convert-me.com

Enviro-Met Ltd

Rubicon Centre, Broad Ground Road
Redditch, Worcs. B98 8YP
Tel/Fax. 01527 516579

Emissions to Air
from
Atritor Ltd, Coventry

Report No EM3319

22 August 2003

QMS
ISO 9002
REGISTERED FIRM
Registration No. GB4683

ENVIRO-MET LTD. Registered in England & Wales Company No. 2716910
Registered Office: Redditch B98 8YP. Directors, Mr T N Blackman, Mrs C A Hanks

Source Testing Association Member
STA

EM3319
22 August 2003

Emissions to Air
from
Atritor Ltd, Coventry

1. Introduction

The above site was visited on the 19th August 2003 in order to carry out a particulate emission test on the wet arrestor which serves the main foundry extraction system. Under the conditions of authorisation of a prescribed process the results of such tests should be forwarded to the local authority within eight weeks of completion of testing.

Sampling was carried out by T N Blackman MIM C.Eng.

2. Methods of Test

The particulate test was carried out in accordance with BS3405:1983, as far as conditions allowed, using a BSC design-sampling probe. The particulates were collected onto glass wool depth filters that has a nominal container weight of 25g, the mass collected was determined gravimetrically after drying at 160°C. The use of relatively heavy depth filters means that at low emission concentrations it is unlikely that sufficient mass of particulates will be collected to satisfy the requirements of BS3405. (minimum of 0.3% of the container mass). However, the resolution of the balance is greater than that required of the standard and reproducibility of the weighings is shown to be good. The use of depth filters will have no effect on the accuracy of the test. Depth filters are the preferred option when sampling ducts where the discharge is likely to comprise granular particulates, often these do not adhere to filter papers and may be lost during handling and transport which can result in an underestimation of emission levels.

Airflow and velocity measurements in the ducts were determined using an ellipsoidal pitot-static tube and electronic manometer. Temperature measurements were made using a K-type thermocouple and electronic thermometer. The manometer, thermometer and balance all have calibrations traceable to NPL standards.

All results are reported under standard conditions of 0°C, 101.3 kPa, uncorrected for water vapour. A full sampling protocol is included in the Appendix.

3. Results

Particulates
Full results of the particulate emission tests and conditions in the ducts are given in the tables at the end of this report. A summary of the main findings is produced below.

Duct	Run No.	Time min	Vol. lt.	Wt collected mg	Concentration mg/m^3
Main foundry extraction	1	32	786	6.5	8.3
	2	30	692	14.3	20.3

Velocity in discharge stack
The diameter of the final discharge stack is 762mm. Based on the volume flow measurements at the sample points, the velocity in the stack is calculated to be 17.8m/s. This is significantly greater than the maximum of 9m/s, which is specified in the authorisation.

4. Comments

The sampling conditions of the test on the main foundry extraction fully met the requirements of BS3405 except the variation in the results of the two sample runs was greater than the 1.5:1 permitted in the standard. However, this is a reflection of the different operational conditions during the two runs and does not imply any reduction in the accuracy of the test.

The results show that emission during knockout periods (20 minutes, up to three times a day), were around half the emission limit. Emissions at other times were shown to be substantially less at around 8mg/m^3.

The velocity in the stack was nearly twice the maximum specified in the authorisation. A stack velocity of less than 9m/s is generally recommended for wet systems in order to avoid discharge of water from the stack, which may be present due to condensation or carry over from the arrester. When this occurs in wet arresters serving sand plants, it can give rise to 'black rain'. However, there is no evidence of this having occurred, either from the condition of the outside of the stack or the ground in the vicinity of the arrester.

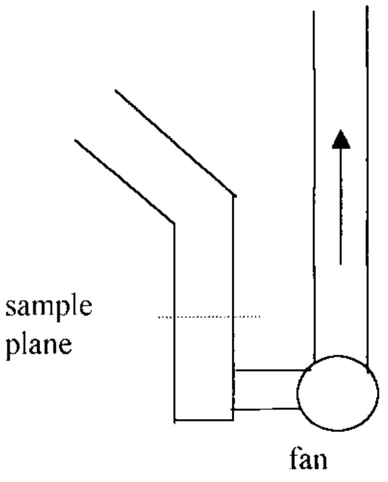
[redacted]

Terry Blackman MIM C.Eng.

