON BAR AMBIENT TEMPERATURE 70
 DATE 5-20-91 BAROMETRIC PRESSURE _____
 LOCATION GREEN BAR ASSUMED MOISTURE, % SAT
 OPERATOR WJD PROBE LENGTH, in. 3'5"
 STACK NO. 1 NOZZLE DIAMETER, in. 3/8
 RUN NO. _____ STACK DIAMETER, in. 60 X 27
 SAMPLE BOX NO. _____ PROBE HEATER SETTING 250
 _____ HEATER BOX SETTING 250



CROSS SECTION

C FACTOR _____ PROCESS WEIGHT RATE ~175 TPH
 ORSAT RESULTS
 CO2 8.4
 CO 0.1
 N2 80.6
 POST LKMC POST LKMC
 POST LKMC POST LKMC

TRAVERSE POINT NUMBER	SAMPLING TIME (a), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p), (ft/s) ²	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H ₂ O	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING OR CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY ft/s
							INLET (T _{m,IN}), °F	OUTLET (T _{m,OUT}), °F				
A 1	091500		155	.19	2.15	3221.00	80	149.32	75		3	
2	11		155	.19	2.15	73.1	81					
3	20	-10	155	.20	2.25	25.2	82					
4	22		155	.20	2.25	27.2	82					
5	25		155	.19	2.15	29.2	83					
6	27/29		155	.16	1.80	31.2	86					
7	31	-10	155	.18	2.00	33.0	87					
8	34		155	.18	2.00	54.9	88					
9	36		155	.14	1.60	36.7	89					
10	39		155	.14	1.60	38.5	90					
B 11	41/45		155	.17	1.70	40.3	92					
12	45		155	.17	1.70	62.0	93					
13	48	-10	155	.18	1.80	93.7	93					
14	51		155	.18	1.80	45.6	94					
15	55		155	.10	1.05	97.4	95					
E 16	55/51		155	.25	2.55	48.8	97					
17	59		155	.25	2.55	50.8	97					
18	02	-10	155	.25	2.55	53.0	98					
19	04		155	.21	2.15	55.0	98					
20	07		155	.20	2.05	56.9	98					
C 21	05/11		155	.17	1.75	58.8	326.7	98				
22	13/04	-10	150	.17	1.75	60.9	89					
23	06		150	.15	1.55	62.4	90					151.22/81
24	09/17		155	.15	1.55	64.18	90					7.50/73

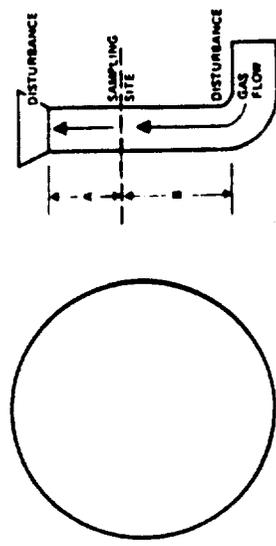
DOWN 1524-1400

PARTICULATE FIELD DATA

PLANT GREENSBAY ASPHALT METER ΔH _____
 DATE 5-20-91 AMBIENT TEMPERATURE 70 C FACTOR _____
 LOCATION GREENSBAY BAROMETRIC PRESSURE _____
 OPERATOR WJD/CJH ASSUMED MOISTURE, % 5AT
 STACK NO. 1 PROBE LENGTH, in. 38
 RUN NO. 2 NOZZLE DIAMETER, in. 60x07
 SAMPLE BOX NO. 2 STACK DIAMETER, in. 750
 METER BOX NO. 1 PROBE HEATER SETTING 250
 HEATER BOX SETTING 250

