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.

AP42 Section: 11.1

Reference Number: 372

Title: Stack Emission Test, Payne and Dolan, Inc., Control 8 Plant, Cedar Lake, WI,

Environmental Technology and Engineering Corporation, Elm Grove, WI,

August 14, 1997.

Sec. 11.1
Ref. 372

SO2

Report to

PAYNE & DOLAN, INC.
Waukesha, Wisconsin

for

STACK EMISSION TEST
CONTROL 8 PLANT
WDNR FID NO. 998215240

August 14, 1997

by

ENVIRONMENTAL TECHNOLOGY & ENGINEERING CORPORATION
13000 West Bluemound Road
Elm Grove, Wisconsin 53122
Phone 414-784-2434
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ETE

SUMMARY

On August 14, 1997, Environmental Technology & Engineering Corp. personnel performed stack emissions testing at the Payne & Dolan, Inc. Control 8 Plant located in Cedar Lake, Wisconsin. The tests were performed as a provision of a new Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources. Tests were performed in order to determine compliance with the applicable particulate emission limitation. Formaldehyde testing was performed as a condition of a BACT requirement for the plant. Additional tests were performed to determine plant specific emission factors for sulfur dioxide. All measured particulate emissions were well below the limits shown in the following table:

TEST NO.	PARTICULATE	FORMALDEHYDE	SULFUR DIOXIDE
1	0.005 gr/dscf	5.25 lb/hr	2.65 lb/hr
2	0.004	4.34	2.14
3	0.005	2.65	2.15
AVERAGE	0.005 gr/dscf	4.08 lb/hr	2.31 lb/hr
DNR LIMIT	0.039	NA	NA
% OF LIMIT	12.0 %	NA	NA

1.0 GENERAL

On August 14, 1997, Environmental Technology & Engineering Corp. (ETE) personnel performed stack emissions testing at the Payne & Dolan, Inc. Control 8 plant located in Cedar Lake, Wisconsin. The purpose of the testing was to determine the particulate emissions from the plant as a condition of a new Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources (WDNR). The facility Identification Number (FID) for this plant is 998215240. Formaldehyde testing was also performed as a condition of a BACT requirement for the plant. Sulfur dioxide testing was also performed at this time.

Pete Tolsma of Payne & Dolan was responsible for assuring proper operating conditions throughout the testing. During the test the plant production rate was approximately 287 tons per hour and included approximately 25 % recycled asphalt. The plant was fired with drain oil. A log of plant activity throughout the test was kept and is included in the APPENDIX. All testing was coordinated with the plant operator. Mike Griffin of the DNR was notified of the tests witnessed the field testing, plant operation, and stack opacity. The field tests, corresponding laboratory analysis, and report preparation were performed by ETE personnel; Bill Dick was the test team leader.

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

2.0 RESULTS

Isokinetic sampling for particulate matter was performed in accordance with the procedures outlined in EPA Method 17. Formaldehyde testing was performed using non-isokinetic method 0011. Sulfur dioxide samples were collected and analyzed in accordance with EPA Method 6. A brief summary of the methods 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. Detailed results of the testing to determine particulate matter emissions are shown in Tables 2-1 through 2-3. All results were well below the permit limits. The results are summarized below:

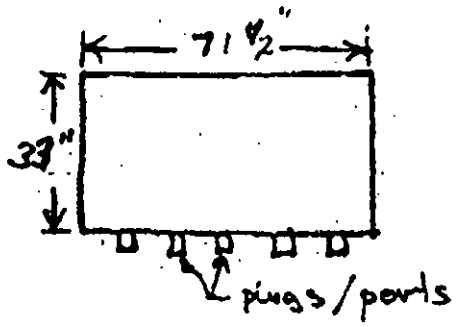
TEST NO.	PARTICULATE	FORMALDEHYDE	SULFUR DIOXIDE
1	0.005 gr/dscf	5.25 lb/hr	2.65 lb/hr
2	0.004	4.34	2.14
3	0.005	2.65	2.15
AVERAGE	0.005 gr/dscf	4.08 lb/hr	2.31 lb/hr
DNR LIMIT	0.039	NA	NA
% OF LIMIT	12.0 %	NA	NA

