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: 371

Title: Stack Emission Test, Payne And Dolan, Inc., Control 4 Plant, Sussex, WI,

Environmental Technology and Engineering Corporation, Elm Grove, WI,

October 22, 1997.

SO2 Sec. 11.1 Ref. 371

Report to

PAYNE & DOLAN, INC.

Waukesha, Wisconsin

for

STACK EMISSION TEST
CONTROL 4 PLANT
WDNR Air Pollution Control Permit No. 97-JSB-269-OP
Facility Identification Number (FID) 268185610

October 22, 1997

by

ENVIRONMENTAL TECHNOLOGY & ENGINEERING CORPORATION
13000 West Bluemound Road
Elm Grove, Wisconsin 53122
Phone 414-784-2434
Fax 414-784-2436

ETE

SUMMARY

On October 22, 1997, Environmental Technology & Engineering Corp. personnel performed stack emissions testing at the Payne & Dolan, Inc. Control 4 Plant located in Sussex, Wisconsin. The tests were performed as a provision of Air Pollution Control Permit No. 97-JSB-267-OP issued by the State of Wisconsin Department of Natural Resources. Tests were performed in order to determine compliance with the applicable particulate emission limitation. Tests were also performed to determine formaldehyde emissions as a BACT provision. Additional tests were performed to determine a plant specific emission factor for sulfur dioxide. All measured particulate emissions were well below the limits shown in the following table:

TEST NO.	PARTICULATE	SULFUR DIOXIDE	FORMALDEHYDE
1	0.014 gr/dscf	22.63 lb/hr	4.02 lb/hr
2	0.011	20.45	3.35
3	0.009	21.40	3.95
AVERAGE	0.011 gr/dscf	21.49 lb/hr	3.77 lb/hr
DNR LIMIT	0.039	NA	NA
% OF LIMIT	29.1 %		

1.0 GENERAL

On October 22, 1997, Environmental Technology & Engineering Corp. (ETE) personnel performed stack emissions testing at the Payne & Dolan, Inc. Control 4 plant located in Sussex, Wisconsin. The purpose of the testing was to determine the particulate and formaldehyde emissions from the plant as a condition of Air Pollution Control Permit No. 97-JSB-267-OP issued by the State of Wisconsin Department of Natural Resources (WDNR). An additional parameter tested at this time was sulfur dioxide. This parameter was tested to establish a plant specific emission factor for use in the emission inventory.

Pete Tolsma and Louis Gandt of Payne & Dolan were responsible for assuring proper operating conditions throughout the testing. During the test the plant production rate was approximately 362 tons per hour and included approximately 24 % recycled asphalt. The plant was fired with drain oil. All testing was coordinated with Lou Gandt. Tom Zelinski of the DNR 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 in accordance with Method 0011 (non-isokinetic). 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
1	0.014 gr/dscf
2	0.011
3	0.009
AVERAGE	0.011 gr/dscf
DNR LIMIT	0.039
% OF LIMIT	29.1 %

PAYNE & DOLAN
CONTROL 4 PLANT

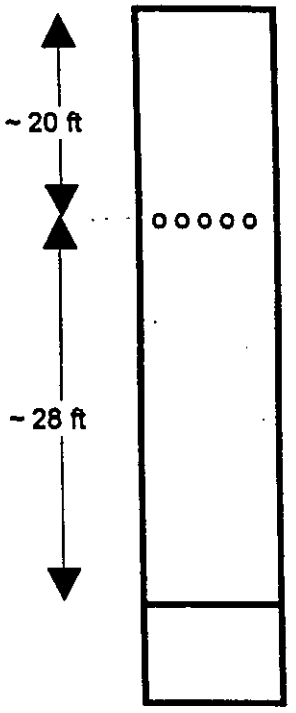
L x W
47.5" x 47.5"

SAMPLE POINT LOCATION

POINT	DISTANCE
1	5.9"
2	17.8
3	29.7
4	41.6

FIGURE 2-1

SAMPLE PORT LOCATION



PAYNE & DOLAN 22-Oct-97 CONTROL 4 TABLE 2-1

TEST NO.	1			
BAROMETRIC PRESSURE	29.35	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	47.5	IN	47.5	IN
STACK AREA	15.668	FT3		
SAMPLING TIME PER POINT	3.0	MIN		
NUMBER OF POINTS	20			
METER VOLUME	45.57	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.008			
PARTICULATE COLLECTED	0.0424	GRAMS		
WATER COLLECTED	282	ML		
STATIC PRESSURE	-0.62	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.50%	10.50%	0.00%	85.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	238	1.40	2.50	42	80.39
2	240	1.25	2.25	43	76.07
3	242	1.00	1.80	45	68.13
4	242	0.75	1.35	46	59.01
5	245	1.30	2.30	49	77.85
6	248	1.15	2.05	50	73.38
7	250	0.95	1.70	51	66.79
8	255	0.75	1.35	52	59.55
9	257	1.15	2.05	55	73.84
10	260	1.00	1.80	56	69.00
11	260	0.95	1.70	57	67.26
12	260	1.00	1.80	58	69.00
13	260	1.00	1.80	60	69.00
14	262	1.00	1.80	61	69.10
15	262	0.95	1.70	62	67.35
16	260	0.95	1.70	63	67.26
17	260	1.00	1.80	63	69.00
18	258	1.00	1.80	64	68.91
19	255	0.95	1.70	65	67.02
20	255	0.90	1.60	66	65.23
AVERAGE	253		1.83	55	69.16