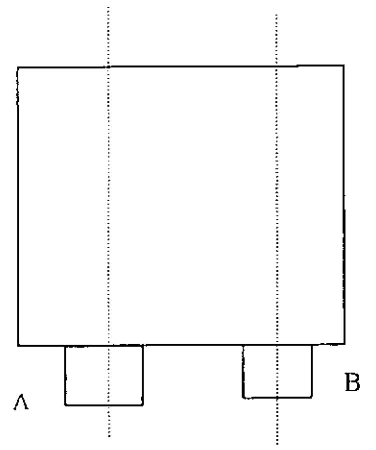
Particulate emission test to BS3405:1983

Attritor Ltd
Main foundry extraction
Date: 19/8/03

Plant layout



Section of duct at sample plane



Duct size: 760 x 700 mm

Process/test conditions

Arrestment type	wet arrestor
Particulate type	ferrous foundry particulate
Appearance of plume	visible emission during knockout only

Sample ports located in downcomer from wet arrestor, 1m after 45° bend and 750mm before entry into fan.

The unit extracts from sand plant, knockout grid and furnace canopy hood.
Run 1, sand plant in operation and moulds being poured.
Run 2, knockout grid in use for 27mins, furnace being re-charged.

Conformance

The test complied with BS3405 except that the variation between the two sample runs was greater than permitted in the standard.

Main extraction

Duct size	0.760 m x 0.700 m
Duct temperature	18 °C
Atmospheric pressure	100.4 kPa
Static pressure in duct	-8.58 "wg -2136 Pa
Mean velocity in duct	15.28 m/s
Gas flow rate	26634 Nm3/hr

Preliminary Survey

Pitot-static pressures ("wg) ↗	↗	↗	↗	↗	↗	↗	↗	↗	↗ 9pts sampled.
Position (xD)	0.065	0.125	0.25	0.375	0.50	0.625	0.75	0.875	0.935
Traverse A	0.28	0.30	0.27	0.26	0.29	0.31	0.31	0.34	0.32
Traverse B	0.87	0.89	0.84	0.85	0.90	0.91	0.89	0.92	0.91
Pitot-static pressures (Pa)				← minimum velocity 65Pa					
Traverse A	70	75	67	65	72	77	77	85	80
Traverse B	217	222	209	212	224	227	222	229	227

same as above but in pascals

Ratio of highest to lowest pitot-static reading: (Max 9:1) 3.54:1 (= 229 - 65 = 3.52:1) ✓

Sampling details

Nozzle size: 1/4" Number of sample points: 4

Position	0.25A	0.75A	0.25B	0.75B
Run 1				
Velocity pressure "wg	0.27	0.34	0.84	0.89
Flow rate l/min	20	22	35	36
Pump temp °C	20	22	35	36
Run 2				
Velocity pressure "wg	0.28	0.33	0.80	0.87
Flow rate l/min	20	22	34	36
Pump temp °C	27	30	33	34
velocity pressure end	0.29	0.32	0.82	0.91

Pump correction factor: Run 1: 0.925 Run 2: 0.915

Variation in sum of velocity pressures during test: (Max 10%)

Run 1 -2.56 % Run 2 2.63 %

Results

Filter No.	Run 1	Run 2
~~Duration min~~	D3	D16
~~Condensate mls~~ minutes	30	27
Concensate mls	0	0
Volume sampled.lt	786	692
Weight collected. mg	6.5	14.3 ✓
Concentration mg/m3	8.27 ✓	20.68 ✓

Ratio of final emission concentrations: (Max 1.5:1) 2.50 :1

APPENDIX

Enviro-Met Ltd

Isokinetic Sampling To BS3405:1983

Particulate sampling is carried out using either the Enviro-Met isokinetic sampler, based on a BSC design or a Zambelli ZB2 sampler, the design of which complies with BS 3405. The equipment consists of an in-stack filter, water-cooled condenser (for hot applications), sample pump and flow measurement device. Pressure, air velocity and flow rates are measured using an ellipsoidal pitot-static tube and electronic manometer. Temperature measurements are made using a k-type thermocouple and electronic thermometer.

The tests are carried out adopting the following protocol:

A Preparation

1. Verify sampling ports are fitted and in accordance with the requirements of BS3405. Ensure there is safe access and platform at the sampling position and that power will be available locally. Check whether there are any potential hazard such as dangerous gases.
2. Establish the likely levels of emissions and whether there may be cyclical variations in the process. Determine sampling times and duration accordingly. Minimum sample times of 60 minutes are normally used.
3. Check isokinetic sampler and measuring equipment is working correctly.
4. Pack depth filters with a tightly packed layer of ultrafine glass fibre followed by a loosely packed layer of fine glass fibre. Dry depth filters in an oven at 120°C overnight and cool in a desiccator. Weigh to a constant weight using a four figure balance weighing to 0.1mg.
5. Leave GFA filter papers to equilibrate for 24hrs in the weighing room before weighing to a constant weight on a five figure balance to 0.01mg. Weigh two blanks per batch to compensate for any humidity or temperature changes.

