Passionate about Particulate

PCME

Technical Paper

Case Study on the Practical Implementation of EN-14181

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Introduction

This case study summarises the results of implementing particulate monitoring according to EN-14181 in a municipal incinerator operated by SITA in Teesside, UK, with a ProScatter™ type particulate instrument (Model PCME QAL 181). It also provides a comparison of results for monitoring the same stack with an ElectroDynamic™ particulate instrument (Model PCME QAL 991).

This case study is specifically relevant to operators of Municipal Waste Incineration plant using bagfilter type arrestment plant, but has significance to processes using electrostatic precipitators and dry scrubbing systems.

Plant description

The Teesside Energy from Waste plant is run by SITA Tees Valley Ltd, a joint venture between SITA UK and the four Teesside local authorities of Stockton, Middlesbrough, Redcar & Cleveland, and Hartlepool.

The plant is one of the newest in the UK and has been fully operational since May 1998. Operating 24 hours a day, 7 days a week, the plant processes municipal and non-hazardous industrial & commercial waste. Key facts about the plant are:

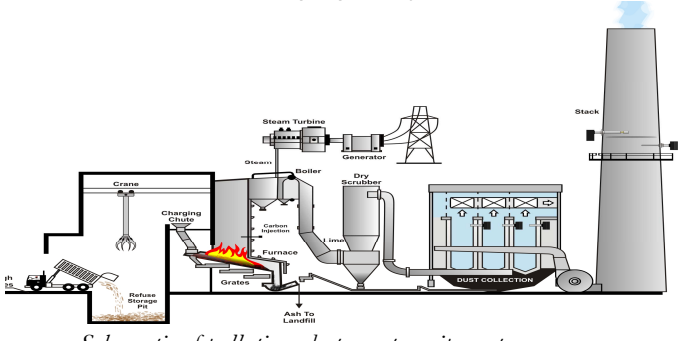
- The plant has two furnace lines with a combined processing capacity of 250,000 tonnes of municipal waste per year. Up to 100 waste collection vehicles carrying 1,000 tonnes of waste arrive at the plant every day.
- The plant produces an average of 20 megawatts of electricity per hour, enough electricity to supply 40,000 homes with power.

SITA Waste to Energy Plant

Stack location of instruments

Emissions from the two boiler plant are controlled by two parallel series of pollution abatement stages:

1. Limestone is injected into the flue gas from the boiler to absorb HCL
2. The flue gas then passes through a cyclone as a first stage of filtration
3. Activated carbon is injected into the gas to absorb heavy metals
4. The flue gas then passes through an 8 compartment bagfilter
5. The flue gas then passes into each of the two vertical stacks (these stacks are connected together for structural purposes)



Schematic of pollution abatement equipment

The particulate instruments in this case study are installed in the final emission stacks.

The implications of WID in relation to particulate

SITA's plant is covered by the European Waste Incineration Directive 2000/76/EC. This has two major implications in relation to particulate control and monitoring:

1. The directive specifies a daily average emission limit for particulate of 10mg/m³. This limit poses little practical problems to achieve since the SITA plant is fitted with bag filter dust arrestment plant which control particulate emissions to well below 1 mg/m³
2. The directive requires that emissions be continuously measured with a methodology that gives a total uncertainty of less than 30%. This new type of compliance monitoring is underpinned with two new European standards, EN-14181, which relates to the Quality Control of Automatic Monitoring Systems (covering dust and gas) and EN-13284-2 that is specifically relevant to particulate. EN-14181 and EN-13284-2 require monitoring that is similar to compliance monitoring that is performed in the USA. This requirement is new to the SITA plant and the operator has upgraded its monitoring system to meet this requirement. A PCME QAL 181 ProScatter™ instrument is now being used to meet the monitoring requirements. In parallel a PCME QAL 991 ElectroDynamic™ system has been installed to obtain comparative data.