Payne & Dolan

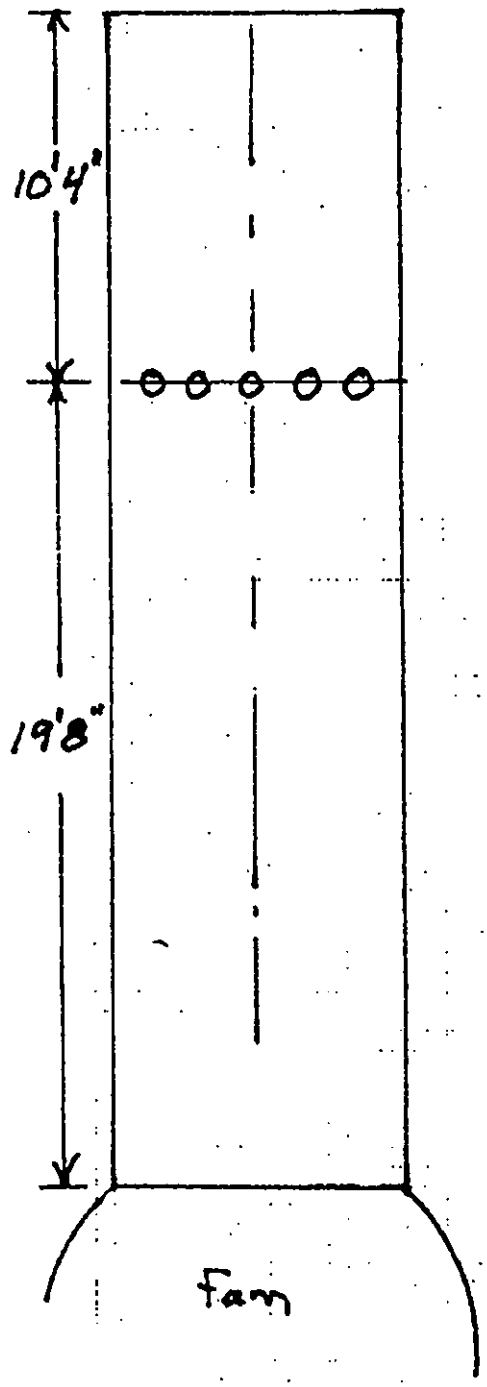
Control B - Cedar Lake HMA

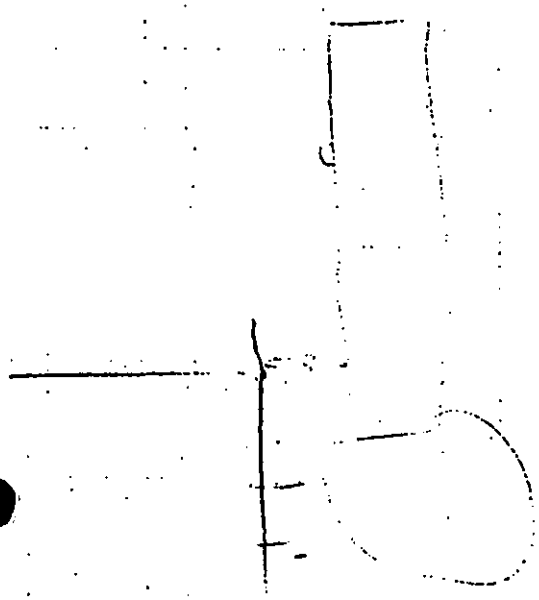
FID 998 215 240

(414) 644-6011



Stack Dimensions





PAYNE & DOLAN 14-Aug-97 CONTROL 8 TABLE 2-1

TEST NO.	1			
BAROMETRIC PRESSURE	29.25	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	71.5	IN	33	IN
STACK AREA	16.385	FT3		
SAMPLING TIME PER POINT	2.5	MIN		
NUMBER OF POINTS	25			
METER VOLUME	45.35	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.004			
PARTICULATE COLLECTED	0.0151	GRAMS		
WATER COLLECTED	267	ML		
STATIC PRESSURE	-1.10	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.20%	15.80%	0.00%	80.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	275	0.90	1.68	71	66.02
2	275	1.30	2.40	76	79.35
3	276	2.10	3.88	77	100.92
4	276	2.50	4.62	78	110.11
5	276	2.50	4.62	79	110.11
6	277	0.80	1.48	79	62.33
7	277	1.10	2.04	80	73.09
8	275	1.60	2.96	81	88.03
9	275	2.30	4.25	83	105.55
10	276	2.40	4.47	85	107.89
11	276	0.60	1.12	87	53.94
12	275	0.90	1.68	88	66.02
13	276	1.20	2.22	89	76.29
14	276	1.50	2.78	90	85.29
15	277	1.60	2.96	90	88.15
16	277	0.40	0.75	90	44.08
17	277	0.55	1.02	92	51.68
18	278	0.50	0.93	94	49.31
19	278	0.50	0.93	96	49.31
20	278	0.40	0.75	98	44.11
21	277	0.30	0.56	99	38.17
22	276	0.30	0.56	99	38.14
23	276	0.25	0.46	99	34.82
24	275	0.25	0.46	100	34.80
25	275	0.20	0.37	100	31.12
AVERAGE	276		2.00	88	67.55

DRY STANDARD VOLUME	44.83	SCF
PERCENT WATER VAPOR	21.90	% VOL
FLOW RATE	66406	ACFM
	36265	DSCFM
	61621	M3/HR
PARTICULATE CONCENTRATION	0.005	GR/DSCF
PARTICULATE EMISSION RATE	1.61	LB/HR
LB PART PER 1000 LB GAS	0.008	
ISOKINETIC PERCENT	99.0	

PAYNE & DOLAN 14-Aug-97 CONTROL 8 TABLE 2-2

TEST NO.	2			
BAROMETRIC PRESSURE	29.25	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	71.5	IN	33	IN
STACK AREA	16.385	FT3		
SAMPLING TIME PER POINT	2.5	MIN		
NUMBER OF POINTS	25			
METER VOLUME	45.45	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.004			
PARTICULATE COLLECTED	0.0115	GRAMS		
WATER COLLECTED	286	ML		
STATIC PRESSURE	-1.10	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.40%	15.20%	0.00%	80.40%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	270	0.90	1.68	90	65.95
2	270	1.40	2.59	91	82.25
3	270	2.10	3.89	91	100.74
4	270	2.50	4.62	92	109.92
5	270	2.50	4.62	92	109.92
6	272	0.70	1.30	92	58.24
7	272	0.90	1.68	92	66.04
8	273	1.30	2.40	93	79.43
9	276	2.00	3.70	93	98.72
10	276	2.40	4.47	92	108.14
11	278	0.70	1.30	93	58.48
12	278	0.80	1.48	92	62.52
13	277	1.20	2.22	93	76.52
14	277	1.50	2.78	93	85.55
15	273	1.50	2.78	92	85.32
16	272	0.40	0.75	93	44.03
17	272	0.50	0.93	93	49.22
18	273	0.60	1.12	94	53.96
19	274	0.60	1.12	96	54.00
20	274	0.60	1.12	96	54.00
21	273	0.30	0.56	98	38.15
22	275	0.35	0.65	100	41.27
23	275	0.35	0.65	104	41.27
24	265	0.30	0.56	90	37.95
25	270	0.25	0.46	91	34.76
AVERAGE	273		1.98	93	67.85

DRY STANDARD VOLUME	44.96	SCF
PERCENT WATER VAPOR	23.04	% VOL
FLOW RATE	66708	ACFM
	36051	DSCFM
	61257	M3/HR
PARTICULATE CONCENTRATION	0.004	GR/DSCF
PARTICULATE EMISSION RATE	1.22	LB/HR
LB PART PER 1000 LB GAS	0.006	
ISOKINETIC PERCENT	99.9	