B On site

<u>Preliminary</u>

1. Ensure access and sample position is safe. Carry out a risk assessment prior to commencement of sampling. If any risk is considered "high" do not commence sampling until measures to reduce the risk have been taken.
2. Agree on notification and emergency evacuation procedures.
3. Determine that the plant is operating under normal conditions. Arrange for notification in the event of any stoppages or abnormal conditions.

<u>Sampling Procedure</u>

1. Carry out preliminary survey at ten points across both traverses of the duct for pitot-static pressure. Velocity pressure across the duct should not vary by more than a factor of 9:1
2. Note the extent of any swirl, the direction of flow should not be more than 20° to axis of the duct.
3. Measure the duct static pressure and record any variation in temperature across the duct. Record the atmospheric pressure.

4 Calculate ratio of highest to lowest pitot static measurements and assess whether sampling can be carried out in accordance with BS3405 and if so whether 4 or 8 point sampling is necessary.

5 Select a suitable nozzle and calculate the flow rate to achieve isokinetic sampling. For cumulative sampling the product of sample time and nozzle area must remain constant.

6 Assemble sampling equipment train and check for leaks.

7 Load a clean filter into the sample head and locate the sample probe at the first sample point with the nozzle facing upstream, start the pump and stopwatch simultaneously. Adjust the flowrate so the calculated sample rate is shown on the rotameter.

8 Record the temperature of the exhaust gas during the test.

9 At the end of the required sample time move the sample head to the next position and adjust the flow rate to maintain isokinetic sampling conditions.

10 When all points have been sampled transfer the sample filter to a clean dry transport container. In order to remove any particulate adhering to the nozzle, brush through the nozzle and sample head surfaces into the transport container.

11 Re-measure the pitot static pressures at the points sampled. Variation in the sum of the measurements should not exceed 10%.

C Processing

1 Dry depth filters overnight at 120°C, re weigh after cooling in a desiccator.

2 Filter papers are dried and weighed following the same procedure as during the preparation stage. Any difference in the weight of the blank is taken into account when detemining the mass collected

D Metal analysis

1 Where determination of emissions concentrations of specific metals, such as lead copper etc. are required, the filters used for the particulate test will be sent to a NAMAS accredited laboratory for analysis.

2 The analysis method is chosen by the laboratory as being the one most suitable for the metal and the media it is presented on.

3 The most popular method is an in-house method based on NIOSH 7300, acid dissolution followed by determination by inductively coupled plasma (ICP) analysis.

E Reporting

The report will include the following:

Description of plant and process operation
Activity level during the period of test
Method of sampling and standard to which sampling is carried out.
Physical conditions in duct.
Gas temperature
Velocity profiles
Mean velocity
Mean volume flow
Results of the emission test
Discussion and interpretation of the results, including details of compliance with any stated emission limit, comments on the effectiveness of abatement equipment along with recommendations where appropriate.
Statement of conformity and identification of any deviation from the stated standard.
The flow rates in the duct and the final emission concentration results are calculated using the following equations.

Mean gas velocity

$v_{(mean)} = \sqrt{(2/\rho)}.\sqrt{h}$
$= m/s$

ρ = density of air
h = mean velocity pressure (Pa)

Mean gas flowrate (Q)

$Q = v.A.(273/T+273)(DP/101.3)$
$= Nm^3/s$

A = area of duct (m^2)
T = duct gas temp (°C)
DP = duct pressure (static pressure + atmospheric pressure)

Sample volume (at 0°C)

$V = \Sigma(f\phi)\omega$
$= lt$

$f\phi$ = product of flowrate and sample duration at each point
ω = temp. correction factor.

Concentration of particulates (at 0°C)

$C = m.1000/V$
$= mg/m^3$

m = mass collected on filter

F. Calibration of Continuous Monitors

Where continuous monitors are installed at the sample points and these are fitted with a data logging facility, then the units may be calibrated using the results of the particulate emission test.

The exact time of the start and finish of each sample run is noted and the data logger can later be interrogated to find the response over that same time period. The actual emission concentration determined from the particulate test can then be compared with the response of the continuous monitor and if there is a difference than the calibration factor of the instrument can be re-calculated and altered as necessary.

Some instruments do not have a simple means of interrogation at a later date, or the calibration mode overwrites, and in these cases the calibration mode of the instrument must be started and stopped at the same time as the particulate emission test run in order to determine the instrument readings over the time period.

Non-isokinetic sampling

Certain collectors do not have ducted emissions, in these situations it is only possible to carry out an indicative test by non-isokinetic sampling just inside the discharge grille. It is not possible to guarantee the accuracy of this test although it can serve to demonstrate that the filter is working correctly and to show compliance with the emission limits of 50 or $100mg/m^3$.