EN-14181/13284-2 requirements for monitoring

These new standards support the requirement that emissions are measured within the total uncertainty budget allowed within the relevant EU Directive (30% in the case of WID). The standards focus on the Quality Assurance of the Automatic Monitoring System (AMS) in four key areas referred to as Quality Assurance Levels (QAL):

1) QAL1 (Instrument certification)
2) QAL2 (Calibration)
3) QAL3 (On going Quality Assurance)
4) AST (Annual surveillance test)

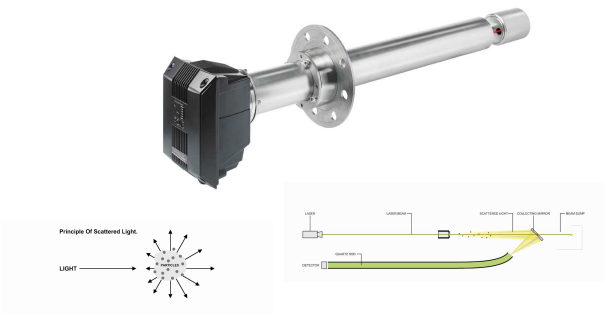
To meet these requirements SITA, like other plant operators, must use instruments with an appropriate QAL1 instrument certification (carried out by a certification body at the request of the instrument manufacturer), organise a team to calibrate the instrument according to the details of QAL2, ensure that there is an appropriate QAL3 procedure in place (typically this is automatic within the instrument as in this case) and then annually organise a test on the calibration and instrument linearity.

Description of installed instruments

The ProScatter™ PCME QAL 181 particulate AMS manufactured by PCME Ltd was installed on the stacks to meet EN-14181. A PCME QAL 991 has also been installed on the stack for comparative purposes.

A) ProScatter™ Particulate AMS (model PCME QAL 181)

The PCME QAL 181 instrument comprises a sensor probe with an in-situ measurement volume at the tip of the probe which is inserted in the stack. The instrument uses ProScatter™ technology, a form of light scattering technique, to measure the particle concentration and is calibrated by reference to the SRM to EN13284-2. The cone of light scattered from particles in a low angle to the incident laser beam is collected by a concave mirror and collected on a quartz rod.



PCME QAL 181 ProScatter™ instrument

The PCME QAL 181 instrument is specifically relevant to monitoring to satisfy EN-14181 since the instrument is certified to meet QAL1 requirements with a certification range of 0-15mg/m^3 and has the resolution and sensitivity to monitor emissions from below 1mg/m^3 to in excess of 50mg/m^3. Unlike traditional Opacity instruments, it is therefore suitable for the lower levels of particulate found after processes meeting the new WID emission limits.

B) ElectroDynamic™ Particulate AMS (model PCME QAL 991)

The PCME QAL 991 instrument comprises an ElectroDynamic™ sensor inserted directly in the stack connected to a central control unit for user interface and data acquisition. The sensor operates by monitoring the natural charge signature induced as particles pass the probe with the advantage of being unaffected by contamination on the sensor rod surface. The instrument is mainly suitable for constant bagfilter applications where the particle charge is predictable and relatively constant.

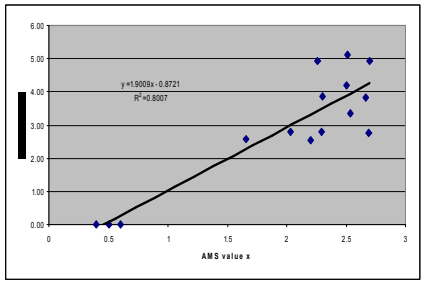
PCME QAL 991 ElectroDynamic™ sensor

PCME QAL 181 instrument results

The PCME QAL 181 was installed in November 2005 and an evaluation was conducted over a 12 month period.

Key positive milestones in the instruments operation were:

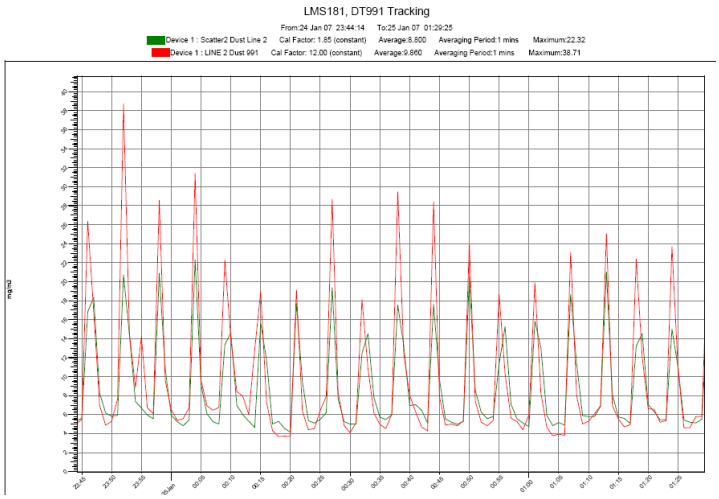
- The instrument passed its QAL2 calibration test with 15 iso-kinetic samples taken over a 3 day period. Higher dust levels were obtained by putting the bagfilter into a continuous bag-cleaning cycle.
    - It should be noted that sampling was compliant to EN-13284-1, however issues such as filter holder, filter handling and sample train flow rate did not necessarily meet the updated recommendations contained in MID-13284-1.