PAYNE & DOLAN 14-Aug-97 CONTROL 8 TABLE 2-3

TEST NO.	3			
BAROMETRIC PRESSURE	29.25	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	71.5	IN	33	IN
STACK AREA	16.385	FT3		
SAMPLING TIME PER POINT	2.5	MIN		
NUMBER OF POINTS	25			
METER VOLUME	45.63	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.004			
PARTICULATE COLLECTED	0.0140	GRAMS		
WATER COLLECTED	299	ML		
STATIC PRESSURE	-1.00	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.60%	15.10%	0.00%	80.30%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	280	0.90	1.68	90	66.47
2	280	1.40	2.59	88	82.90
3	281	2.20	4.07	90	103.99
4	282	2.50	4.62	91	110.93
5	282	2.60	4.80	91	113.13
6	282	0.70	1.30	92	58.70
7	282	1.10	2.03	93	73.58
8	265	1.40	2.59	90	82.06
9	265	2.10	3.88	90	100.50
10	267	2.30	4.25	91	105.32
11	270	0.60	1.11	91	53.90
12	274	0.85	1.58	92	64.33
13	278	1.10	2.04	92	73.38
14	282	1.50	2.78	93	85.93
15	287	1.60	2.96	93	89.04
16	290	0.40	0.75	93	44.61
17	290	0.50	0.93	92	49.88
18	288	0.60	1.11	92	54.56
19	286	0.70	1.30	94	58.86
20	286	0.60	1.11	94	54.49
21	288	0.30	0.56	96	38.58
22	290	0.30	0.56	98	38.63
23	292	0.30	0.56	99	38.69
24	292	0.25	0.46	100	35.31
25	290	0.20	0.37	100	31.54
AVERAGE	282		2.00	93	68.37

DRY STANDARD VOLUME	45.14	SCF
PERCENT WATER VAPOR	23.77	% VOL
FLOW RATE	67219	ACFM
	35558	DSCFM
	60421	M3/HR
PARTICULATE CONCENTRATION	0.005	GR/DSCF
PARTICULATE EMISSION RATE	1.47	LB/HR
LB PART PER 1000 LB GAS	0.008	
ISOKINETIC PERCENT	101.7	

3.0 METHODS

3.1 Particulate

The equipment used to sample was the Western Precipitation Division of the Joy Manufacturing Company Emission Parameter Analyzer. Samples were collected in accordance with EPA Method 17.

The sampling train consisted of a probe tip, an in-stack thimble holder with tared thimble, and a tared back up 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 of the same solution; the third was a modified Greenburg Smith impinger dry; and 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.

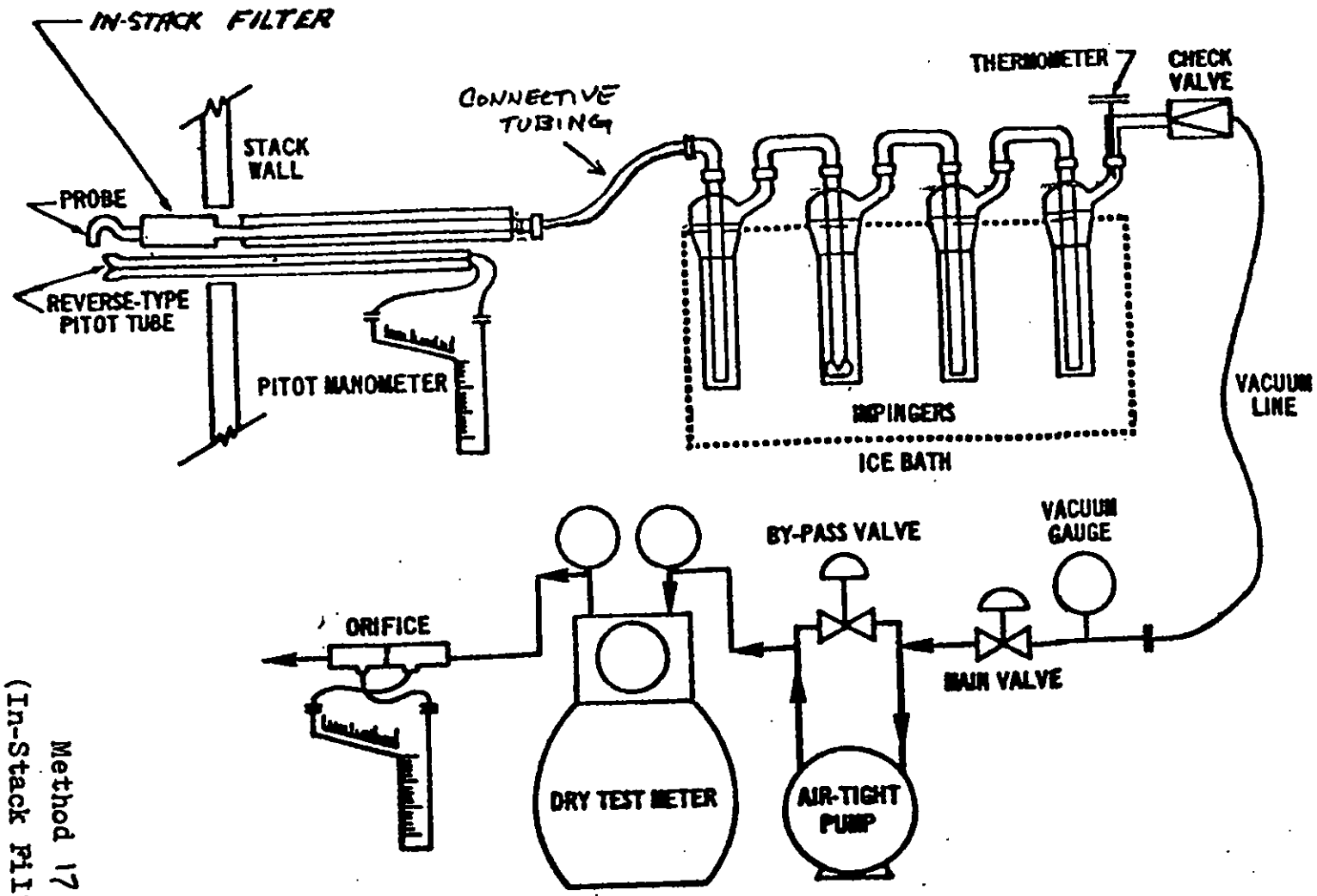
The temperatures of the stack gas stream, as well as strategic locations within the sampling devices, were monitored by RTDs and read directly from a gauge on the control unit.