DRY STANDARD VOLUME	45.19	SCF
PERCENT WATER VAPOR	22.71	% VOL
FLOW RATE	65015	ACFM
	36425	DSCFM
	61894	M3/HR
PARTICULATE CONCENTRATION	0.014	GR/DSCF
PARTICULATE EMISSION RATE	4.50	LB/HR
LB PART PER 1000 LB GAS	0.023	
ISOKINETIC PERCENT	99.0	

PAYNE & DOLAN 22-Oct-97 CONTROL 4 TABLE 2-2

TEST NO.	2			
BAROMETRIC PRESSURE	29.35	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	47.5	IN	47.5	IN
STACK AREA	15.668	FT3		
SAMPLING TIME PER POINT	3.0	MIN		
NUMBER OF POINTS	20			
METER VOLUME	44.45	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.008			
PARTICULATE COLLECTED	0.0326	GRAMS		
WATER COLLECTED	284	ML		
STATIC PRESSURE	-0.60	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.50%	10.50%	0.00%	85.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	255	1.00	1.80	68	68.84
2	257	1.00	1.80	68	68.93
3	260	0.95	1.70	69	67.33
4	258	0.90	1.60	70	65.44
5	255	1.05	1.90	71	70.54
6	256	1.00	1.80	71	68.89
7	256	0.95	1.70	72	67.14
8	252	0.95	1.70	73	66.95
9	252	1.10	2.00	73	72.05
10	255	1.00	1.80	73	68.84
11	255	1.00	1.80	74	68.84
12	252	0.90	1.60	74	65.17
13	252	1.15	2.05	74	73.66
14	252	1.10	2.00	75	72.05
15	255	1.00	1.80	76	68.84
16	255	0.80	1.45	76	61.57
17	255	1.20	2.15	77	75.41
18	255	1.00	1.80	78	68.84
19	252	0.95	1.70	78	66.95
20	250	0.80	1.45	78	61.35
AVERAGE	254		1.78	73	68.38

DRY STANDARD VOLUME	44.17	SCF
PERCENT WATER VAPOR	23.23	% VOL
FLOW RATE	64285	ACFM
	35722	DSCFM
	60698	M3/HR
PARTICULATE CONCENTRATION	0.011	GR/DSCF
PARTICULATE EMISSION RATE	3.46	LB/HR
LB PART PER 1000 LB GAS	0.018	
ISOKINETIC PERCENT	98.6	

PAYNE & DOLAN 22-Oct-97 CONTROL 4 TABLE 2-3

TEST NO.	3			
BAROMETRIC PRESSURE	29.35	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	47.5	IN	47.5	IN
STACK AREA	15.668	FT3		
SAMPLING TIME PER POINT	3.0	MIN		
NUMBER OF POINTS	20			
METER VOLUME	44.55	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.008			
PARTICULATE COLLECTED	0.0257	GRAMS		
WATER COLLECTED	283	ML		
STATIC PRESSURE	-0.60	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.50%	10.50%	0.00%	85.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	255	1.20	2.15	78	75.39
2	255	1.15	2.05	79	73.80
3	254	1.00	1.80	80	68.77
4	250	0.85	1.50	80	63.23
5	252	1.20	2.15	81	75.23
6	250	1.00	1.80	82	68.58
7	255	0.95	1.70	82	67.08
8	255	0.90	1.60	83	65.29
9	252	1.05	1.90	83	70.37
10	250	1.00	1.80	83	68.58
11	250	0.95	1.70	83	66.84
12	250	0.95	1.70	83	66.84
13	253	1.00	1.80	83	68.72
14	255	1.00	1.80	84	68.82
15	252	1.00	1.80	84	68.68
16	252	0.95	1.70	84	66.94
17	250	1.05	1.90	84	70.27
18	248	1.00	1.80	84	68.48
19	250	0.95	1.70	84	66.84
20	250	0.90	1.60	84	65.06
AVERAGE	252		1.80	82	68.69

DRY STANDARD VOLUME	44.31	SCF
PERCENT WATER VAPOR	23.11	% VOL
FLOW RATE	64576	ACFM
	36069	DSCFM
	61289	M3/HR
PARTICULATE CONCENTRATION	0.009	GR/DSCF
PARTICULATE EMISSION RATE	2.74	LB/HR
LB PART PER 1000 LB GAS	0.014	
ISOKINETIC PERCENT	98.0	

Formaldehyde results are included as Table 2-4.

