

ae/ai/ea/coventry/cccllet/02/06

12 June 2006

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Coventry City Council  
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Dear Mrs Field

**Re: Aggregate Industries UK Limited – Express Asphalt, Coventry  
Pollution Prevention and Control Act 1999  
Particulate emission testing**

Please find enclosed a copy of the test report for the Parker asphalt plant, following our site visit on 07 June 2006. You will note that the measured emission from the plant was found to comply with the emission standards, which apply to the site.

I can also confirm that the PCME DT 990 continuous emissions monitor has been calibrated against the test result.

Should you have any queries about the results please do not hesitate to contact either Mr C Ford, the production supervisor or myself.

Yours sincerely



K Gough  
Company Principal

Enc.

cc. Mrs A Shenton – Aggregate Industries UK Limited  
Envoy

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**PARTICULATE EMISSION MONITORING  
AGGREGATE INDUSTRIES UK LIMITED  
EXPRESS ASPHALT  
COVENTRY  
WARWICKSHIRE**



Report on Particulate Emission Monitoring  
to  
Determine the Levels of Particulate Emission  
from the  
Parker Asphalt Plant  
at  
Aggregate Industries UK Limited  
Express Asphalt  
Coventry  
Warwickshire

**Report Submitted to:**

Aggregate Industries UK Limited  
Express Asphalt  
Doyle Drive  
Coventry  
Warwickshire  
CV6 6NW

**Report Prepared By:**

K Gough  
Company Principal

A Yelland  
Associate

**Date:**

12 June 2006



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## SUMMARY INFORMATION

<b>DETERMINED</b>	<b>UNITS</b>	<b>RESULTS</b>	<b>LIMIT</b>
Particulate Concentration (STP)	mg/m <sup>3</sup>	18.7	50
Mass Emission (STP)	Kg/hr	0.40	-
Stack Temperature	°C	83	
Gas Velocity	ms <sup>-1</sup>	16.67	
Stack Volume Flow Rate (Actual)	m <sup>3</sup> /hr	29420	
Stack Volume Flow Rate (STP)	m <sup>3</sup> /hr	22694	

All results are reported at reference conditions of 273K, 101.3kPa, wet gas.



## **1. INTRODUCTION**

On 07 June 2006, particulate emission testing was undertaken by Advance Environmental, on the Parker asphalt plant at Aggregate Industries UK Limited, Express Asphalt, Coventry. During the test, the weather was noted as dry and sunny with an ambient air temperature of 23 °C.

The purpose of the emission testing was to ensure compliance with the requirements of the permit issued by Coventry City Council under The Pollution Prevention and Control (PPC) regime introduced by the PPC Act 1999.



## **2. BACKGROUND INFORMATION**

The Pollution Prevention and Control Act came into force in December 1999, superseding Part 1 of the Environmental Protection Act, 1990. The Act introduced a new regime of integrated pollution prevention and control (IPPC) for those industrial activities regulated by the Environment Agency and Local Authority Pollution Prevention and Control (LAPPC) for those regulated by Local Authorities. Roadstone coating, mineral drying and cooling and other quarry processes were scheduled for LAPPC under Section 3.5 of Part B of the Pollution Prevention and Control (England and Wales Regulations) 2000, and were brought under the revised regime in March 2003.

To continue operations, all sites operating scheduled processes must obtain a permit from their Local Authority and comply with the conditions contain therein. The conditions will include a requirement to monitor emissions to air both periodically and continuously in accordance with relevant clauses of following process guidance note:-

- PG3/15a(04) Secretary of State's Guidance – Roadstone Coating Processes



### **3. MONITORING CONTRACTOR**

The emissions test was co-ordinated by Mr K Gough, Company Principal, Advance Environmental. Mr Gough has 18 years experience of undertaking particulate emission testing on plant used in the quarrying and allied industries.