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.

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

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



Particulate sampling train.

Method 17
(In-Stack Filter)

3.2 Sulfur Dioxide

Samples were collected and analyzed in accordance with the procedures outlined in EPA Method 6 (40 FR, Part 60, Appendix A). The sampling train consisted of a stainless steel probe with a glass wool plug serving as a filter. A series of four midget impingers followed in an ice bath. The first impinger contained 15 milliliters (ml) of 80% isopropyl alcohol, the second and third each contained 15 ml of 3% hydrogen peroxide, and the fourth was dry to serve as a trap for carry-over of any liquid. This train separates out sulfuric acid and sulfur trioxide in the first impinger and sulfur dioxide is collected in the second and third impingers. The gas then passed through a water trap and silica gel tube to trap all water vapor prior to the sampling pump and dry gas meter. A schematic of the sampling train is included as Figure 3-2.

The principle of the method was to collect a representative sample of the exhaust gas stream by placing the probe at a single point in the duct and sampling for a 20 minute period at a nominal sampling rate of 1 liter per minute. At the completion of each test, a leak check was performed and ambient air was purged through the sampling train for approximately 15 minutes.

The first impinger contents were then discarded while the second and third impinger contents were combined along with the washings from the connected tubing. Aliquots of this solution were diluted with known quantities of isopropyl alcohol and titrated with barium perchlorate using thorin indicator. From the quantity of titrant required, the weight of sulfur dioxide was calculated. This information was combined with the volume of gas sampled to determine the sulfur dioxide concentration. The emission rates were then calculated using these concentrations and the volumetric flow rate.

SO2 EMISSIONS CALCULATIONS

3D Control 8 FID 998215240

Sulfur in Burner Fuel

Sample 8-01 was collected during the first test run
Sample 8-02 was collected during the second test run
Sample 8-03 represents burner fuel used during the first 15 minutes orf the third test run
Sample 8-04 represents burner fuel used during the last 45 minutes of the third test run

%S = 1/3 (0.38 + 0.37 + 1/4 (0.28) + 3/4 (0.40)) = 0.37% S by weight

Mass of Oil

Mass of one gallon oil = mass of water x specific gravity of oil
Mass = 8.34 lb/gallon x (0.8939 + 0.8915 + 1/4(0.8724) + 3/4(0.8871)) = 7.42 lb/gallon

Mass Flow of Sulfur Dioxide from the Burner

9.0 gallons/minute x 60 minutes/hour x 7.42 lbs/gallon x 0.37/100 sulfur/oil x 2 SO2/S = 29.65 lbs SO2/hour

Mass Flow of Sulfur Dioxide from the Plant Stack

2.31 lbs/hour

Sulfur Dioxide Capture Efficiency

EF = 100 x (Burner SO2 - Stack SO2) / Burner SO2

EF = **92.21** %

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S-F ANALYTICAL LABORATORIES, INC

A Subsidiary of Sommer-Frey Laboratories, Inc.

Payne & Dolan of Wisc.,Inc.
P.O. Box 781
Waukesha, WI 53186

Attn: Peter Tolsma

Received: 08/18/1997
Reported: 08/21/1997
Project#: 97004695

Analytical Results

Parameter	Result	MDL	Analyzed	By	Method
97A11141 : 8-01 8/14/97					
Collected: 08/14/1997					
Flash Point	>210 F		08/20/97	RAB	D3828
Arsenic	2.0 ppm	0.5	08/21/97	GGG	6010
Cadmium	2.0 ppm	0.1	08/21/97	GGG	6010
Chromium	2.8 ppm	0.1	08/21/97	GGG	6010
Lead	30.1 ppm	0.1	08/21/97	GGG	6010
API Gravity @ 60F	26.8 -		08/20/97	RAB	D1298
Specific Gravity	0.8939 -		08/20/97	RAB	D1298
Halogens as Cl	665 mg/kg	100	08/20/97	RAB	D808
Sulfur	0.38 %	0.04	08/20/97	RAB	D129
Acidity	Neutral -		08/20/97	RAB	D1093
Ash	0.61 %	0.01	08/20/97	RAB	D482
BTU/Gallon	134700 BTU/gal	100	08/20/97	RAB	D240
97A11142 : 8-02 8/14/97					
Collected: 08/14/1997					
Flash Point	>210 F		08/20/97	RAB	D3828
Arsenic	<0.5 ppm	0.5	08/21/97	GGG	6010
Cadmium	1.0 ppm	0.1	08/21/97	GGG	6010
Chromium	1.9 ppm	0.1	08/21/97	GGG	6010
Lead	28.8 ppm	0.1	08/21/97	GGG	6010
API Gravity @ 60F	27.2 -		08/20/97	RAB	D1298
Specific Gravity	0.8915 -		08/20/97	RAB	D1298
Halogens as Cl	573 mg/kg	100	08/20/97	RAB	D808
Sulfur	0.37 %	0.04	08/20/97	RAB	D129
Acidity	Neutral -		08/20/97	RAB	D1093
Ash	0.65 %	0.01	08/20/97	RAB	D482
BTU/Gallon	136200 BTU/gal	100	08/20/97	RAB	D240