TABLE 2-4

TEST NO.	FORMALDEHYDE
1	4.02 lb/hr
2	3.35
3	3.95
AVERAGE	3.77 lb/hr
FACTOR	0.0104 lb/ton

Sulfur dioxide results are included as Table 2-5.

TABLE 2-5

TEST NO.	SULFUR DIOXIDE
1	22.63 lb/hr
2	20.45
3	21.40
AVERAGE	21.49 lb/hr
FACTOR	0.0564 lb/ton

SO2 EMISSIONS CALCULATIONS

Control 4 FID 268185610

Sulfur in Burner Fuel

S = 0.46% by weight

Mass of Oil

Mass of one gallon oil = mass of water x specific gravity of oil
Mass = 8.34 lb/gallon x 0.89 = 7.42 lb/gallon

Mass Flow of Sulfur Dioxide from the Burner

10.61 gallons/minute x 60 minutes/hour x 7.42 lbs/gallon x 0.46/100 sulfur/oil x 2 SO2/S = 43.46 lbs SO2/hour

Mass Flow of Sulfur Dioxide from the Plant Stack

21.49 lbs/hour

Sulfur Dioxide Capture Efficiency

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

EF = **50.55 %**

comp\plt\so2test.wk1

10-22-97

JACOBUS QUICKFLASH / Madison
3715 Lexington Avenue
Madison, Wisconsin 53714
608-241-4131

PRODUCT SPECIFICATIONS DATA SHEET
JACOBUS PETROLEUM PRODUCT

Jacobus Petroleum Products is supplying the following analysis to you as a used oil fuel burner subject to EPA regulations 40 CFR Part 266, and other individual state requirements.

Batch Tank I.D. #WB197 Product Name: #3 Special Test Date: 3/14/97

CONSTITUENCY/EPA PROPERTY	SPECIFICATION USED OIL	ANALYSIS	
Arsenic	5 PPM max	<1.0	PPM
Cadmium	2 PPM max	<1.0	PPM
Chromium	10 PPM max	1.0	PPM
Lead	100 PPM max	14	PPM
Flash Point	100 DEG min	>200.0	DEG. F
Total Halogens	4000 PPM max	550	PPM
Sulfur % by Wt.	N/A	0.46	% by Wt.
API Gravity	N/A	28.568	
Ash % by Wt.	N/A	74	% by Wt.
BTU/Gallon	N/A	136,740	Per Gallon
PCBs	TSCA regulated	N/D	PPM

Used oil containing more than 1,000 PPM of total Halogens is presumed hazardous, unless rebuttal analysis is performed to prove there are no hazardous constituents per EPA regulation 40 CFR Part 266.40(C), and Subpart D.

In closing, this letter is to provide you with total assurance that Jacobus Petroleum Products will continue to comply with all of your needs as well as the EPA and individual state requirements. If we can be of further assistance, please feel free to call us at 1-800-362-3835.

Respectfully,

Steve Anacker
General Manager

ASPHALT PLANT STACK TEST DATA

Date 10-22-97
FID # 268 185 610

Control # 4

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 %
8:30	78	110#	360	262	12.2	87	278	250	.975	6.5	10.6			
8:45	78	110#	361	261	12.2	88	277	260	.975	6.75	10.25			
9:00	78	110#	362	263	12.3	89	279	268	.975	6.5	10.5			
9:15	69	110#	359	257	12.2	88	282	267	.975	6.25	10.6			
9:30	69	110#	361	261	12.2	88	285	264	.975	5.75	9.75			
9:45	74	110#	368	269	12.3	87	275	265	.975	5.75	10.8			
10:00	71	105#	364	265	12.4	87	271	264	.975	5.5	10.7			
10:15	71	105#	363	264	12.3	87	276	263	.975	5.75	10.6			
10:30	71	105#	359	261	12.3	86	277	265	.975	5.75	10.8			
10:45	71	110#	361	261	12.2	88	285	269	.975	5.5	10.8			
11:00	68	110#	362	262	12.1	88	283	270	.975	5.75	10.7			
11:15	70	110#	360	262	12.3	86	272	262	.975	5.6	10.7			
11:30	74	110#	362	263	12.3	87	272	263	.975	5.25	10.7			
11:45	74	110#	362	264	12.4	86	277	261	.975	5.0	10.9			
12:00	74	110#	362	262	12.3	88	275	263	.975	5.0	10.7			

Fuel Type Waste Oil

Sulfur in Fuel 0.46 %

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

10.61 gpm oil

PAYNE & DOLAN
CONTROL 4 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
C4-1	2.02	40	60.92	1795.69	29.48	61894	4.02	361	0.0111
C4-2	2.00	46	59.60	1490.44	25.01	60698	3.35	363	0.0092
C4-3	2.00	45	59.72	1744.94	29.22	61289	3.95	362	0.0109
		AVERAGE			27.90		3.77		0.0104

Meter Gama 1.028
Bar.Pressure 29.35

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

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.

