AP42 Section: 11.1

Reference Number: 384

Title: Stack Emission Test, Northeast Asphalt, Inc., Control 65 Plant, Green Bay, WI,

Environmental Technology and Engineering Corporation, Elm Grove, WI,

June 24, 1999.

Benzene

Sec. 11.1
Ref. 384

Report to

NORTHEAST ASPHALT, INC.

Waukesha, Wisconsin

for

STACK EMISSION TEST
CONTROL 65 PLANT
FID NO. 998375510
June 24, 1999

by

ENVIRONMENTAL TECHNOLOGY & ENGINEERING CORPORATION

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ETE

SUMMARY

On June 24, 1999, Environmental Technology & Engineering Corp. personnel performed stack emissions testing at the Northeast Asphalt, Inc. Control 65 stationary plant located in Green Bay, Wisconsin. The tests were performed as a provision of an 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 benzene. Simultaneous visible emissions testing was also performed by a certified observer from Northeast Asphalt. All measured particulate emissions were well below the limits shown in the following table:

TEST NO.	PARTICULATE	FORMALDEHYDE	BENZENE
1	0.002 gr/dscf	0.0012 lb/ton	0.0003 lb/ton
2	0.002	0.0013	0.0003
3	0.002	0.0015	0.0003
AVERAGE	0.002 gr/dscf	0.0013 lb/ton	0.0003 lb/ton
DNR LIMIT	0.039	NA	NA
% OF LIMIT	5.1 %	NA	NA

All individual opacity observations were 0 %.

1.0 GENERAL

On June 24, 1999, Environmental Technology & Engineering Corp. (ETE) personnel performed stack emissions testing at the Northeast, Inc. Control 65 stationary counterflow plant located in Green Bay, Wisconsin. The purpose of the testing was to determine the particulate emissions from the plant as a condition of an Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources (WDNR). The facility Identification Number (FID) for this plant is 998375510. Formaldehyde testing was also performed as a condition of a BACT requirement for the plant. Benzene testing was also performed at this time in order to determine a plant specific emission factor. Visible emission testing was also performed simultaneously with these tests by a certified observer from Northeast Asphalt. This data is also included in this report.

Pete Tolsma and Bob Willis of Northeast Asphalt were responsible for assuring proper operating conditions throughout the testing. During the test the plant production rate was approximately 450 tons per hour and included approximately 20 to 25 % recycled asphalt. The plant was fired with natural gas. A log of plant activity throughout the test was kept and is included in the APPENDIX. All testing was coordinated with the plant operator. Randy Matty of the DNR was notified of the tests but did not witness. 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. Benzene samples were collected and analyzed in accordance with EPA Method 18. 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. Formaldehyde results are included as Table 2-4 and benzene results as Table 2-5. All results were well below the permit limits. The results are summarized below:

TEST NO.	PARTICULATE	FORMALDEHYDE	BENZENE
1	0.002 gr/dscf	0.0012 lb/ton	0.0003 lb/ton
2	0.002	0.0013	0.0003
3	0.002	0.0015	0.0003
AVERAGE	0.002 gr/dscf	0.0013 lb/ton	0.0003 lb/ton
DNR LIMIT	0.039	NA	NA
% OF LIMIT	5.1 %	NA	NA

All individual opacity observations were 0 %. Copies of these data sheets are included in the APPENDIX.

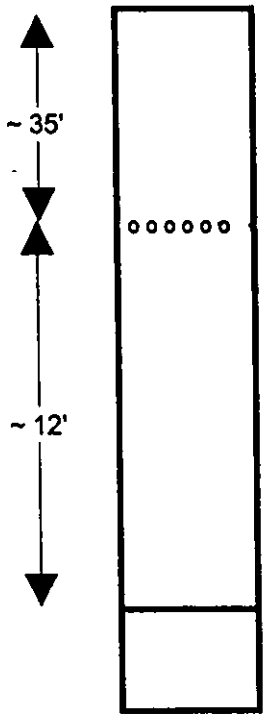
NORTHEAST ASPHALT
CONTROL 65
FIGURE 2-1

SAMPLE POINT LOCATION

Point	Distance in
1	5.9
2	17.8
3	29.7
4	41.6

TEST PORT LOCATION

L	62.5
W	47.5



NORTHEAST ASPHALT **24-Jun-99** **CONTROL 65** **TABLE 2-1**

TEST NO.	1			
BAROMETRIC PRESSURE	29.30	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	47.5	IN	62.5	IN
STACK AREA	20.616	FT3		
SAMPLING TIME PER POINT	2.5	MIN		
NUMBER OF POINTS	24			
METER VOLUME	36.38	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.013			
PARTICULATE COLLECTED	0.0053	GRAMS		
WATER COLLECTED	377	ML		
STATIC PRESSURE	-0.50	IN H2O		

ORSAT RESULTS

CO2	**O2**	**CO**	**N2**
3.80%	14.20%	0.00%	82.00%

POINT	**STACK TEMP** DEG F	**DELTA P** IN H2O	**ORIFICE DEL P** IN H2O	**METER TEMP** DEG F	**VELOCITY** AFPS
1	288	1.50	2.60	72	88.05
2	288	1.00	1.70	72	71.89
3	290	0.75	1.30	73	62.34
4	290	1.00	1.70	73	71.99
5	292	0.90	1.55	75	68.38
6	290	0.75	1.30	76	62.34
7	290	0.50	0.85	78	50.90
8	288	0.90	1.55	80	68.20
9	290	0.75	1.30	82	62.34
10	292	0.50	0.85	83	50.97
11	292	0.55	0.95	85	53.46
12	290	1.05	1.80	85	73.76
13	287	0.80	1.35	88	64.26
14	290	0.55	0.95	90	53.39
15	292	0.50	0.85	91	50.97
16	290	1.00	1.70	92	71.99
17	292	0.85	1.45	93	66.46
18	290	0.75	1.30	94	62.34
19	290	0.55	0.95	95	53.39
20	290	1.00	1.70	96	71.99
21	295	1.00	1.70	96	72.23
22	292	0.80	1.35	97	64.47
23	290	0.80	1.35	98	64.39
24	288	1.00	1.70	98	71.89
AVERAGE	290		1.41	86	64.68