PROCESS WEIGHT RATE _____
 ORSAT RESULTS
 CO₂ 8.8
 CO 02 11.0
 N₂ 80.2
 PRELUDE IN POST HEATER
 P. INFLUENCE POST HEATER

SCHEMATIC OF STACK



CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p) (V _{sp})	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H ₂ O ACTUAL DESIRED	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER (F)	PUMP VACUUM (in. Hg gauge)	VELOCITY (fps)
							INLET (T _{m in}), °F	OUTLET (T _{m out}), °F			
C 1	184500		155	.17	1.75	329.00	82	151.80/82			
2	424	-10	155	.16	1.65	70.8	83				
3	45		155	.15	1.55	72.6	84				
4	414		155	.15	1.55	74.3	84				
5	50		155	.12	1.25	75.7	84				
E 6	504/54		155	.24	2.30	77.4	88				
7	504		155	.20	2.30	79.0	90				
8	57	-10	155	.14	1.50	81.6	91				
9	014		155	.23	2.40	83.7	91				
10	04		155	.23	2.40	83.7	91				
B 11	04/02		157	.17	1.75	87.7	95				
12	104	-10	155	.16	1.65	89.5	96				
13	13		155	.15	1.55	91.2	97				
14	154		155	.15	1.55	92.7	98				
15	18		155	.11	1.15	94.4	100				
D 16	201/22		151	.23	2.60	95.8	102				
17	204/22		150	.18	1.85	97.0	82				
18	204	-10	150	.18	1.85	95.0	96				
19	21		155	.14	1.65	01.4	97				
20	244		155	.16	1.61	03.1	98				
A 21	32/30		151	.24	2.50	01.6	101				
22	304	-10	155	.23	2.60	06.8	102				
23	39		155	.23	2.40	08.8	102				
24	014		155	.23	2.40	10.2	105				

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME Green Bay Asphalt

DATE OF TEST 5-20-91

JOB NO. 1359

TEST ENGINEER WJD

RUN NO. 1 STACK Scrubber

Sample Box 1 Filter 1403

Wash Bottle —

Beaker No. 7

WATER COLLECTED

<u>Impinger No.</u>	<u>Final Wt. g</u>	<u>Initial Wt. g</u>	<u>Collected grams</u>
<u>1</u>	<u>258</u>	<u>100</u>	<u>158</u>
<u>2</u>	<u>252</u>	<u>100</u>	<u>152</u>
<u>3</u>	<u>117</u>	<u>0</u>	<u>117</u>
<u>SIL GEL</u>	<u>690</u>	<u>660</u>	<u>30</u>
		TOTAL	<u><u>457</u></u>

PARTICULATE COLLECTED

	<u>Final Wt. g</u>	<u>Tare Wt. g</u>	<u>Collected grams</u>
<u>Blank</u>			
Filter	<u>0.5754</u>	<u>0.7723</u>	<u>0.1211</u>
Washings (.0002)	<u>93.9217</u>	<u>93.8898</u>	<u>0.0317</u>
		TOTAL	<u><u>0.1528</u></u>

WATER COLLECTED 457 GRAMS

PARTICULATE COLLECTED 0.1528 GRAMS

.051 gr/dust

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME GREEN BAY ASPHALT

DATE OF TEST 5-20-91

JOB NO. 91-1359

TEST ENGINEER WJD/CSH

RUN NO. 2 STACK SCRUBBER

Sample Box 2 Filter 1404

Wash Bottle _____

Beaker No. 18

WATER COLLECTED

<u>Impinger No.</u>	<u>Final Wt. g</u>	<u>Initial Wt. g</u>	<u>Collected grams</u>
<u>1</u>	<u>249</u>	<u>100</u>	<u>149</u>
<u>2</u>	<u>242</u>	<u>100</u>	<u>142</u>
<u>3</u>	<u>148</u>	<u>-</u>	<u>148</u>
<u>SIL GR</u>	<u>666</u>	<u>648</u>	<u>18</u>
		TOTAL	<u><u>457</u></u>

PARTICULATE COLLECTED

	<u>Final Wt. g</u>	<u>Tare Wt. g</u>	<u>Collected grams</u>
<u>Blank</u>			
Filter	<u>0.8843</u>	<u>0.7773</u>	<u>0.1070</u>
Washings (0002)	<u>93.3438</u>	<u>93.3120</u>	<u>0.0316</u>
		TOTAL	<u><u>0.1386</u></u>

WATER COLLECTED 457 GRAMS

PARTICULATE COLLECTED 0.1386 GRAMS

0.047 gr/dscf

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME GREEN BAY ASPHALT

DATE OF TEST 5-20-91

JOB NO. 91-1359

TEST ENGINEER WJD/CSH

RUN NO. 3 STACK SCRUBBER

Sample Box 3 Filter 1402

Wash Bottle _____

Beaker No. 10

WATER COLLECTED

<u>Impinger No.</u>	<u>Final Wt. g</u>	<u>Initial Wt. g</u>	<u>Collected grams</u>
<u>1</u>	<u>282</u>	<u>100</u>	<u>182</u>
<u>2</u>	<u>202</u>	<u>100</u>	<u>102</u>
<u>3</u>	<u>140</u>	<u>-</u>	<u>140</u>
<u>Sil Gel</u>	<u>702</u>	<u>672</u>	<u>30</u>
		TOTAL	<u><u>454</u></u>