6125 West National Avenue, P.O. Box 14513, Milwaukee, Wisconsin 53214
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Toll-Free: 800-300-6700

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Project: 97004695 Page - 2 - 08/21/1997

Parameter	Result	MDL	Analyzed	By	Method
97A11143 : 8-03 8/14/97 Collected: 08/14/1997					
Flash Point	161 F		08/20/97	RAB	D3828
Arsenic	<0.5 ppm	0.5	08/21/97	GGG	6010
Cadmium	2.2 ppm	0.1	08/21/97	GGG	6010
Chromium	1.6 ppm	0.1	08/21/97	GGG	6010
Lead	16.6 ppm	0.1	08/21/97	GGG	6010
API Gravity @ 60F	30.7 -		08/20/97	RAB	D1298
Specific Gravity	0.8724 -		08/20/97	RAB	D1298
Halogens as Cl	477 mg/kg	100	08/20/97	RAB	D808
Sulfur	0.28 %	0.04	08/20/97	RAB	D129
Acidity	Neutral -		08/20/97	RAB	D1093
Ash	0.38 %	0.01	08/20/97	RAB	D482
BTU/Gallon	135300 BTU/gal	100	08/20/97	RAB	D240
97A11144 : 8-04 8/14/97 Collected: 08/14/1997					
Flash Point	>210 F		08/20/97	RAB	D3828
Arsenic	<0.5 ppm	0.5	08/21/97	GGG	6010
Cadmium	0.9 ppm	0.1	08/21/97	GGG	6010
Chromium	2.2 ppm	0.1	08/21/97	GGG	6010
Lead	28.6 ppm	0.1	08/21/97	GGG	6010
API Gravity @ 60F	28.0 -		08/20/97	RAB	D1298
Specific Gravity	0.8871 -		08/20/97	RAB	D1298
Halogens as Cl	408 mg/kg	100	08/20/97	RAB	D808
Sulfur	0.40 %	0.04	08/20/97	RAB	D129
Acidity	Neutral -		08/20/97	RAB	D1093
Ash	0.72 %	0.01	08/20/97	RAB	D482
BTU/Gallon	136900 BTU/gal	100	08/20/97	RAB	D240

Gary G. Geipel
Senior Analyst

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ASPHALT PLANT STACK TEST DATA

Control # 8

Date August 4, 19

FID # 998 215 240

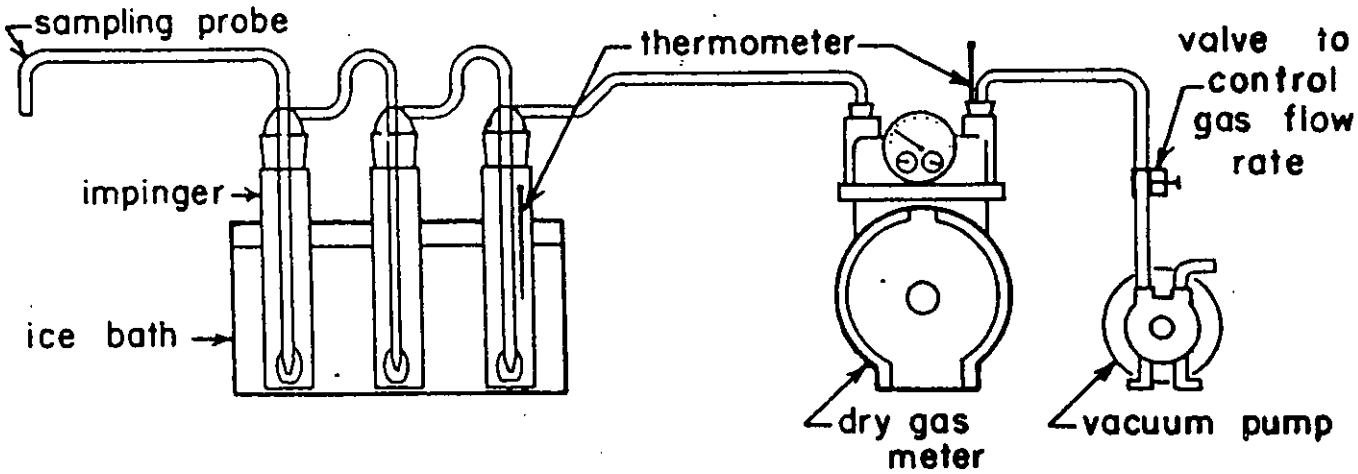
Time*	Burner %	PSI Fuel Pressure	Production TPH	Aggregate TPH	A/C TPH	RAP TPH	Mix Temp	Stack Temp	Photo-helic	Magne-helic	Fuel Flow Rate	CO ppm	CO2 ppm	O2 %
0900	55	65	289	197	9.3	79	280	275	.25	6.9	9.0			
0915	54	65	285	195	9.4	82	275	280	.28	7.0	9.0			
0930	54	66	283	194	9.1	80	270	275	.23	6.6	9.0			
0945	56	65	285	193	9.3	85	277	280	.25	6.8	9.0			
1000	56	65	288	192	9.5	87	273	280	.30	6.7	9.0			
1110	57	64	283	196	9.3	75	278	275	.29	6.5	9.0			
1125	56	65	290	198	9.3	80	272	275	.37	6.6	9.0			
1140	57	64	286	194	9.4	83	298	280	.37	6.7	9.0			
1155	55	66	286	195	9.3	81	275	280	.29	6.5	9.0			
1210	58	64	285	190	9.5	83	274	280	.37	6.4	9.0			
1225	54	66	289	197	9.4	80	274	280	.40	6.7	9.0			
1315	55	65	290	198	9.5	82	270	280	.35	7.0	9.0			
1330	55	65	288	190	9.3	83	270	280	.25	7.0	9.0			
1430	57	65	292	197	9.4	87	270	285	.24	7.0	9.0			
1445	57	65	288	192	9.2	86	276	290	.25	7.0	9.0			

Fuel Type waste oil

Sulfur in Fuel 0.46 %

* Record time in 15-minute intervals during stack test runs.