DRY STANDARD VOLUME	36.29	SCF
PERCENT WATER VAPOR	32.84	% VOL
FLOW RATE	80010	ACFM
	36985	DSCFM
	62845	M3/HR
PARTICULATE CONCENTRATION	0.002	GR/DSCF
PARTICULATE EMISSION RATE	0.73	LB/HR
LB PART PER 1000 LB GAS	0.003	
ISOKINETIC PERCENT	103.0	

NORTHEAST ASPHALT | 24-Jun-99 | CONTROL 65 | TABLE 2-2

TEST NO.	2			
BAROMETRIC PRESSURE	29.30	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	47.5	IN	62.5	IN
STACK AREA	20.616	FT3		
SAMPLING TIME PER POINT	2.5	MIN		
NUMBER OF POINTS	24			
METER VOLUME	35.65	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.013			
PARTICULATE COLLECTED	0.0035	GRAMS		
WATER COLLECTED	364	ML		
STATIC PRESSURE	-0.50	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.20%	14.00%	0.00%	81.80%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	295	1.00	1.70	102	72.11
2	292	0.85	1.45	102	66.35
3	295	0.90	1.55	103	68.41
4	290	1.00	1.70	104	71.87
5	295	0.95	1.60	105	70.28
6	296	0.80	1.35	105	64.54
7	297	0.60	1.00	105	55.93
8	297	0.95	1.60	105	70.38
9	300	1.00	1.70	106	72.35
10	300	0.70	1.15	106	60.53
11	295	0.55	0.90	108	53.48
12	292	0.85	1.45	110	66.35
13	292	0.75	1.25	111	62.33
14	293	0.75	1.25	111	62.37
15	292	0.50	0.85	111	50.89
16	290	1.00	1.70	112	71.87
17	290	0.90	1.55	114	68.18
18	290	0.55	0.90	114	53.30
19	291	0.65	1.10	115	57.98
20	290	1.00	1.70	115	71.87
21	291	1.50	2.50	117	88.08
22	292	0.85	1.45	118	66.35
23	290	0.85	1.45	119	66.26
24	290	1.10	1.80	120	75.38
AVERAGE	293		1.44	110	66.14

DRY STANDARD VOLUME	35.66	SCF
PERCENT WATER VAPOR	32.45	% VOL
FLOW RATE	81818	ACFM
	37895	DSCFM
	64391	M3/HR
PARTICULATE CONCENTRATION	0.002	GR/DSCF
PARTICULATE EMISSION RATE	0.49	LB/HR
LB PART PER 1000 LB GAS	0.002	
ISOKINETIC PERCENT	98.8	

NORTHEAST ASPHALT | 24-Jun-99 | CONTROL 65 | TABLE 2-3

TEST NO.	3			
BAROMETRIC PRESSURE	29.30	IN HG		
TIP DIAMETER	0.245	IN		
STACK DIMENSIONS	47.5	IN	62.5	IN
STACK AREA	20.616	FT3		
SAMPLING TIME PER POINT	2.5	MIN		
NUMBER OF POINTS	24			
METER VOLUME	35.37	FT3		
PITOT COEFFICIENT	0.84			
METER COEFFICIENT	1.013			
PARTICULATE COLLECTED	0.0043	GRAMS		
WATER COLLECTED	341	ML		
STATIC PRESSURE	-0.50	IN H2O		

ORSAT RESULTS

CO2	O2	CO	N2
4.00%	13.80%	0.00%	82.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	290	1.50	2.50	120	87.82
2	291	0.95	1.60	121	69.94
3	291	0.80	1.35	121	64.18
4	290	1.00	1.70	121	71.71
5	285	0.80	1.35	122	63.92
6	286	0.55	0.90	122	53.04
7	286	0.60	1.00	123	55.40
8	285	1.00	1.70	124	71.47
9	287	0.85	1.45	126	65.98
10	290	0.70	1.15	127	59.99
11	291	0.50	0.85	127	50.74
12	290	1.00	1.70	127	71.71
13	295	0.95	1.60	127	70.12
14	295	0.85	1.45	128	66.33
15	295	0.60	1.00	128	55.73
16	292	1.00	1.70	129	71.80
17	295	0.95	1.60	129	70.12
18	294	0.80	1.35	129	64.31
19	293	0.55	0.90	129	53.29
20	290	1.00	1.70	129	71.71
21	292	1.00	1.70	130	71.80
22	292	0.85	1.45	130	66.20
23	291	0.75	1.25	130	62.14
24	290	1.00	1.70	130	71.71
AVERAGE	291		1.44	126	65.88

DRY STANDARD VOLUME	35.45	SCF
PERCENT WATER VAPOR	31.17	% VOL
FLOW RATE	81494	ACFM
	38590	DSCFM
	65572	M3/HR
PARTICULATE CONCENTRATION	0.002	GR/DSCF
PARTICULATE EMISSION RATE	0.61	LB/HR
LB PART PER 1000 LB GAS	0.003	
ISOKINETIC PERCENT	96.4	