PARTICULATE COLLECTED

	<u>Final Wt. g</u>	<u>Tare Wt. g</u>	<u>Collected grams</u>
<u>Blank</u>			
Filter	<u>0.8800</u>	<u>0.7760</u>	<u>0.1040</u>
Washings (0.0002)	<u>104.2580</u>	<u>104.2441</u>	<u>0.0137</u>
		TOTAL	<u><u>0.1177</u></u>

WATER COLLECTED 454 GRAMS

PARTICULATE COLLECTED 0.1177 GRAMS

0.040 gr/dscf

NOTES:

APPENDIX B

SAMPLE CALCULATIONS.

SAMPLE CALCULATION

BAROMETRIC PRESSURE, in Hg (Pb) = 29.200
 STACK PRESSURE, in Hg (Pb + Pg/13.6) = 29.178
 TIP DIAMETER, in (An = PI*D^2/576) = .2450
 STACK AREA, sq ft (A) = 10.560
 SAMPLING TIME PER POINT, min = 2.50
 NUMBER OF POINTS = 24
 GAS METER VOLUME, acf (Vm) = 66.06
 WATER COLLECTED, ml (Vf - Vi) = 86.00
 PARTICULATE COLLECTED, grams (Mn) = 0.0755
 CO2 = 0.60 O2 = 21.00 CO = 0.00 N2 = 78.40
 WET MOLECULAR WEIGHT, lb/mole (Ms) = 28.45

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE DEL H inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	110	1.450	4.05	32	72.51
2	110	1.350	3.75	32	69.97
3	110	1.350	3.75	32	69.97
4	110	1.300	3.70	32	68.66
5	110	1.250	3.60	32	67.33
6	110	1.250	3.60	32	67.33
7	110	1.050	2.95	32	61.71
8	110	1.000	2.85	32	60.22
9	110	1.000	2.85	34	60.22
10	110	1.050	2.95	34	61.71
11	110	0.950	2.75	38	58.69
12	115	0.950	2.75	38	58.95
13	115	1.300	3.70	42	68.96
14	115	1.250	3.60	42	67.62
15	115	1.200	3.40	42	66.26
16	115	1.200	3.40	42	66.26
17	115	1.150	3.30	44	64.86
18	115	1.150	3.30	46	64.86
19	115	1.050	2.95	48	61.98
20	115	1.150	3.30	48	64.86
21	115	1.000	2.85	50	60.48
22	115	1.100	3.15	50	63.43
23	115	1.050	2.95	50	61.98
24	115	0.900	2.55	50	57.38
AVG VALUES	113		3.250	40	64.42

TOTAL GAS WITHDRAWN, scf = 69.39
 DRY GAS WITHDRAWN, scf (Vmstd) = 65.35
 WATER VAPOR WITHDRAWN, scf (Vwstd) = 4.05
 PERCENT WATER VAPOR (%H2O) = 5.83
 ACTUAL WET FLOW RATE, acfm = 40,819.39
 STANDARD DRY FLOW RATE, scfm (Qs) = 34,558.69
 PARTICULATE CONCENTRATION, grains/dscf (Cs) = 0.018
 PARTICULATE EMISSION RATE, lb/hr (ER) = 5.325
 PARTICULATE EMISSIONS, lb/1000 lb (EC) = 0.033
 PERCENT OF ISOKINETIC SAMPLING (I) = 101.67

SAMPLE CALCULATIONS

1. DRY MOLECULAR WEIGHT (Md) lb/lb-mole

$$Md = .44\% \text{ CO}_2 + .32\% \text{ O}_2 + .282\% \text{ N}_2 + .28\% \text{ CO}$$

2. WATER VAPOR PERCENT (%H₂O)

$$V_w \text{ std} = 0.04707 \cdot (V_f - V_i)$$

where: $V_w \text{ std}$ = standard cubic feet of water vapor
 V_f = Final volume of impingers, ml
 V_i = Initial volume of impingers, ml

$$\% \text{H}_2\text{O} = V_w \text{ std} \cdot 100 / (V_m \text{ std} + V_w \text{ std})$$

where $V_m \text{ std}$ = standard cubic feet of gas sampled

3. WET MOLECULAR WEIGHT (Ms) lb/lb-mole

$$Ms = Md \cdot (1 - \% \text{H}_2\text{O} / 100) + 18 \cdot \% \text{H}_2\text{O} / 100$$