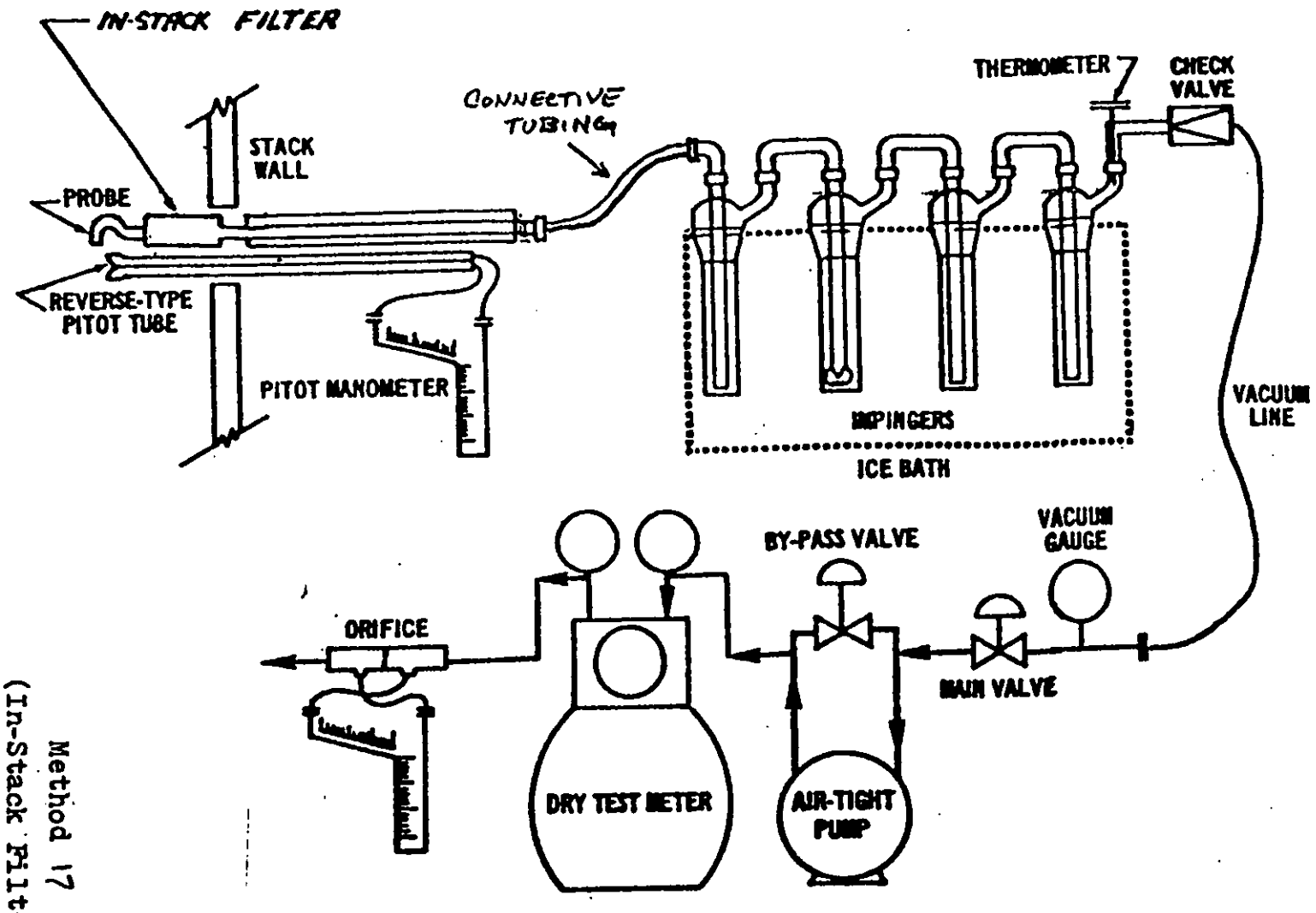
The temperatures of the stack gas stream, as well as strategic locations within the sampling devices, were monitored by RTDs and read directly from a gauge on the control unit.

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.

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.