## **4. MONITORING PROTOCOL**

### **4.1 Test method and references**

Isokinetic sampling of the contained emission sources was undertaken using the APEX Instruments Inc Method Five isokinetic sampling apparatus in accordance with the main procedural requirements of given within the following British Standards and Technical Guidance Notes:-

- **BS ISO 9096:2003** - Stationary source emissions. Manual determination of mass concentration of particulate matter.
- **Environment Agency - Technical Guidance Document (Monitoring) M1** Sampling requirements for monitoring stack emissions to air from industrial installations; and
- **Environment Agency - Technical Guidance Document (Monitoring) M2** Monitoring of Stack Emissions to Air.

### **4.2 Sampling Procedure**

The work carried out was, as far as was reasonably practical, in accordance with BS ISO 9096.

Isokinetic flow means that sample gases laden with particulates are drawn off at the same velocity as the free stream velocity in the flue. Isokinetic sampling thus avoids possible inertial effects of particulates approaching the vicinity of the inlet nozzle which may result in significant error.

The Apex Instruments test equipment used, is designed to meet the sampling requirements of US EPA Method 5 and with a modified nozzle design, meets the sampling requirements of BS ISO 9096.



The principle of BS ISO 9096 is to draw a known volume of dust laden gas isokinetically through a filter. The weight gain on the filter, after sampling, divided by the gas sample volume equates to the particulate concentration, which in turn can be used to calculate a mass emission.

### 4.3 Sampling equipment

The test equipment is inspected prior to use and the calibration status observed. This includes:-

- *Pitot Tube* - All pitot tubes are checked for damage, alignment and that there are no blockages;
- *Manometer* - Oil levels, connectors and orientation level are checked;
- *Thermocouple* - Temperature is measured using k type thermocouples. Each thermocouple is inspected for calibration and damage. Digital temperature meters are used in conjunction with k type thermocouples which are also checked for calibration dates;
- *Gas meter* - The calibration of the gas meter is checked before and after sampling using a critical orifice.
- *Nozzles* - All nozzles used have been constructed in accordance with BS ISO 9096. Each nozzle is checked for damaged and measured using a vernier caliper on at least 3 planes. Non conforming nozzles will be rejected.
- *Balance* - A Mettler Toledo balance is used to weigh filters. It is calibrated yearly by the manufacturer and checked daily by in-house weights.
- *Filters* - Pall quartz membrane filters with a collection efficiency of >99.5% at 0.3microns.



## **4.4 Preparation for sampling**

### **4.4.1 Filter Preparation**

Filters are pre-conditioned before arrival on site. The filters are dried in an oven at 180 ° C for a period of at least one hour and then placed to cool in a dessicator for at least four hours. The filters are then weighed on a five figure balance and placed in individual transport containers. Spare filters are prepared to obtain blank values.

### **4.4.2 Sampling Location**

No site visit was undertaken prior to undertaking the sampling procedure, as monitoring had previously been undertaken at the site, during which time the sampling position, working platform, sampling ports, access and safety precautions were found to be satisfactory.

The internal dimension of the flue was known from the previous monitoring undertaken. However, further measurements were taken to check that the internal diameter had not changed.

Prior to sampling a pressure and temperature survey, using a pitot static tube, a micromanometer, a digital thermometer and a nickel-chromium/nickel-aluminium thermocouple, is carried out to check whether the flow conditions meet with the requirements of BS ISO 9096. From this initial survey sample locations, isokinetic flow rates, nozzle size, and sample period can be calculated.

Sampling

## **4.5 Sample collection**

A leak check is carried out before and after sampling to confirm all the suction is drawn through the nozzle.



With the required isokinetic flow rates known the sample probe was inserted into the stack at 90° to the gas flow, this is to stop any particulate matter impinging on the filter before sampling.

The filter head and probe were allowed to obtain the stack gas temperature.

The initial gas meter volume was noted and the suction device and timer started. The correct flow rate for isokinetic sampling was set and the nozzle positioned to face parallel to the gas flow.

Sampling was then carried out for the planned duration and number of sample points, recording all the necessary data for final calculations. On completion, the suction device, timer were stopped and the final gas meter volume recorded.

The probe was removed from the process stack and a further leak test carried out prior to removal of the filter, which was subsequently removed and placed in a storage container.