4. STACK PRESSURE (Ps) in. Hg

$$Ps = Pb + Pg / 13.6$$

where: Pb = barometric pressure (uncorrected), in. Hg
 Pg = stack gauge pressure, in. H₂O
13.6 = specific gravity of mercury (Hg)

5. AVERAGE STACK VELOCITY (Vs) feet per second

$$Vs = K_p \cdot C_p \cdot (\text{DEL P})^{.5} / T_{s \text{ avg}} \cdot (Ps \cdot Ms)$$

where: K_p = 85.49 unit conversion
 C_p = 0.85, pitot tube calibration factor
DEL P = square root of velocity head, in. H₂O
 $T_{s \text{ avg}}$ = average stack temperature, deg R (460+F)
 Ps = stack pressure
 Ms = wet molecular weight

6. STACK GAS FLOW RATE (Qs) std cubic feet per minute

$$Qs = 60 \cdot (1 - \% \text{H}_2\text{O} / 100) \cdot Vs \cdot A \cdot (528 \cdot Ps / T_{s \text{ avg}} / 29.92)$$

where: A = stack area, ft²
528 = std temperature, deg R
29.92 = std pressure, in. Hg

7. DRY GAS VOLUME (Vm std) std cubic feet

$$V_m \text{ std} = GAMA * (V_m - (AL - .02)t) * (P_b + DELH/13.6) / 29.92$$

where: GAMA = dry gas meter calibration factor
Vm = volume of dry gas metered, cubic feet
AL = post test leak rate, cubic feet per minute
t = total time of test, minutes
DELH = average orifice pressure drop, in.H2O

8. PARTICULATE CONCENTRATION (Cs) grains/dry std cubic foot

$$C_s = M_n * 15.43 / V_m \text{ std}$$

where: Mn = particulate captured, grams
15.43 = grains per gram

9. EMISSION RATE (ER) pounds per hour

$$PMRA = M_n * A * 60 / (t * A_n * 453.6) \quad \text{AREA METHOD lb/hr}$$

$$PMRC = C_s * Q_s * 60 / (15.43 * 453.6) \quad \text{CONC. METHOD lb/hr}$$

$$ER = (PMRA + PMRC) / 2$$

where: An = area of sampling nozzle, square feet

10. EMISSION CONCENTRATION (EC) lb/1000 lb exhaust gas

$$EC = ER * 38000 * (1 - \%H_2O/100) / (Q_s * 60 * M_s)$$

where: 38000 = lb mole * 1000

11. ISOKINETIC SAMPLING PERCENTAGE (I) %

$$I = PMRA / PMRC$$

GREEN BAY ASPHALT FORMALDEHYDE CALCULATIONS

TEST 1 $V_m = 2.50 \text{ ft}^3$ $z = 1.070$
181.8 TPH $T_m = 79^\circ\text{F}$

$$V_{m \text{ std}} = 2.50 * 1.070 * \frac{528}{538} = \frac{79.4}{29.92}$$

$$= 2.46 \text{ scf} = .07832 \cdot .070 \text{ m}^3$$

$$C = \frac{.194 \text{ mg}}{.070 \text{ m}^3} = 2.77 \text{ mg/m}^3$$

$$\text{ER} = 0.11 \text{ lb/hr.}$$
$$= .0006 \text{ lb/ton}$$

TEST 2 $V_m = 2.50$
175.1 TPH $T_m = 84^\circ\text{F}$

$$V_{m \text{ std}} = 2.43 \text{ scf} = .069 \text{ m}^3$$

$$C = \frac{.197}{.069} = 2.85 \text{ mg/m}^3$$

$$\text{ER} = 0.12 \text{ lb/hr.}$$
$$.0007 \text{ lb/ton}$$

TEST 3 $V_m = 2.00$
173.9 TPH $T_m = 84^\circ\text{F}$

$$V_{m \text{ std}} = 1.95 \text{ scf} = .055 \text{ m}^3$$

$$C = \frac{.143}{.055} = 2.60 \text{ mg/m}^3$$

$$\text{ER} = 0.10 \text{ lb/hr.}$$
$$= .0006 \text{ TPH}$$