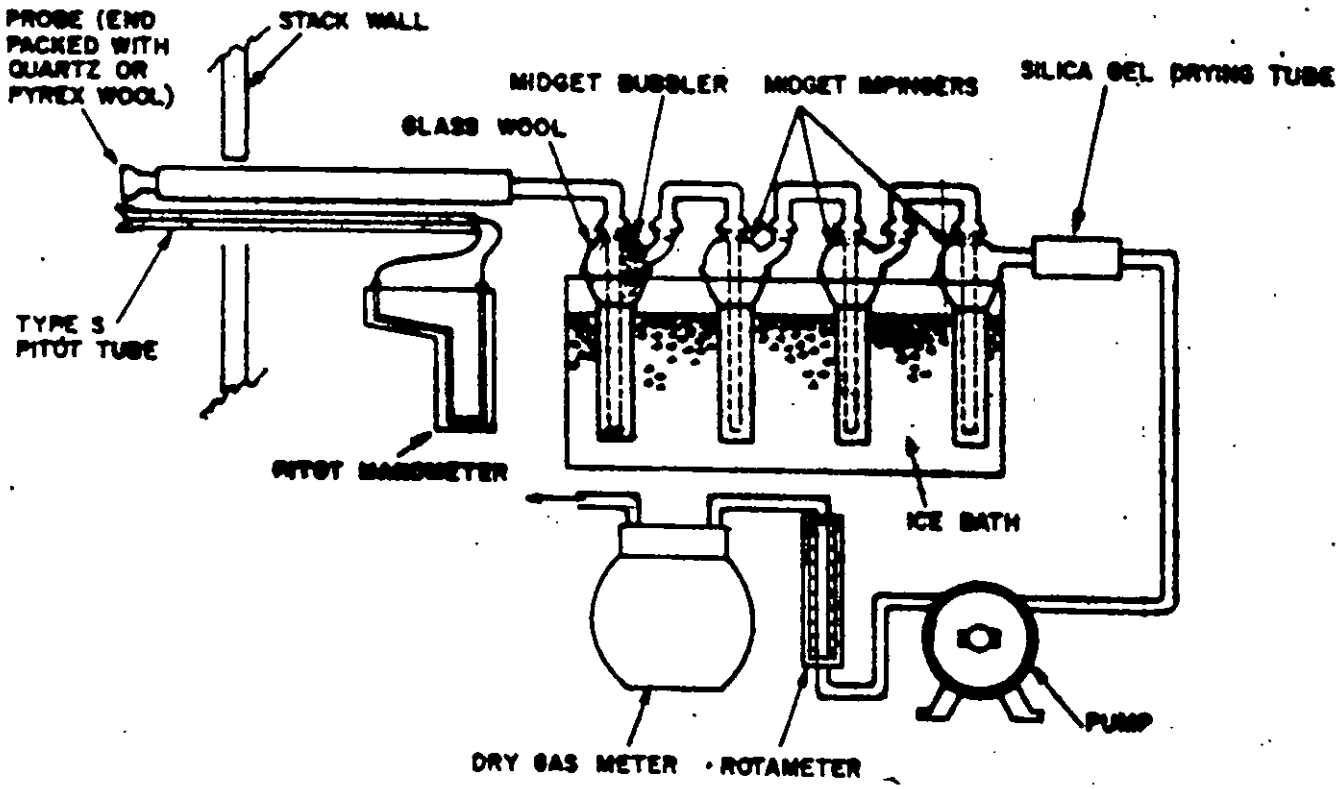


FIGURE - 1 SO_2 SAMPLING TRAIN

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.

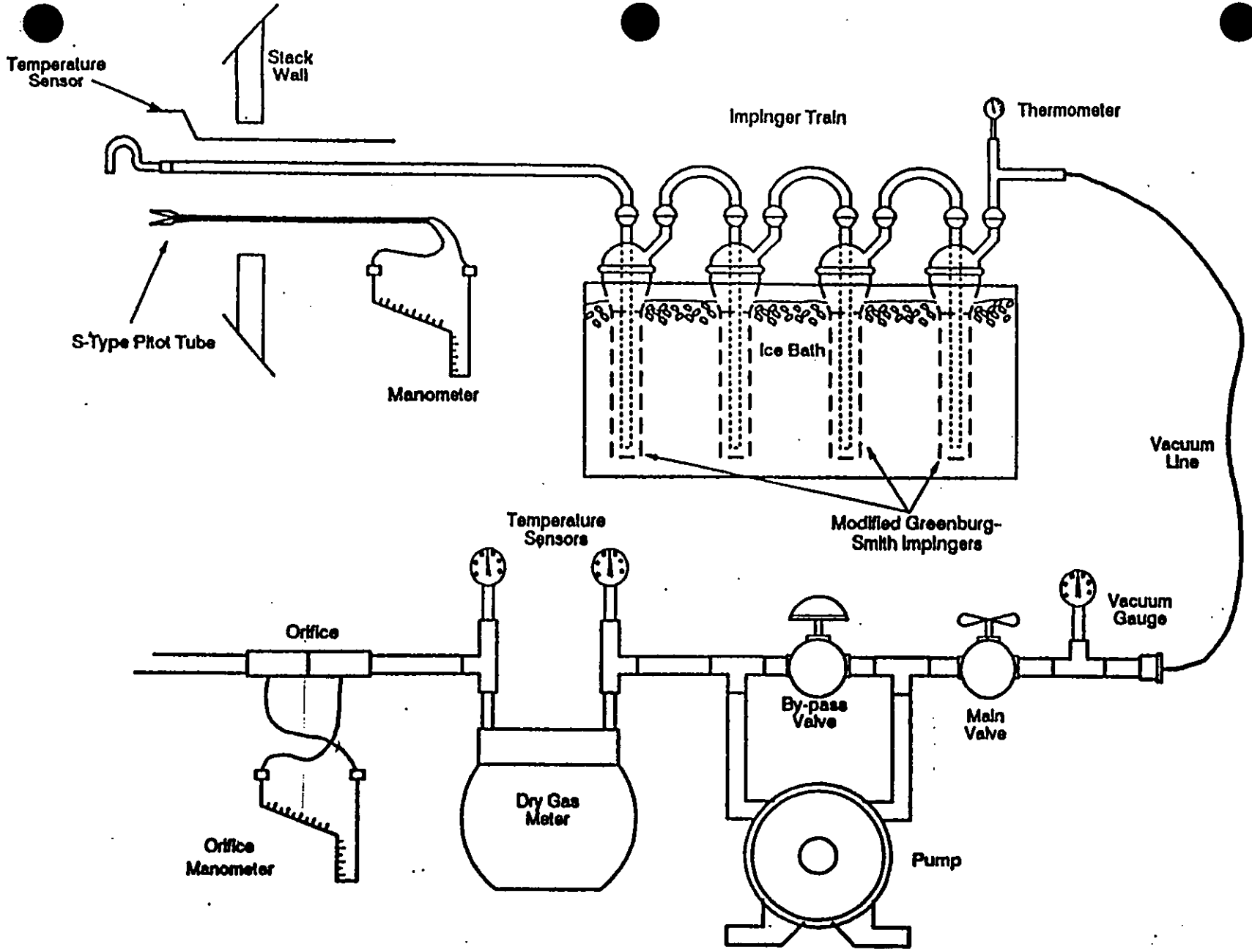
Following the sampling, the samples were sealed and returned to the lab for analysis. The samples were analyzed via HPLC methods as described by the EPA. A blank was handled in the field in a method identical to the samples and also submitted for analysis