COMP\PLT\TESTDATA.WK1



IMPINGER SAMPLING TRAIN

3.3 Formaldehyde

The sampling and analysis were performed using procedures outlined in EPA Method 0011, the method required 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; the first two contained 10 ml of a DNPH solution and were followed by an empty impinger and 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 returned to the lab for analysis. The samples were analyzed via HPLC methods as described by the EPA. A blank was handled in the field in a method identical to the samples and also submitted for analysis.

4.0 CALIBRATIONS

4.1 Particulate

The probe tips, pitot tubes, dry gas meters, and orifices were calibrated prior to the test according to standard procedures as to procedures published by the EPA. The values obtained were:

Probe tip diameter	0.245"
Pitot tube coeff.	0.84
Orifice coeff.	1.814
Dry Gas Meter	1.004

4.2 Other Parameters

A dry gas meter was used to determine the sample volume obtained in the SO2 and formaldehyde tests. These dry gas meters were calibrated with a wet test meter. The values obtained were:

Sulfur Dioxide Meter	1.027
Formaldehyde Meter	1.064

APPENDIX A

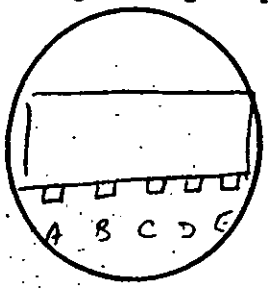
Field and Laboratory Data

Environment[illegible]
Technol[illegible]
Engineering Corp.

NEOL - OPERATOR
P. TASHA - PID ENVIR
M GRIFFIN - WDNR

PARTICULATE F[illegible]LD DATA

8 = 1.004 [illegible] -9/97



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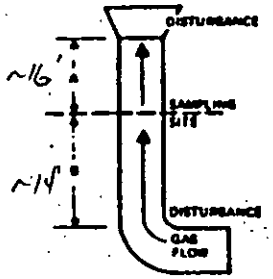


PLANT Payne & Dolan
DATE 8/[illegible]/97
LOCATION Cedar Lake - Control 8
OPERATOR MJH/CSK
STACK NO. Asphalt Baghouse
RUN NO. 1
SAMPLE BOX NO. 1
METER BOX NO. 1

AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.75
ASSUMED MOISTURE, % 26%
PROBE LENGTH, in. 5 FT
NOZZLE DIAMETER, in. 1/4"
STACK DIAMETER, in. 71/2 x 33"
PROBE HEATER SETTING –
HEATER BOX SETTING –

METER ΔH@ 1.814
C FACTOR
PROCESS WEIGHT RATE RAP

ORSAT RESULTS
CO2 4.2
O2 15.8
CO <0.1
N2 80.0

LEAK CHECKS
Pre <.02@21"
Pitot ok@4"
Post <.02@21"
Pitot ok@4"

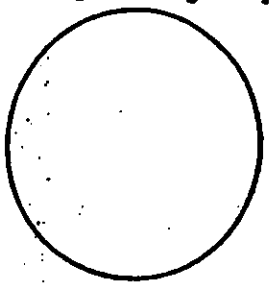
2½ min/pt T-846

T_c : 280

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY fps
E 1	912:30		275	0.90	1.68		895.00		71			3	
2	15		275	1.30	2.40		96.8		76				
3	17½	-1.5	276	2.10	3.88		98.9		77			8½	
4	20		276	2.50	4.62		901.6		78				
5	22½		276	2.50	4.62		4.5		79			10½	
D 1	25/25½		277	0.80	1.48		7.4		79				
2	28		277	1.10	2.04		9.2		80			5	
3	30½	-1.5	275	1.60	2.96		11.1		81				
4	33		275	2.20	4.25		13.5		83			10	
5	35½		276	2.40	4.47		16.3		85				
C 1	38/38½		276	0.60	1.12		19.2		87			3	
2	41		275	0.90	1.68		20.7		88				
3	43½	-1.0	276	1.20	2.22		22.5	45.35	89			5	
4	46		276	1.50	2.78		24.5		90				
5	48½		277	1.60	2.96		26.8		90			6½	
B 1	51/51½		277	.40	.75		29.1		90				
2	54		277	.55	1.02		30.3		92			3	
3	56½	-1.0	278	.50	.93		31.7		94				
4	59		278	.50	.93		33.0		96			3	
5	1001½		278	.40	.75		34.4		98				
A 1	4/4½		277	.30	.56		35.6		99			2	
2	7	-0.5	276	.30	.56		36.6		99				
3	9½		276	.25	.46		37.7		99			2	
4	12		275	.25	.46		38.6		100				
5	14½		275	.20	.37		39.6		100			<2	

Environmental
Technol[illegible]
Engineering Corp.

PARTICULATE F[illegible]LD DATA



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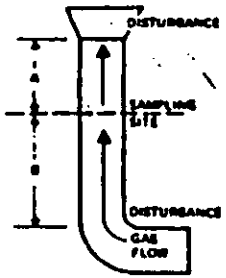


PLANT Payne + Dolan - C[illegible] 8
DATE 8/14/97
LOCATION Cedar Lake
OPERATOR MJH/CSH
STACK NO. Asphalt Pt. Baghouse
RUN NO. 2
SAMPLE BOX NO. 2
METER BOX NO. 1

AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.25
ASSUMED MOISTURE, % 26%
PROBE LENGTH, in. 5 FT
NOZZLE DIAMETER, in. 1/4"
STACK DIAMETER, in. 71½" x 33"
PROBE HEATER SETTING –
HEATER BOX SETTING –

METER ΔH, 8 = 1.004 1.814
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2 4.4
O2 15.2
CO 10.1
N2 80.4