NORTHEAST ASPHALT
CONTROL 65 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
65-1	2.02	95	54.68	214.03	3.91	62845	0.54	451	0.0012
65-2	2.00	98	53.85	215.93	4.01	64391	0.57	451	0.0013
65-3	2.00	100	53.66	251.98	4.70	65572	0.68	451	0.0015
		AVERAGE			4.21		0.60		0.0013

Meter Gama 1.026
Bar.Pressure 29.30

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

GAS CHROMATOGRAPH ANALYSIS SHEET
METHOD 18 DATA

TABLE 2-6

CLIENT — NORTHEAST ASPHALT
PROCESS/STACK — Control 65 Plant
CALIBRATION FACTORS

PARAMETER	STD ug	STD AREA	FACTOR
Benzene	14.6	215676	6.769E-05

RECOVERY FACTOR 1.00

TEST			
1	PUMP	SKC2	
	PUMP CAL	0.440	cc/count
	PUMP COUNTS	23706	counts
	SAMPLE VOLUME	10.43	std liters
	PEAK AREA	126075	
	WT OF BENZENE	8.53	ug
	BENZ CONCENTRATION	0.82	mg/m3
	BENZ EMISSION RATE	0.113	lb/hr
	STACK FLOW RATE	62845	m3/hr
	PRODUCTION RATE	451	tph
	BENZENE EMISSION FACTOR	0.0003	lb/ton
TEST			
2	PUMP	SKC2	
	PUMP CAL	0.440	cc/count
	PUMP COUNTS	22699	counts
	SAMPLE VOLUME	9.99	std liters
	PEAK AREA	142070	
	WT OF BENZENE	9.62	ug
	BENZ CONCENTRATION	0.96	mg/m3
	BENZ EMISSION RATE	0.137	lb/hr
	STACK FLOW RATE	64391	m3/hr
	PRODUCTION RATE	451	tph
	BENZENE EMISSION FACTOR	0.0003	lb/ton
TEST			
3	PUMP	SKC2	
	PUMP CAL	0.440	cc/count
	PUMP COUNTS	23713	counts
	SAMPLE VOLUME	10.43	std liters
	PEAK AREA	124527	
	WT OF BENZENE	8.43	ug
	BENZ CONCENTRATION	0.81	mg/m3
	BENZ EMISSION RATE	0.117	lb/hr
	STACK FLOW RATE	65572	m3/hr
	PRODUCTION RATE	451	tph
	BENZENE EMISSION FACTOR	0.0003	lb/ton

AVERAGE BENZENE EMISSION RATE	0.122	lb/hr
AVERAGE BENZENE EMISSION FACTOR	0.0003	lb/ton

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.

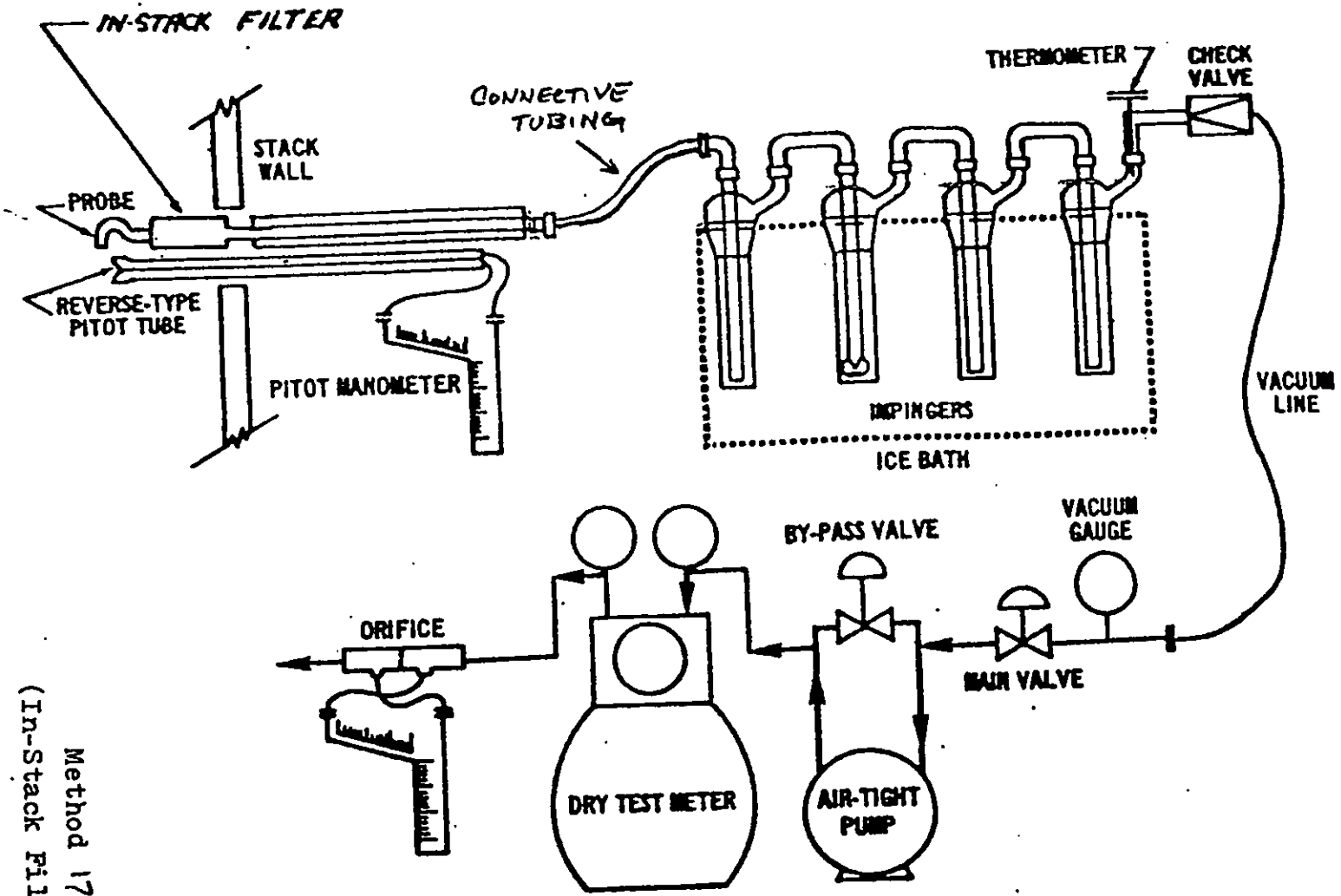
The temperatures of the stack gas stream, as well as strategic locations within the sampling devices, were monitored by RTDs and read directly from a gauge on the control unit.