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 published by the EPA. The values obtained were:

PARAMETER	VALUE
Probe tip diameter	0.245"
Pitot tube coeff	0.84
Orifice coeff	1.832
Dry Gas Meter	1.008



Formaldehyde Sampling Train

4.2 Sulfur Dioxide

A dry gas meter was used to determine the sample volume obtained in the SO2 tests. This dry gas meter was calibrated with a wet test meter. The value obtained was:

PARAMETER	VALUE
Dry Gas Meter	1.065

4.3 Formaldehyde

A dry gas meter was used to determine the sample volume obtained in the formaldehyde tests. This dry gas meter was calibrated with a wet test meter. The value obtained was:

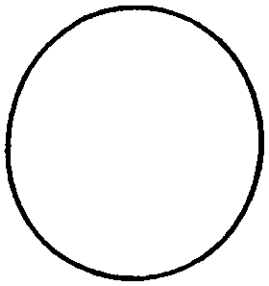
PARAMETER	VALUE
Dry Gas Meter	1.028

APPENDIX A

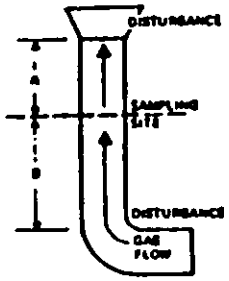
Field and Laboratory Data

Environmental Technology Engineering Corp.

PARTICULATE FIELD DATA



CROSS SECTION



PLANT Payne & Polan
DATE 10-22-97
LOCATION Sussex
OPERATOR WJD
STACK NO. Control 4
RUN NO. 1
SAMPLE BOX NO. 1
METER BOX NO. 1

AMBIENT TEMPERATURE 85
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 28
PROBE LENGTH, in. 5'+
NOZZLE DIAMETER, in. 1/4
STACK DIAMETER, in. 47½ x 47½
PROBE HEATER SETTING -
HEATER BOX SETTING -

METER ΔH
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2
O2
CO
N2

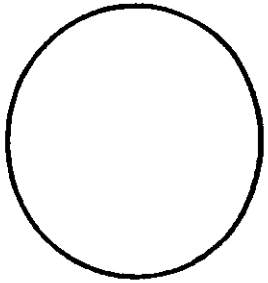
886

LEAK CHECKS
ok Pre <.01 22"
ok Pitot 4"
ok Post <.01 21"
ok Pitot 4"