Any residual particulates upstream of the filter was washed with water and acetone into an appropriate beaker.

The above procedures were then repeated to obtain duplicate samples.

At all times during the sampling procedure the sampling technicians were in contact with the process operator to ensure that the plant was in full production and there were no changes in the process that might affect the representative nature of the samples collected.



#### **4.6 Analysis of samples**

On returning to the laboratory, the used filters were dried in an oven at 160 °C for a minimum of one hour and then desiccated and weighed as before. The water/acetone washings are first evaporated, without boiling, then dried and weighed as above. The total particulate mass is the sum of the differential filter weight added to the differential water/acetone component.

#### **4.7 Calculation of results**

The calculations were made using the formula specified in BS ISO 9096.

The recorded filter weights, velocity, temperature, sampling duration and internal flue dimensions were then used to calculate:-

- the mass rate of solids emission in kg/hr; and
- the solids concentration in mg/m<sup>3</sup>.

#### **4.8 Sampling Results**

Two particulate tests were carried out, under continuous operating conditions, to assess the emission concentration in the exhaust gases. The sample time of each test was 12 minutes, primarily due to the limited production time to enable completion of the test.

At the time of sampling, a mean particulate matter concentration of 18.7 mg/m<sup>3</sup> at reference conditions. It can be concluded, therefore, that the emission from this plant was found to comply with the emission limit currently imposed.



## 4.9 Comments

On the completion of sampling, the data from the PCME DT 990 continuous emission monitor was interrogated and the average results, which were recorded during each measurement period, noted. Levels of 23.9498 mg/m<sup>-3</sup> (Test 1) and 18.4613 mg/m<sup>-3</sup> (Test 2) were obtained together with an existing calibration factor of 7.831. It can be concluded that the monitor could be adjusted to improve the level of accuracy and requires an adjustment of the calibration factor to 6.922.

Full test data demonstrating procedural compliance with BS ISO 9096 for total particulate monitoring is provided the following sections.



## **5. SAMPLING RECORDS**



## 5.1 - Process Conditions

Table A

Arrestment Plant:	Bag Filter
Particulate Type:	Aggregate
Plant Loading:	Continuous - Various grades
Appearance of plume:	Visible discharge.





## 5.2 - Sampling Results

**Table B**

	Test Run No. 1.	Test Run No. 2.	Average
Time of Test:	12.02 - 12.14	12.14 - 12.26	
Sampling Duration: (mins)	12	12	
Gas Temperature (°C)	83	84	83
Mean Velocity at Sampling Points: (m/s)	17.03	16.91	16.97
Gas Flow Rate at STP (1): (m <sup>3</sup> /min)	385.2	382.4	383.8
Particulate Loading at STP (1): (mg/m <sup>3</sup> )	20.29	17.20	18.74
Particulate at Normalised Conditions (2): (mg/m <sup>3</sup> )	-----	-----	-----

(1) Particulate stated at 273K, 101.3kPa without correction for water vapour.

(2) State normalised conditions (eg 11% O<sub>2</sub>, etc).



### 5.3 - Calculations Sample Run No. 1

#### On-site measurements

$$\begin{array}{llll} \text{O}_2 = & 19.4 \% & \text{CO}_2 = & 1 \% & \text{N}_2 = & 79.6 \% \\ \text{Bws} = & 0.01 & \text{Ps} = & 101.9 \text{ kPa} & \text{Ts} = & 355.8 \text{ K} \end{array}$$

$$\begin{aligned} \text{Md} &= \text{Molecular weight of gas at DGM (g/g mole)} \\ \text{Md} &= (0.44 \times \% \text{CO}_2) + (0.32 \times \% \text{O}_2) + (0.28 \times \% \text{N}_2) \\ &= 28.94 \text{ g/g mole} \end{aligned}$$

$$\begin{aligned} \text{Ms} &= \text{Molecular weight of gas wet (g/g mole)} \\ &= 28.83 \text{ g/g mole} \end{aligned}$$