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 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.

3.2 Benzene

Sampling for benzene was performed in accordance with EPA Method 18 - "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography." Samples were drawn from the exhaust gas stream onto solid sorbent tubes (charcoal for benzene and chlorobenzenes) using an SKC pump with a stroke counter to measure the sample volume. A minimum of two tubes were placed in series. A "drip" impinger was used prior to the tubes to eliminate moisture. At the completion of the tests the tubes were desorbed and analyzed by a gas chromatograph equipped with a flame ionization detector.

Standard concentrations of the benzene were prepared by injecting a known quantity into a tube and then desorbing and analyzing the tube in the same manner as the samples.

The concentrations of the exhaust gas stream were then determined by comparing the response of the standards to the response to the exhaust stack samples. Sample retention times and peak heights were used to quantify both the benzene and chlorobenzene emissions. The compound concentrations were then used in conjunction with the exhaust gas flow rates to determine organic compound emission rates in units of pounds per hour (lb/hr).

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.	1.819
Dry Gas Meter	1.013

4.2 Other Parameters

A dry gas meter and a calibrated pump were used to determine the sample volumes obtained in the formaldehyde and benzene tests. These were both calibrated with a wet test meter. The values obtained were:

Formaldehyde Meter	1.026
Benzene Pump	0.440 cc/count

APPENDIX A

Field and Laboratory Data

(1)

Department of Natural Resources

SMOKE FORM
Form 4500-29 Rev. 6-85

Name of Company: Northeast Asphalt, Inc	Date: June 24, 1999
Location: Green Bay	FID Number: 998375 510
City, State, Zip Code: WI	Observer Certification Date: April 13, 1999
Discharge Location: Stack Tip	Control Device: Baghouse
Height of Discharge Above Ground: 60'	Steam Plume? Attached (Yes) Detached (No)

	Initial		Final
Time of Observation	07:45.00		09:44.55
Observer Location			
Distance to Discharge	250'		
Direction from Discharge	SSE		
Height of Observation Point in Relation to Discharge	55' below		
Plume Description (Color, Length, etc.)	Water Vapor, 200' long		
Plume Background Description	Sky		
Weather Conditions			
Wind Direction	WSW		
Wind Speed	10mph		
Ambient Temperature	70°F		
Sky Conditions (clear, overcast, % clouds, etc.)	Clear		

Describe Point in Plume at Which Opacity was Determined
within 10' of stack tip discharge point

Remarks:

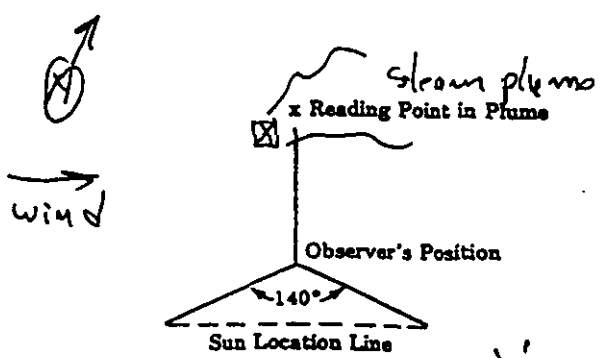
(1) Combusting Natural Gas

(2) Hot mix Production @ ~~4500~~ average 451 tons/hour (20% RAP).

(3) NSPS testing of new plant

Signature of Observer	Name of Observer (Please print)
Peter Tolsma	Peter Tolsma

Sketch of Observer, Discharge, and Sun Location.