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	SO2 γ=1.065 SAMPLE BOX TEMPERATURE °F	HCOH γ=1.078 TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	~~[illegible]~~ PUMP VACUUM in. Hg gauge	Bouzek SKC 2 VELOCITY fps
1	0830		238	1.40	2.50		377.00		42	388.69/30	169.16/40	3	208704
2	33		240	1.25	2.25		79.7		43	39.49/32	71.18/40		232622
3	36	-0.6	242	1.00	1.80		82.3		45	0.80/31	2.02/40		
4	39		242	0.75	1.35		84.6		46	1A			
5	42		245	1.30	2.30		86.6		49				
6	47		248	1.15	2.05		89.2		50	339.89/34			
7	48	-0.7	250	0.95	1.70		91.6		51	40.69/36			
8	51		255	0.75	1.35		93.9		52	0.80/35			
9	51		257	1.15	2.05		95.9		55	1B		2	
10	51		260	1.00	1.80		98.3		56				
11	00	-0.6	260	0.95	1.70		400.6		57				
12	03		260	1.00	1.80		02.8		58				
13	06		260	1.00	1.80		05.0		60				
14	09		262	1.00	1.80		07.3		61			2	
15	12	-0.6	262	0.95	1.70		09.5		62				
16	15		260	0.95	1.70		11.7		63				
17	18		260	1.00	1.80		13.9		63				
18	21	-0.6	258	1.00	1.80		16.2		64				
19	24		255	0.95	1.70		18.2		65				
20	27		255	0.90	1.60		20.4		66				
	0930						422.57						
							45.57						

Environmental Technology Engineering Corp.

PARTICULATE FIELD DATA



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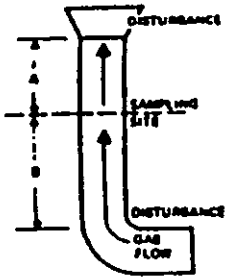


PLANT Payne & Dolan
DATE 10-22-97
LOCATION Sussex
OPERATOR WJD
STACK NO. Control 4
RUN NO. 2
SAMPLE BOX NO. 2
METER BOX NO. 1

AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 28
PROBE LENGTH, in. 5'r
NOZZLE DIAMETER, in. 1/4
STACK DIAMETER, in. 47½ x 47½
PROBE HEATER SETTING -
HEATER BOX SETTING -

METER ΔH, 1.832 } 1.008 9-3-97
C FACTOR
PROCESS WEIGHT RATE

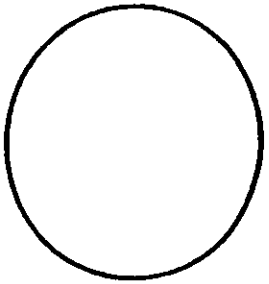
ORSAT RESULTS
CO2
O2
CO
N2
887

LEAK CHECKS
Pre <.01 22"
Pitot 4"
Post <.01 2"
Pitot

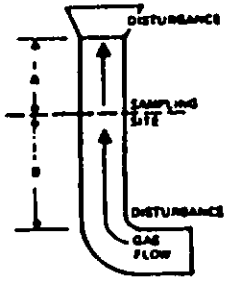
TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s) ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F	SO_2 SAMPLE BOX TEMPERATURE °F	HCOH TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	Beta VELOCITY fps
E 1	0943		255	1.00	1.80		424.00		68	341.28/34	171.18/46	3	232622
2	46		257	1.00	1.80		26.3		68	42.08/38	73.18		260311
3	49	-0.6	260	0.95	1.70		28.5		69	0.80/36			
4	52		258	0.90	1.60		30.7		70	2A			
D 5	55		255	1.05	1.90		32.9		71				
6	58		256	1.00	1.80		35.1		71				
7	0[illegible]	-0.6	256	0.95	1.70		37.3		72	342.67/38			
8	0[illegible]		252	0.95	1.70		39.5		73	43.47/38			
C 9	07		252	1.10	2.00		41.7		73	0.80/38			
10	10		255	1.00	1.80		43.9		73				
11	13		255	1.00	1.80		46.2		74	2B			
12	16	-0.6	252	0.90	1.60		48.5		74				
B 13	19		252	1.15	2.05		50.6		74				
14	22	-0.6	252	1.10	2.00		53.1		75			3	
15	25		255	1.00	1.80		55.4		76				
16	28		255	0.80	1.45		57.7		76				
A 17	31		255	1.20	2.15		59.7		77				
18	34	-0.6	255	1.00	1.80		62.0		78				
19	37		252	0.95	1.70		64.2		78				
20	40		250	0.80	1.45		66.4						
	43						468.45						
							44.45						

Environmental Technology Engineering Corp.

PARTICULATE FIELD DATA



CROSS SECTION



PLANT Payne & Dolan
DATE 10-22-97
LOCATION Sussex
OPERATOR WJD
STACK NO. Control 4
RUN NO. 3
SAMPLE BOX NO. 3
METER BOX NO. 1

AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 28
PROBE LENGTH, in. 5'
NOZZLE DIAMETER, in. 1/4
STACK DIAMETER, in. 47 1/2 x 47 1/2
PROBE HEATER SETTING -
HEATER BOX SETTING

METER ΔH@
C FACTOR
PROCESS WEIGHT RATE

ORSAT RESULTS
CO2
O2
CO
N2

880

LEAK CHECKS
Pre 01 22"
Pitot 4"
Post 01 27"
Pitot 4"