LEAK CHECKS
Pre <02@21"
Pitot OK@4"
Post <02@21"
Pitot OK@4"

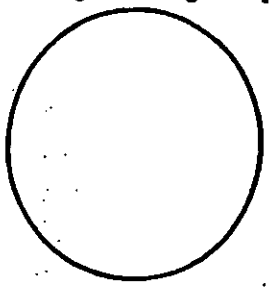
T-847 2½ min/PT

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s) ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	VELOCITY fps
E 1	1110		270	0.90	1.68		941.00		90			4	
2	12½		270	1.40	2.59		42.8		91				
3	15		270	2.10	3.89		45.0		91			8	
4	17½	-1.5	270	2.50	4.62		47.7		92				
5	20		270	2.50	4.62		50.7		92			10	
D 1	22½/23½		272	.70	1.30		53.6		92				
2	26		272	.90	1.68		55.1		92			4	
3	28½	-1.4	273	1.30	2.40		56.9		93				
4	31		276	2.00	3.70		59.0		93			8	
5	33½		276	2.40	4.47		61.6		92				
C 1	36/36½		278	.70	1.30		64.4		93			3	
2	39	-1.1	278	.80	1.48		66.0		92				
3	41½		277	1.20	2.22		67.7		93			5	
4	44		277	1.50	2.78		69.7	45.45	93				
5	46½		273	1.50	2.78		71.9		92			6	
B 1	49/49½		272	.40	.75		74.2		93				
2	52	-1.0	272	.50	.93		75.4		93			2½	
3	54½		273	.60	1.12		76.7		94				
4	57		274	.60	1.12		78.2		96			3	
5	59½		274	.60	1.12		79.6		96				
A 1	1202/2½		273	.30	.56		81.1		98			3	
2	5	-0.5	275	.35	.65		82.2		100				
3	7½		275	.35	.65		83.3		104			2	
4	10/1301½		265	.30	.56		84.4		90				
5	4		270	.25	.46		85.5		91			2	

* BURNER KEYED OUT SWITCHED FUEL TANKS

Environmental Technology Engineering Corp.

PARTICULATE FIELD DATA



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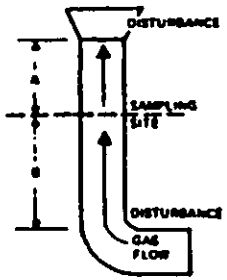

PLANT Payne + Dolan -
DATE 8/11/97
LOCATION Cedar Lake
OPERATOR MJH/CSK
STACK NO. Asphalt Pit Baghouse
RUN NO. 3
SAMPLE BOX NO. 3
METER BOX NO. 1

AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 25%
PROBE LENGTH, in. 5 FT
NOZZLE DIAMETER, in. 1/4"
STACK DIAMETER, in. 71 1/2 x 33"
PROBE HEATER SETTING –
HEATER BOX SETTING –

METER ΔH 1.004 / 1.814
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2 4.6
O2 15.1
CO <0.1
N2 80.3

LEAK CHECKS
Pre <.02@21"
Pitot ok@4"
Post <.02@21"
Pitot ok@4"

T-848 2 1/2 min/pt

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s) ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{IN}}$), °F	OUTLET ($T_{m_{OUT}}$), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	VELOCITY fps
E 1	1324.00		280	0.90	168		987.00		90			3 1/2	
2	26 1/2		280	1.40	2.59		88.8		88				
3	29	-1.5	281	2.20	407		91.0		90			10	
4	31 1/2		282	2.50	462		93.8		91				
5	34		282	2.60	480		96.7		91			10 1/2	
D 1	36 1/2/37		282	.70	1.30		99.6		92				
2	39 1/2		282	1.10	2.03		001.3		93	* Sorter problems		6	
3	42/1415	-1.3	265	1.40	2.59		3.2		90				
4	17 1/2		265	2.10	3.88		5.5		90			10	
5	20		267	3.30	425		8.1		91				
C 1	22 1/2/23		270	.60	1.11		10.8		91			3	
2	25 1/2		274	.85	1.58		12.3		92				
3	28	-1.0	278	1.10	2.04		14.1	45.63	92			5 1/2	
4	30 1/2		282	1.50	278		16.1		93				
5	33		287	1.60	296		18.3		93			7	
B 1	35 1/2/36		290	.40	.75		20.7		93				
2	38 1/2		290	.50	.93		21.9		92			3	
3	41	-0.8	288	.60	1.11		23.2		92				
4	43 1/2		286	.70	1.30		24.7		94			4	
5	46		286	.60	1.11		26.2		94				
A 1	48 1/2/49		288	.30	.56		27.7		96			2 1/2	
	51 1/2	-0.5	290	.30	.56		28.7		98				
	54		292	.30	.56		29.8		99			2 1/2	
4	56 1/2		292	.25	.46		30.8		100				
5	59		290	.20	.37		31.4		100			2	

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME Payne + Dolan

DATE OF TEST 8-14-97

JOB NO.

TEST ENGINEER MJH

RUN NO. 1 STACK Control 8

Sample Box 1 Filter 846 Wash Bottle

Beaker No. 10

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	246	100	146
2	198	100	98
3	14	0	14
SIL GEL	692	683	9
		TOTAL	267

PARTICULATE COLLECTED

Blank	Final Wt. g	Tare Wt. g	Collected grams
Filter	.9818	.9691	0.0127
Washings (.0002)	104.2457	104.2431	0.0024
		TOTAL	0.0151

WATER COLLECTED 267 GRAMS

PARTICULATE COLLECTED .0151 GRAMS

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME PID C#8 Cedar Lake DATE OF TEST 8-14-97

JOB NO. _____ TEST ENGINEER MJH

RUN NO. 2 STACK Baghouse

Sample Box 2 Filter T-847 Wash Bottle _____

Beaker No. 11

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	267	100	167
2	181	100	81
3	32	0	32
SIL GEL	628	622	6
		TOTAL	286