SEC MIN	0	15	30	45	SEC MIN	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Summary of Average Opacity
(From Computer Program)

Set Number	Time: Start — End	Opacity: Sum	Opacity: Average

Allowable Source Opacity

20%

10
sun

(5)

Department of Natural Resources

SMOKE FORM
Form 4500-29 Rev. 6-85

Name of Company: Northeast Asphalt, Inc.	Date: June 24, 1999
Location: Green Bay	FID Number: 998375510
City, State, Zip Code: WI	Observer Certification Date: April 13, 1999
Discharge Location: Stack Tip	Control Device: Baghouse
Height of Discharge Above Ground: 60'	Steam Plume? Attached Yes Detached (No)

	Initial		Final
Time of Observation	09:45.00		10:44.45
Observer Location Distance to Discharge	250'		10:44.45
Direction from Discharge	SSE		
Height of Observation Point in Relation to Discharge	57' below		
Plume Description (Color, Length, etc.)	No plume		
Plume Background Description	sky		
Weather Conditions Wind Direction	WSW		
Wind Speed	5~10 mph		
Ambient Temperature	75°F		
Sky Conditions (clear, overcast, % clouds, etc.)	clear		

Describe Point in Plume at Which Opacity was Determined
Within 10' of stack tip discharge point

Remarks:
① No steam plume
② No visible particulate or organic vapor plumes

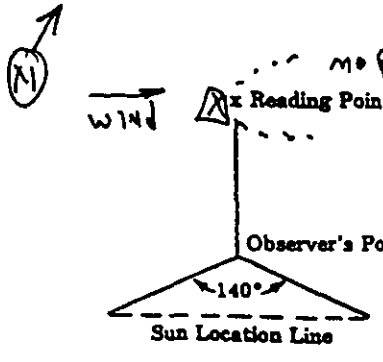
SEC MIN	0	15	30	45	SEC MIN	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Summary of Average Opacity
(From Computer Program)

Set Number	Time Start -- End	Opacity Sum	Opacity Averag

Signature of Observer: Peter Tolsma
Name of Observer (Please print): Peter Tolsma

Sketch of Observer, Discharge, and Sun Location.



Allowable Source Opacity

20%

-0- Sum!

(7)

Department of Natural Resources

(3)

SMOKE FORM
Form 4500-29 Rev. 6-85

Name of Company: Northwest Asphalt, Inc.	Date: June 24, 1999
Location: Broom Bay	FID Number: 998 375 510
City, State, Zip Code: WI	Observer Certification Date: April 13, 1999
Discharge Location: Stack Tip	Control Device: Baghouse
Height of Discharge Above Ground: 60'	Steam Plume? Attached / Yes / Detached / (No)

	Initial		Final
Time of Observation	10:45.00		11:44.45
Observer Location	10:45.04		
Distance to Discharge	250		
Direction from Discharge	SSE		
Height of Observation Point in Relation to Discharge	-57'		
Plume Description (Color, Length, etc.)	No plume		
Plume Background Description	sky		
Weather Conditions			
Wind Direction	WSW		
Wind Speed	10~15mph		
Ambient Temperature	80°F		80°+, F
Sky Conditions (clear, overcast, % clouds, etc.)	10% cumulus		10~15 % cumulus

Describe Point in Plume at Which Opacity was Determined

Remarks:

(1) No plumes visible

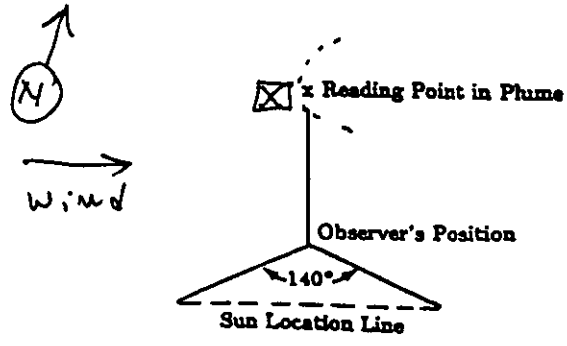
SEC MIN	0	15	30	45	SEC MIN	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Summary of Average Opacity
(From Computer Program)

Set Number	Time Start — End	Opacity Sum	Opacity Avera

Signature of Observer: Peter Tolsma	Name of Observer (Please print): Peter Tolsma

Sketch of Observer, Discharge, and Sun Location.



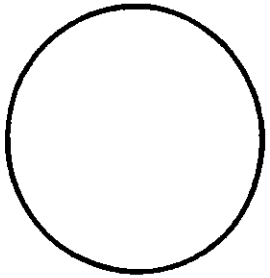
Allowable Source Opacity

20%

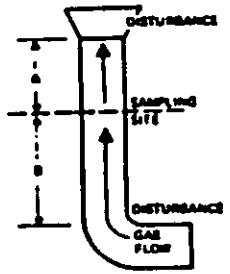
(3)

Environmental Technology Engineering Corp.

PARTICULATE FIELD DATA



CROSS SECTION



PLANT NEA
DATE 6.24.99
LOCATION GREENBAY
OPERATOR WJP
STACK NO. CONTROL 65
RUN NO. 3
SAMPLE BOX NO. 4
METER BOX NO. 1

AMBIENT TEMPERATURE 85
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 28
PROBE LENGTH, in. 5'+
NOZZLE DIAMETER, in. 1/4
STACK DIAMETER, in. 47.0 x 62
PROBE HEATER SETTING -
HEATER BOX SETTING -

METER ΔH,
C FACTOR
PROCESS WEIGHT RATE ~450 TPH

ORSAT RESULTS (INT)
CO2 20
O2 13.8
CO
N2

LEAK CHECKS
Pre OK
Pitot OK
on Post 4.01 21"
on Pitot 4.2"