Results from QAL2

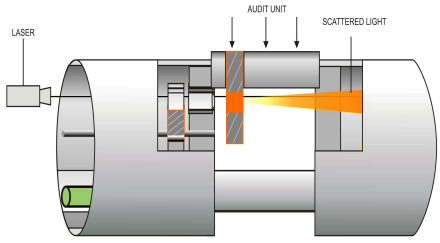
Instrument installation

The instrument was assessed to be suitable for measuring after bagfilters having sufficient response time and dust resolution to track the emissions during pulse cleaning of the bagfilter

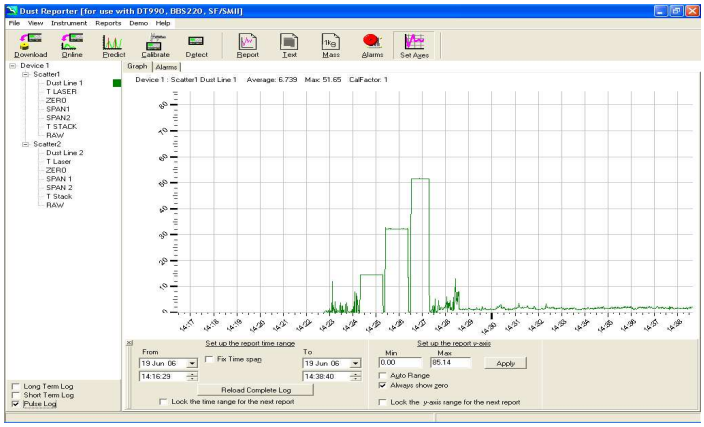


PCME QAL 181 and PCME QAL 991 tracking bag pulsing

- The instrument passed its AST linearity test, using the audit unit. The audit unit is an external audit device which comprises a reference scattering material which can be manually inserted in the interaction volume (once probe removed from stack) to conduct the five-point linearity test during the annual AST audit.

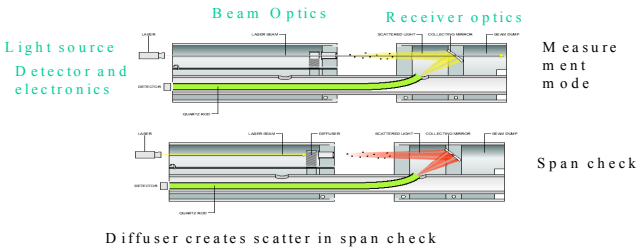


Use of audit unit

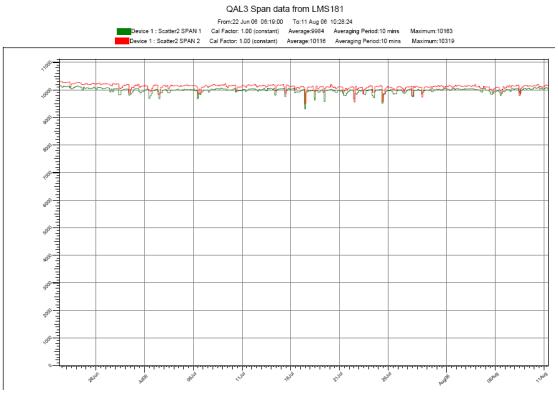


Results from linearity test

- The span check and QAL3 methodology has proven to be a reliable method which is compliant with EN-14181. During the span check a scattering element is automatically inserted in the laser path to provide a reliable measure of instrument drift including any effects of contamination. The results of the QAL3 are stored within the instrument for analysis and reporting via 'QAL Reporter PC software'.