#### Stack gas velocity at sample points

$$\begin{aligned} V &= K_p \times C_p \times \sqrt{\frac{DP}{Ps \times Ms}} \\ &= 17.03 \text{ m/s} \end{aligned}$$
$$\begin{array}{ll} K_p = & 4.07 \\ DP = & 145.5 \text{ average Dp at sample plane} \\ C_p = & 1.00 \text{ pitot tube coefficient} \end{array}$$

#### Stack gas volume at sample points

$$\begin{aligned} Q &= V \times A \times 60 \\ &= 500.9 \text{ m}^3/\text{min} \end{aligned}$$
$$A = 0.49 \text{ area of stack m}^2$$

#### Volume of water vapour collected, standard conditions (m<sup>3</sup>)

$$\begin{aligned} V_{wstd} &= 0.00124 \times V_{lc} \\ &= 0.0012 \text{ m}^3 \end{aligned}$$
$$V_{lc} = 1 \text{ ml}$$

#### Volume of gas metered, standard conditions (m<sup>3</sup>)

$$\begin{aligned} V_{mstd} &= \frac{2.695 \times V_m \times (P_a + (DH/102)) \times Y_d}{(T + T_m)} \\ &= 0.31 \text{ m}^3 \end{aligned}$$
$$\begin{array}{ll} T_m = & 10 \text{ }^\circ\text{C} \\ V_m = & 0.3109 \text{ m}^3 \\ P_a = & 101.9 \text{ kPa} \\ DH = & 76.7 \text{ mm H}_2\text{O} \\ Y_d = & 1.020 \end{array}$$

#### Moisture content

$$\begin{aligned} B_{wo} &= V_{wstd} / (V_{wstd} + V_{mstd}) \\ &= 0.004 \end{aligned}$$

#### Dry total flow of stack gas, standard conditions (m<sup>3</sup>/min)

$$\begin{aligned} Q_{std} &= \frac{Q \times Ps(2.695)(1 - B_{wo})}{Ts + 273} \\ &= 385 \text{ m}^3/\text{min} \end{aligned}$$
$$\begin{array}{ll} Ts = & 82.8 \text{ }^\circ\text{C} \\ Ps = & 101.9 \text{ kPa} \end{array}$$

#### Percent isokinetic

$$\begin{aligned} \%I &= \frac{(6.184 \times 10^5)(Ts + 273) \times V_{mstd}}{Ps \times V \times A_a \times t \times (1 - B_{wo})} \\ &= 103.8 \% \end{aligned}$$
$$A_a = 31.7 \text{ area of nozzle m}^2$$



### 5.3 - Calculations Sample Run No. 1 Cont.

#### Filter & rinsing weights sample no. 1

weight gain on filters = 6.03 mg  
weight of acetone wash = 0.26 mg  
total weight gain (M) = 6.29 mg

#### Particulate concentration (mg/m<sup>3</sup>)

$$C = M/V_{mstd} \\ = 20.29 \text{ mg/m}^3$$

$$M = 6.29 \text{ mg}$$

#### Particulate emission rate (g/hr)

$$E = (C \times Q_{std} \times 60)/1000 \\ = 0.47 \text{ Kg/hr}$$



## 5.4 - Calculations Sample Run No. 2

### On-site measurements

$$\begin{array}{llll} \text{O}_2 = & 19.3 \% & \text{CO}_2 = & 1.1 \% & \text{N}_2 = & 79.6 \% \\ \text{Bws} = & 0.00 & \text{Ps} = & 101.9 \text{ kPa} & \text{Ts} = & 356.5 \text{ K} \end{array}$$

$$\begin{aligned} \text{Md} &= \text{Molecular weight of gas at DGM (g/g mole)} \\ \text{Md} &= (0.44 \times \% \text{CO}_2) + (0.32 \times \% \text{O}_2) + (0.28 \times \% \text{N}_2) \\ &= 28.95 \text{ g/g mole} \end{aligned}$$

$$\begin{aligned} \text{Ms} &= \text{Molecular weight of gas wet (g/g mole)} \\ &= 28.90 \text{ g/g mole} \end{aligned}$$