TRAVERSE POINT NUMBER	SAMPLING TIME (A), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD ($\sqrt{P_s}$) ($\sqrt{\Delta P_s}$)	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	HCl/H SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	Beta VELOCITY fps	
A1	1100		290	1.50	2.50		670.00		120	716.79/99	35	5	494527	
2	07		291	.95	1.60		720		121					
3	07	-0.55	291	.80	1.35		73.5		121					
4	07+		290	1.00	1.70		75.0		121					
B 5	10/14		285	.80	1.35		76.5		122		38	4		
6	13		286	.55	.90		77.9		122					
7	15+	-0.50	286	.60	1.00		79.2		123					
8	18		285	1.00	1.70		80.5		124					
C9	20/21		287	.85	1.45		82.1		126		40	4		
10	23+		290	.70	1.15		83.5		127					
11	26	-0.50	291	.50	.85		84.8		127	717.71				
12	28		290	1.00	1.70		86.0		127					
D13	31/31+		295	.95	1.60		87.4		127		42	4		
14	34		295	.85	1.45		89.2		128					
15	36+	-0.50	295	.60	1.00		90.6		128					
16	39		292	1.00	1.70		91.8		129					
E17	41+/42		295	.95	1.60		93.5		129		45	4		
18	44+	-0.50	294	.80	1.35		95.1		129					
19	47		293	.55	.90		96.5		129					
20	49+		290	1.00	1.70		97.7		129					
F21	52/52+		292	1.00	1.70		99.3	(35.37)	130		48	4		
22	55	-0.55	292	.85	1.45		701.0		130					
23	57+		291	.75	1.25		02.5		130					
24	00		290	1.00	1.70		03.5		130					
	1705						705.37			718.29/100 (2 (3)/10')			498240 (93 713)	

Environmental Technology & Engineering Corp.

PARTICULATE FIELD DATA

PLANT NEA
DATE 6.24.99
LOCATION GREEN BAY
OPERATOR WJD
STACK NO. CONTROL 6J
RUN NO. 2
SAMPLE BOX NO. 3
METER BOX NO. 1

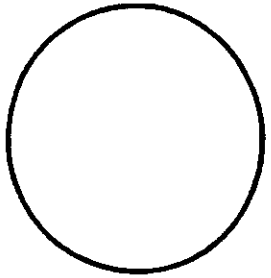
AMBIENT TEMPERATURE 80
BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 28
PROBE LENGTH, in. 5'+
NOZZLE DIAMETER, in. 1/4
STACK DIAMETER, in. 97½ x 62½
PROBE HEATER SETTING -
HEATER BOX SETTING -

METER ΔH
C FACTOR
PROCESS WEIGHT RATE ~450 TPH

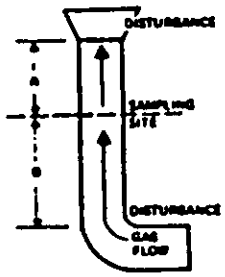
ORSAT RESULTS (INT)
CO2 1.2
O2 12.0
CO
N2

071

LEAK CHECKS
Pre 0/4
Pitot OK
Post 1.21
Pitot 6"L



CROSS SECTION



TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min. (5pt)	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	HCOH: SAMPLE BOX TEMPERATURE F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	BENZ: VELOCITY fps
E 1	0950		295	1.00	1.70		633.00		102	714.76/99	39	4	451828
2	5?		292	.85	1.45		39.6		102				
3	55	-0.50	295	.90	1.55		36.1		103				
4	51+		290	1.00	1.70		37.7		104			4	
E 5	00/02		295	.95	1.60		39.3		105		38	4	
6	03		296	.80	1.35		40.8		105				
7	05?	-0.50	297	.60	1.00		42.4		105				
8	08		297	.95	1.60		43.7		105				
P 9	10?/11		300	1.00	1.70		45.2		106		40	4	
10	13+		300	.70	1.15		46.9		106				
11	16	-0.55	295	.55	.90		48.2		108				
12	18+		292	.85	1.45		49.4		110	715.70/			
C 13	21/24		293	.75	1.25		50.9		111		42	5	
14	24		293	.75	1.25		52.2		111				
15	27+	-0.50	292	.50	.85		53.6		111				61,700
16	29		290	1.00	1.70		54.8		112				
B 17	31-/32+		290	.90	1.55		56.4		114		43	4	
18	35+		295	.55	.90		58.0		114				
19	37	-0.50	291	.65	1.10		59.2		115				
20	39-		290	1.00	1.70		60.3		115				
A 21	42/43+		291	1.50	2.55		62.2		117		45	5	
22	45	-0.55	292	.85	1.41		64.2	(35.65)	118				
23	47-		290	.85	1.45		65.6		119				
24	50		290	1.10	1.50		67.0	"	120				
	1052						669.62			716.76/99			476527

(7.21.99)

Environmental Technology Engineering Corp.

PARTICULATE FIELD DATA

δ - 1.013
Cp · 0.84 {6-1-00

PLANT NEA
DATE 6-24-99
LOCATION GREEN BAY
OPERATOR WJD
STACK NO. CONTROL 65
RUN NO. 1
SAMPLE BOX NO. 2
METER BOX NO. 1

AMBIENT TEMPERATURE 75
BAROMETRIC PRESSURE 29.50
ASSUMED MOISTURE, % 28
PROBE LENGTH, in. 5'+
NOZZLE DIAMETER, in. 1/4
STACK DIAMETER, in. 47⅞ x 62½
PROBE HEATER SETTING -
HEATER BOX SETTING -

METER ΔH, 1.819
C FACTOR
PROCESS WEIGHT RATE ~650 TPH

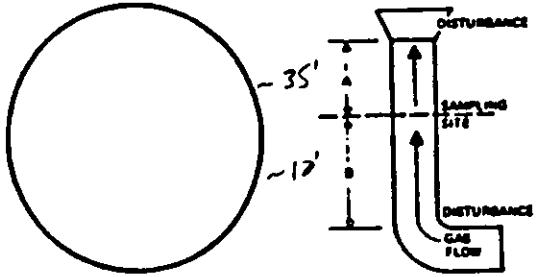
ORSAT RESULTS

	INIT
CO2	3.8
O2	17.2
CO	
N2	
	070

LEAK CHECKS

Pre ok
Pitot ok
ok Post " 01 21"
ok Pitot 4"