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	SO2 SAMPLE BOX TEMPERATURE °F	FROM TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	Bags VELOCITY fps
1	1057		255	1.20	2.15		70.00		78	344.33/40	173.18/44	8	260311
2	55		255	1.15	2.05		72.3		79	345.13/40	75.18/46		283043
3	58	0.6	254	1.00	1.80		74.7		80	0.80/40 3A	2.00/45		
4	01		250	0.85	1.50		77.0		80				-460
5	04		252	1.20	2.15		79.0		81				
6	07		251	1.00	1.80		81.4		82				
7	10	-0.6	255	0.95	1.70		83.7		82	345.73/40			
8	13		255	0.90	1.60		85.9		83	46.53/42			
9	16		252	1.05	1.90		88.0		83	0.80/41 5B		5	
10	19		250	1.00	1.80		90.3		83				
11	22	-0.6	250	0.95	1.70		92.6		83				
12	25		250	0.95	1.70		94.7		83				
13	28		253	1.05	1.90		96.9		83				
14	31		255	1.00	1.80		99.1		84				
15	34	-0.6	252	1.00	1.80		501.3		84				
16	37		252	0.95	1.70		03.5		84				
17	40		250	1.05	1.90		05.8		84				
18	43		248	1.00	1.80		08.1		84				
19	46		250	0.95	1.70		10.2		84				
20	49		250	0.90	1.60		12.4		84				
	52						514.55						
							44.55						

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME PAYNE & DUAN DATE OF TEST 10-22-97

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 1 STACK CONTROL 4

Sample Box 1 Filter 886 Wash Bottle —

Beaker No. 7

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	322	100	222
2	153	100	53
3	1	0	1
SILGEL	710	704	6
		TOTAL	282

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.1595	1.1195	0.0400
Washings (0.0003)	115.4376	115.4349	0.0024
		TOTAL	0.0424

WATER COLLECTED [ ] GRAMS

PARTICULATE COLLECTED [ ] GRAMS

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME PAYNE FDJAN DATE OF TEST 10-22-97

JOB NO. _____ TEST ENGINEER WJO

RUN NO. 2 STACK CONTROL 4

Sample Box 2 Filter 887 Wash Bottle _____

Beaker No. 8

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	279	100	179
2	119	100	19
3	76	0	76
SIL GEL	663	653	10
		TOTAL	284

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.0994	1.0690	0.0304
Washings (0.0003)	103.1755	103.1730	0.0022
		TOTAL	0.0326

WATER COLLECTED [ ] GRAMS

PARTICULATE COLLECTED [ ] GRAMS

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME PAYNE & DUNAN DATE OF TEST 10-22-97

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 3 STACK CONTROL 4

Sample Box 3 Filter 888 Wash Bottle _____

Beaker No. 9

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	250	100	150
2	160	100	60
3	68	0	68
SIL GEL	648	643	5
		TOTAL	283

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.2096	1.1854	0.0242
Washings (0 0003)	102.1668	102.1650	0.0015
		TOTAL	0.0257

WATER COLLECTED [ ] GRAMS

PARTICULATE COLLECTED [ ] GRAMS

NOTES:

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

Sample Analysis Certificate

Environmental Technology and Engineering, Inc.
13000 West Bluemound Rd.
Elm Grove, WI 53122

Date:	11/17/97
Project ID:	1097045
Sample Date:	10/24/97
Sample Time:	NA
Date Received:	10/28/97

Attn: Bill Dick
Project #: 2222
Sampled by: NA

FORMALDEHYDE ANALYSIS BY METHOD TO-5

Project: 1097019

Lab Id:	Client Id:	Analyte	Total ug	Q
1097045-1	C4-1	Formaldehyde	1796.45	D
1097045-2	C4-2	Formaldehyde	1491.20	D
1097045-3	C4-3	Formaldehyde	1745.70	D
1097045-4	C4-Blank	Formaldehyde	0.76	
1097045-MB	Method Blank	Formaldehyde	0.07	ND

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

Reviewed and approved for release by: _____ Date: 11/17/97
President

PAYNE & DOLAN
CONTROL 4 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	22.5	3.0	1.75	0.02	0.010	4.156	163.28	0.80	1.065	31	29.35	0.899	0.025	61894	22.28
1B	18.7	3.0	2.15	0.02	0.010	4.253	168.44	0.80	1.065	35	29.35	0.891	0.025	61894	22.98
AVG							165.86								22.63
2A	18.5	3.0	2.00	0.02	0.010	3.911	155.22	0.80	1.065	36	29.35	0.890	0.025	60698	20.77
2B	18.8	3.0	1.90	0.02	0.010	3.774	150.37	0.80	1.065	38	29.35	0.886	0.025	60698	20.12
AVG							152.79								20.45
3A	18.5	3.0	2.05	0.02	0.010	4.010	160.42	0.80	1.065	40	29.35	0.883	0.025	61289	21.68
3B	18.0	3.0	2.05	0.02	0.010	3.901	156.40	0.80	1.065	41	29.35	0.881	0.025	61289	21.13
AVG							158.41								21.40

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