### Stack gas velocity at sample points

$$\begin{aligned} V &= K_p \times C_p \times \sqrt{\text{Ts} \cdot \text{DP} / \text{Ps} \cdot \text{Ms}} \\ &= 16.91 \text{ m/s} \end{aligned}$$

$$\begin{array}{ll} K_p = & 4.07 \\ \text{DP} = & 143.5 \text{ average Dp at sample plane} \\ C_p = & 1.00 \text{ pitot tube coefficient} \end{array}$$

### Stack gas volume at sample points

$$\begin{aligned} Q &= V \times A \times 60 \\ &= 497.3 \text{ m}^3/\text{min} \end{aligned}$$

$$A = 0.49 \text{ area of stack m}^2$$

### Volume of water vapour collected, standard conditions (m<sup>3</sup>)

$$\begin{aligned} V_{wstd} &= 0.00124 \times V_{lc} \\ &= 0.0006 \text{ m}^3 \end{aligned}$$

$$V_{lc} = 1 \text{ ml}$$

### Volume of gas metered, standard conditions (m<sup>3</sup>)

$$V_{mstd} = \frac{2.695 \times V_m \times (\text{Pa} + (\text{DH}/102)) \times Y_d}{(T + T_m)}$$

$$= 0.3129 \text{ m}^3$$

$$\begin{array}{ll} T_m = & 11 \text{ }^\circ\text{C} \\ V_m = & 0.3149 \text{ m}^3 \\ \text{Pa} = & 101.9 \text{ kPa} \\ \text{DH} = & 77 \text{ mm H}_2\text{O} \\ Y_d = & 1.020 \end{array}$$

### Moisture content

$$\begin{aligned} B_{wo} &= V_{wstd} / (V_{wstd} + V_{mstd}) \\ &= 0.002 \end{aligned}$$

### Dry total flow of stack gas, standard conditions (m<sup>3</sup>/min)

$$\begin{aligned} Q_{std} &= \frac{Q \times \text{Ps} (2.695) (1 - B_{wo})}{\text{Ts} + 273} \\ &= 382.4 \text{ m}^3/\text{min} \end{aligned}$$

$$\begin{array}{ll} \text{Ts} = & 83.5 \text{ }^\circ\text{C} \\ \text{Ps} = & 101.9 \text{ kPa} \end{array}$$

### Percent isokinetic

$$\begin{aligned} \%I &= \frac{(6.184 \times 10^5) (\text{Ts} + 273) \times V_{mstd}}{\text{Ps} \times V \times A_a \times t \times (1 - B_{wo})} \\ &= 105.5 \% \end{aligned}$$

$$A_a = 31.7 \text{ area of nozzle m}^2$$



## 5.4 - Calculations Sample Run No. 2 Cont.

### Filter & rinsing weights sample no. 2

weight gain on filters = 5.16 mg  
weight of acetone wash = 0.22 mg  
total weight gain (M) = 5.38 mg

### Particulate concentration (mg/m<sup>3</sup>)

$$C = M/V_{mstd} \\ = 17.20 \text{ mg/m}^3$$

$$M = 5.38 \text{ mg}$$

### Particulate emission rate (g/hr)

$$E = (C \times Q_{std} \times 60)/1000 \\ = 0.39 \text{ Kg/hr}$$



## 5.5 - Sample Blank

An overall sample blank was taken after the measurement series, following the sampling procedure in the methodology without starting the suction device and keeping the blank in the duct for 15 minutes with the sampling nozzle 180° from the direction of flow. This leads to an estimation of the dispersion of results related to the whole procedure.

weight gain on filters = 0.00030 mg  
weight of acetone wash = 0.00005 mg  
total weight gain (M) = 0.00035 mg

### Particulate concentration (mg/m<sup>3</sup>)

$$C = M/V_{mstd}$$
$$= 1.12 \text{ mg/m}^3$$

$$M = 0.35 \text{ mg}$$



## 5.6 - On Site Velocity and Flow Data

Company	EXPRESS ASPHALT	Stack Diameter	0.79	m
Site	DOYLE DRIVE	Area	0.49	m <sup>2</sup>
Location	ROADSTONE COATING PLANT	Barometric Pressure	101.9	kPa
Job No	023	Stack Pressure	0.01	kPa
Operators	AJY/MJR	Pitot Tube Coefficient	0.997	