CROSS SECTION



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 (1HCOH Y=1.026)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. H_g gauge	Blank #2 (.640) VELOCITY fps
A1	0840		282	1.50	1.60		596.00		72	712.7/90	35	4	428122
2	47+	-0.55	288	1.00	1.10		98.2		72				
3	5+		290	.75	1.30		99.9		73				
4	57+		290	1.00	1.70		601.4		73			3	
B5	55/56+		292	.90	1.55		03.1		75		40		
6	53	-0.50	290	.75	1.30		04.8		76				
7	55+		290	.50	.85		06.2		78				
8	58		288	.90	1.55		07.5		80			3	
C9	00+/01		290	.75	1.30		09.1		82		42		
10	03+		292	.50	.85		10.6		83				
11	06	-0.50	292	.55	.95		11.9		80				435012
12	08+		290	1.05	1.80		13.2		85	713.80			
D13	11/11+		287	.80	1.35		15.0		88		45		
14	14		290	.55	.95		16.4		90				
15	16+	-0.50	292	.50	.85		17.7		91				
16	19		290	1.00	1.70		18.9		92			4	
E17	21+/22		292	.85	1.45		20.4		93		48		
18	24+		290	.75	1.30		21.9		94				
19	27	-0.55	290	.55	.95		23.3		95			3	
20	29+		290	1.00	1.70		24.6		96				
F21	32/33+		295	1.00	1.70		26.2		96		50	4	
22	35		292	.80	1.35		27.9	(36.38)	97				
23	37+	-0.50	290	.80	1.35		29.3		98				
24	40		288	1.00	1.70		30.8		98			4	
	0967/40						632.38			710.76/96 (713.82/95)			435122 (239.6)

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME P&D C #65 DATE OF TEST 6-24-99

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 1 STACK Baghouse

Sample Box 1 Filter 7-070 Wash Bottle —

Beaker No. 1

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	367	100	267
2	182	100	82
3	7	0	7
Sil Gel	644	633	11
		TOTAL	377

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.1201	1.1159	0.0042
Washings (0.0003)	106.3264	106.3250	0.0011
		TOTAL	0.0053

WATER COLLECTED [ ] GRAMS

PARTICULATE COLLECTED [ ] GRAMS

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME P&D C-65 DATE OF TEST 6-24-99

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 2 STACK Baghouse

Sample Box 2 Filter T-071 Wash Bottle. —

Beaker No. 2

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	302	100	202
2	251	100	151
3	3	0	3
SILICA GEL	641	633	8
		TOTAL	364

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.0837	1.0805	0.0032
Washings (0.0003)	110.5620	110.5614	0.0003
		TOTAL	0.0035

WATER COLLECTED [ ] GRAMS

PARTICULATE COLLECTED [ ] GRAMS

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME P.D C65 DATE OF TEST 6.24.99

JOB NO. _____ TEST ENGINEER WJD

RUN NO. 2 STACK Baghouse

Sample Box 3 Filter T-072 Wash Bottle —

Beaker No. 3

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
1	287	100	187
2	246	100	146
3	3	0	3
SIL GEL	683	678	5
		TOTAL	341

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	1.0410	1.0371	0.0039
Washings (0.0003)	94.1771	94.1764	0.0004
		TOTAL	0.0043

WATER COLLECTED [ ] GRAMS

PARTICULATE COLLECTED [ ] GRAMS

NOTES:

ASPHALT PLANT STACK TEST DATA

Control # 65

Date

FID # 998375510

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	70		448	331	23	20	320	326	.40	4.2				
8:45	70		451	335	23	20	310	330	.38	4.3				
9:00	71		447	328	23.6	20	317	337	.37	4.4				
9:15	67		452	343	17.5	20	324	332	.41	4.4				
9:30	64		454	345	17.5	20	314	317	.42	4.2				
9:45	72		445	330	23.0	20	310	337	.40	4.2				
10:00	70		349	334	23.1	20	315	326	.38	4.2				
10:15	66		455	341	17.6	20	322	322	.40	4.0				
10:30	62		453	343	17.6	20	310	312	.40	3.8				
10:45	62		451	342	17.0	25	312	313	.44	3.8				
11:00	62		455	343	17.0	25	318	319	.38	3.8				
11:15	64		450	340	23.0	20	311	321	.42	4.0				
11:30	66		455	344	23.3	20	309	320	.38	3.8				
11:45	62		457	347	17.8	20	318	318	.40	3.8				
12:00	60		450	340	17.4	20	307	308	.36	3.6				
12:15	65		449	338	22.5	20	314	316	.40	4.2				

Fuel Type Natural Gas Sulfur in Fuel 0 %

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

COMPUTETESTDATA WK1

Average TPH = 451

Data Summary Table

Project 0699036
Method 0011

Client ID	Lab ID	ug/ml	ml ext	ug Total	q
65-1	0699036-1	17.836	12	214.03	
65-2	0699036-2	15.995	13.5	215.93	
65-3	0699036-3	19.383	13	251.98	
65-BLANK	0699036-4	0.205	14	2.87	
MCC-1 IN	0699036-5	66.7	19.5	1300.65	D
MCC-1 OUT	0699036-6	7.627	15	114.41	
MCC-2 IN	0699036-7	121.7	19.5	2373.15	D
MCC-2 OUT	0699036-8	9.086	18	163.55	
MCC-3 IN	0699036-9	130.3	17	2215.10	D
MCC-3 OUT	0699036-10	7.702	21.5	165.59	
MCC BLANK	0699036-11	0.13	19	2.47	