PARTICULATE COLLECTED

Blank	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.0126	1.0026	0.0100
Washings (.0002)	114.3439	114.3422	0.0015
		TOTAL	0.0115

WATER COLLECTED 286 GRAMS

PARTICULATE COLLECTED .0115 GRAMS

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME P&D C-8 Cedar Lake DATE OF TEST 8-14-97

JOB NO. _____ TEST ENGINEER MJH

RUN NO. 3 STACK Baghouse

Sample Box 3 Filter T-848 Wash Bottle —

Beaker No. 12

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	287	100	187
2	183	100	83
3	25	0	25
SIL GEL	670	666	4
		TOTAL	299

PARTICULATE COLLECTED

Blank	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.0322	1.0202	0.0120
Washings (.0002)	105.4127	105.4105	0.0020
		TOTAL	0.0140

WATER COLLECTED 299 GRAMS

PARTICULATE COLLECTED .0140 GRAMS

NOTES:

PAYNE & DOLAN
CONTROL 8 PLANT
SO2 LAB RESULTS

Sample no.	Vol.Solution ml	Vol. Aliq. ml	Vol.Titrant ml	Vol.Tit. BL ml	N. Titrant	mg. SO2	mg/m3	Meter Vol. ft3	Meter GAMA	Meter T deg F	Pb in Hg	Meter Std. scf	Std m3	Flow Rate m3/hr	Emission Rate lb/hr
1A	15.2	3.0	0.30	0.02	0.010	0.454	19.98	0.80	1.027	68	29.25	0.803	0.023	61621	2.71
1B	19.6	3.0	0.25	0.02	0.010	0.486	19.00	0.90	1.027	68	29.25	0.904	0.026	61621	2.58
AVG							19.49								2.65
2A	19.0	3.0	0.25	0.02	0.010	0.487	17.31	0.95	1.027	69	29.25	0.952	0.027	61257	2.34
2B	19.0	3.0	0.20	0.02	0.010	0.365	14.35	0.90	1.027	71	29.25	0.898	0.025	61257	1.94
AVG							15.83								2.14
3A	18.0	3.0	0.25	0.02	0.010	0.442	19.51	0.80	1.027	70	29.25	0.800	0.023	60421	2.60
3B	17.0	3.0	0.20	0.02	0.010	0.327	12.82	0.90	1.027	70	29.25	0.900	0.025	60421	1.71
AVG							16.16								2.15

Data Analysis Technologies, Inc.
6385 Shier Rings Rd.
Dublin, OH 43016

Sample Analysis Certificate

Environmental Technology and Engineering, Inc.
13020 West Bluemound Rd.
Elm Grove, WI 53122

Date:	9/10/97
Project ID:	0997001
Sample Date:	8/19/97
Sample Time:	NA
Date Received:	9/2/97

Attn: Bill Dick
Project #: 2209
Sampled by: NA

FORMALDEHYDE ANALYSIS BY METHOD TO-5
Project: 0997001

Client ID	8-1	8-2	8-3	8-BLANK	Method
Lab ID	0997001-1	0997001-2	0997001-3	0997001-4	Blank
Analyte	Q Total ug	Q Total ug	Q Total ug	Q Total ug	Q Total ug
Formaldehyde	D 3449.8	D 3328.5	D 1768.5	4.94	ND 0.07

ND: Analyte not detected. Miminum detection reported.
D: Dilution result

Reviewed and approved for release by: _____ Date: 9/10/97
President

PAYNE & DOLAN
CONTROL 8 Plant
FORMALDEHYDE RESULTS

TABLE 2-4

Sample No.	Meter Vol. ft3	Meter Temp deg F	Standard Vol liters	Form Captured ug	Form Conc mg/m3	Flow Rate m3/hr	Form ER lb/hr	Production Rate TPH	Emission Factor lb/ton
C8-1	3.00	63	89.22	3444.9	38.61	61621	5.25	286	0.0183
C8-2	3.50	66	103.49	3323.6	32.11	61257	4.34	286	0.0152
C8-3	3.00	67	88.54	1763.6	19.92	60421	2.65	289	0.0092
		AVERAGE			30.21		4.08		0.0142

Meter Gama 1.064
Bar.Pressure 29.25

Calculations

Standard Volume = Meter Vol * Meter Gama*Bar.Pressure*28.32*528/(29.92*(460+Meter Temp))

Concentration = ug/liters = mg/m3

Emission Rate = mg/m3 * m3/hr/453600

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*% CO2 + .32*%O2 + .282*%N2 + .28*%CO

2. WATER VAPOR PERCENT (%H2O)

   Vw std = 0.04707*(Vf - Vi)

   where: Vw std = standard cubic feet of water vapor
   Vf = Final volume of impingers, ml
   Vi = Initial volume of impingers, ml

   %H2O = Vw std * 100/(Vm std + Vw std)

   where Vm std = standard cubic feet of gas sampled

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

   Ms = Md*(1 - %H2O/100) + 18*%H2O/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 = Kp*Cp* (DELP) Tsavg/(Ps*Ms)

   where: Kp = 85.49 unit conversion
   Cp = 0.85, pitot tube calibration factor
   DELP = square root of velocity head, in. H2O
   Tsavg = 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*(1 - %H2O/100)*Vs*A*(528*Ps/Tsavg/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**

Vm std = GAMA*(Vm-(AL-.02)t)*(Pb+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**

Cs = Mn * 15.43/Vm std

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

9. **EMISSION RATE (ER) pounds per hour**

PMRA = Mn*A*60/(t*An*453.6) AREA METHOD lb/hr

PMRC = Cs*Qs*60/(15.43*453.6) 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 * 386700 * (1-%H2O/100)/(Qs*60*Ms)

where: 386700 = cubic feet per lb mole * 1000

11. **ISOKINETIC SAMPLING PERCENTAGE (I) %**

I = PMRA/PMRC