Preliminary readings taken before sampling				
		Pitot Traverse B		
Pitot Settings	D P pa	Temp °C	D P pa	Temp °C
1	120	82	132	82
2	142	82	156	83
3	149	82	163	83
4	148	83	153	83
5	130	83	126	83
6	125	83	125	84
7	133	84	135	84
8	144	84	142	84
9	149	83	135	83
10	132	83	120	83

av temp (K) = ((average temp traverse A + average temp traverse B) / 2) + 273	356
av press (Pa) = ((average press traverse A + average press traverse B) / 2)	138

Suitability of sampling positions & Required No. of sample points	Actual Stack Conditions
Permitted highest to lowest pressure range = 9:1	1.4 : 1
Negative pressure	Not permitted
Differential pressure minimum > 5 Pa	120
No. of sampling points	4



## 5.7 - Sampling Conditions

Sample Position	Sample Run No. 1			Sample Run No. 2		
	Stack Temp °C	Velocity Pressure DP (Pa)	Nozzle Area mm <sup>2</sup>	Stack Temp °C	Velocity Pressure DP (Pa)	Nozzle Area mm <sup>2</sup>
0.15D	82	142	31.7	83	138	31.7
0.85D	83	149	31.7	84	147	31.7
0.15D	83	156	31.7	84	157	31.7
0.85D	83	135	31.7	83	132	31.7





## 5.8 - Weighing Results

The below filters and acetone rinsings were weighed on a balance in a temperature controlled room with corrections made for differences in atmospheric pressure. Control parts and blank filters are used to confirm accuracy of weighings.

Sample Run No.1.	Ref No.	Weight gms			Sample time at each point (mins)	% weight gain
		Before	After	Collected		
Filter	8	0.03641	0.04244	0.00603	3.0	16.6%
Acetone	8A	0.03498	0.03524	0.00026	3.0	0.7%
<b>Total weight = 0.00629</b>						
Sample Run No.2.	Ref No.	Weight gms			Sample time at each point (mins)	
		Before	After	Collected		
Filter	9	0.03808	0.04324	0.00516	3.0	13.6%
Acetone	9A	0.03581	0.03603	0.00022	3.0	0.6%
<b>Total weight = 0.00538</b>						
Sample Blank	Ref No.	Weight gms			Sample time at each point (mins)	
		Before	After	Collected		
Filter	10	0.03655	0.03685	0.00030	n/a	0.8%
Acetone	10A	0.03562	0.03567	0.00005	n/a	0.1%
<b>Total weight = 0.00035</b>						



## 5.9 - Main conditions for compliance with BS ISO 9096:2003

The following requirements must be met:

### Preliminary Velocity Survey

		Pass	Fail
<input type="checkbox"/>	No negative flow at sampling points	*	
<input type="checkbox"/>	Direction of gas flow within 15° of flue axis	*	
<input type="checkbox"/>	Pitot-static pressure differential greater than 5 Pa ( 3m/s )	*	
<input type="checkbox"/>	Ratio of highest to lowest pitot-static readings less than 9:1	*	

### Sampling procedure

<input type="checkbox"/>	Sampling plane was corectly positioned	*	
<input type="checkbox"/>	Sampling centroids of equal area	*	
<input type="checkbox"/>	Nozzle was facing upstream to within $\pm 10^\circ$	*	
<input type="checkbox"/>	Leak check performed	*	
<input type="checkbox"/>	Constant 'at' during cumulative sampling	*	

### Post Sampling Operations

<input type="checkbox"/>	Leak test performed	*	
<input type="checkbox"/>	Isokinetic rate 95 % to 115 %	*	
<input type="checkbox"/>	Samples achieved stable weights	*	

Note : A single tick in the "fail" column indicates that this test does not comply with the full provisions of BS ISO 9096:2003. Due to site/sampling locations it is not always practically possible for all the conditions to be met. Best practical means are employed to try and achieve a representative result.