				%Recovery
0699036-MB	ND(.05)	14.5	0.73	
0699036-LS	0.946	14	13.24	88.30%
0699036-LSD	1.078	14	15.09	100.60%

D = Dilution result

GAS CHROMATOGRAPH ANALYSIS SHEET
METHOD 18 DATA

CLIENT — NORTHEAST ASPHALT
PROCESS/STACK — Control 65 Plant
CALIBRATION FACTORS

PARAMETER	STD ug	STD AREA	FACTOR
Benzene	14.6	215676	6.769E-05

RECOVERY FACTOR 1.00

TEST			
1	PUMP	SKC2	
	PUMP CAL	0.440	cc/count
	PUMP COUNTS	23706	counts
	SAMPLE VOLUME	10.43	std liters
	PEAK AREA	126075	
	WT OF BENZENE	8.53	ug
	BENZ CONCENTRATION	0.82	mg/m3
	BENZ EMISSION RATE	0.113	lb/hr
	STACK FLOW RATE	62845	m3/hr
	PRODUCTION RATE	451	tph
	BENZENE EMISSION FACTOR	0.0003	lb/ton
TEST 2	PUMP	SKC2	
	PUMP CAL	0.440	cc/count
	PUMP COUNTS	22699	counts
	SAMPLE VOLUME	9.99	std liters
	PEAK AREA	142070	
	WT OF BENZENE	9.62	ug
	BENZ CONCENTRATION	0.96	mg/m3
	BENZ EMISSION RATE	0.137	lb/hr
	STACK FLOW RATE	64391	m3/hr
	PRODUCTION RATE	451	tph
	BENZENE EMISSION FACTOR	0.0003	lb/ton
TEST 3	PUMP	SKC2	
	PUMP CAL	0.440	cc/count
	PUMP COUNTS	23713	counts
	SAMPLE VOLUME	10.43	std liters
	PEAK AREA	124527	
	WT OF BENZENE	8.43	ug
	BENZ CONCENTRATION	0.81	mg/m3
	BENZ EMISSION RATE	0.117	lb/hr
	STACK FLOW RATE	65572	m3/hr
	PRODUCTION RATE	451	tph
	BENZENE EMISSION FACTOR	0.0003	lb/ton

AVERAGE BENZENE EMISSION RATE	0.122	lb/hr
AVERAGE BENZENE EMISSION FACTOR	0.0003	lb/ton

APPENDIX B

Sample Calculations

SAMPLE PARTICULATE CALCULATION SHEET

TEST NO.	Sample	
BAROMETRIC PRESSURE (Pb)	29.45	IN HG
TIP DIAMETER (d)	0.305	IN
STACK DIAMETER (D)	72	IN
STACK AREA (As=PI*D^2/576)	28.274	FT3
SAMPLING TIME PER POINT	2.5	MIN
NUMBER OF POINTS	24	
METER VOLUME (Vm)	66.53	FT3
PITOT COEFFICIENT (cp)	0.84	
METER COEFFICIENT (GAMA)	0.990	
PARTICULATE COLLECTED (Mn)	0.0500	GRAMS
WATER COLLECTED (Vf-Vl)	32	ML
STATIC PRESSURE (Ps)	-0.5	IN H2O

ORSAT RESULTS

CO2	O2	CO	N2
6.40%	13.40%	0.00%	80.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	275	0.32	2.20	35	37.52
2	280	0.37	2.55	38	40.48
3	278	0.37	2.55	40	40.42
4	278	0.40	2.80	41	42.03
5	280	0.50	3.50	43	47.05
6	281	0.70	4.90	44	55.71
7	282	0.72	5.00	44	56.54
8	280	0.72	5.00	44	56.46
9	280	0.62	4.30	45	52.40
10	277	0.57	3.90	46	50.14
11	276	0.65	4.50	47	53.50
12	275	0.60	4.20	48	51.37
13	282	0.70	4.90	50	55.75
14	283	0.82	5.70	53	60.38
15	282	0.85	6.00	56	61.43
16	283	0.75	5.20	60	57.74
17	280	0.59	4.10	62	51.11
18	280	0.60	4.20	65	51.54
19	280	0.60	4.20	67	51.54
20	278	0.65	4.50	70	53.58
21	279	0.72	5.00	72	56.43
22	280	0.72	5.00	74	56.46
23	277	0.65	4.50	75	53.54
24	275	0.30	2.10	75	36.32
AVERAGE	279 (Tsavg)		4.20 (DELH)	54 (Tm)	51.23 (vsavg)

DRY STANDARD VOLUME (Vmstd)	65.51	SCF
PERCENT WATER VAPOR %H2O)	2.25	% VOL
FLOW RATE (Q)	86905	ACFM
	59651	DSCFM
	101360	M3/HR
PARTICULATE CONCENTRATION (cs)	0.0118	GR/DSCF
PARTICULATE EMISSION RATE (ER)	6.08	LB/HR
LB PART PER 1000 LB GAS (EC)	0.0219	
ISOKINETIC PERCENT (I)	102.0	

PARTICULATE SAMPLE CALCULATION FORMULA

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 = 0.84, 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 (Vmstd)** dry 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 per dry standard 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