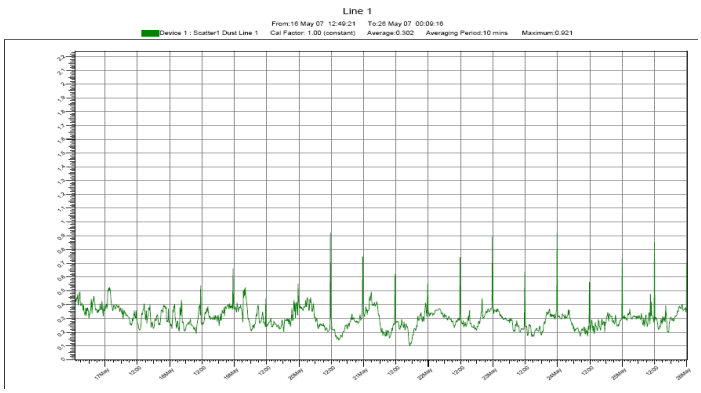


Automatic span mechanism



QAL3 report of Span results

- When the plant was operating with the bagfilter online, emissions were well below the emission limit and the instrument operated with 100% reliability.



Half hourly emission averages monitored by PCME QAL 181

Instrument shortcomings

- The major problem exposed during the evaluation was that the instrument blower system (used to keep optics clean) was not suitable for keeping the instrument free from contamination during plant stop and start up (due to increased stack pressure and elevated water vapour levels). The solution to this issue is to replace the blower with a connection to the plant instrument air which is provided at a higher pressure.

- These instrument contamination incidents also highlighted shortcomings in the ease of cleaning and maintenance of the PCME QAL 181. This was rectified with an upgrade to a later design release of the instrument with features to assist cleaning and reassembly.

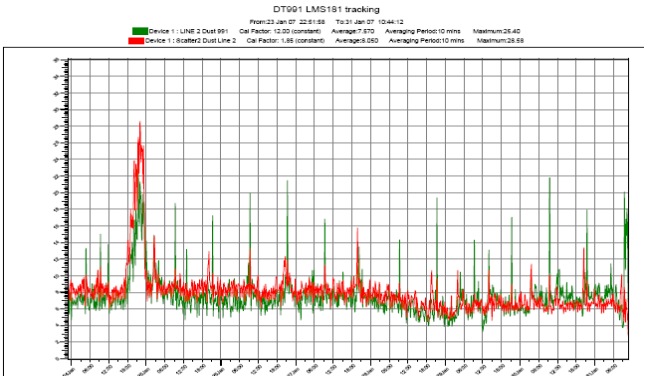
Following the completion of the evaluation, a total of three PCME QAL 181 sensors have been purchased by SITA, one for each of the stacks and the other as a spare (this is a practical way of meeting the Environment Agency's requirement of a maximum instrument down time of less than 4 hours). The PCME QAL 181 has now been installed on the stack at SITA for several years and the instrument is proving to be a reliable method of meeting EN-14181.

PCME QAL 991 instrument results

In January 2007 a PCME QAL 991, manufactured by PCME Ltd, was installed on the same stack to compare the performance of an ElectroDynamic™ instrument to a light scatter instrument. Results from this study have concluded:

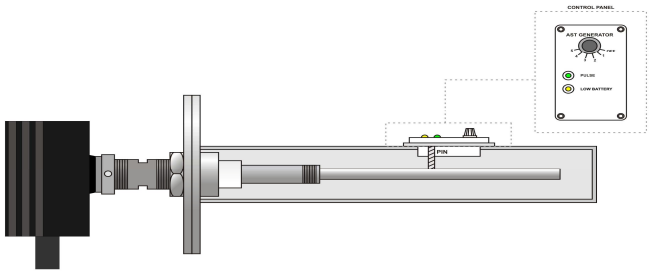
1. The PCME QAL 991 and PCME QAL 181 track short term variations in dust levels associated with bag cleaning in a similar fashion.

2. The PCME QAL 991 and PCME QAL 181 track over extended periods of time while the bagfilter is operating



3. The PCME QAL 991 and PCME QAL 181 have dissimilar results during plant stop and start up when there water condensation issues. This issue appears to be related to the different effects of water vapour on both instruments

4. The PCME QAL 991 has been successfully audited with an external signal generator which injects defined current signal levels (as a surrogate for particulate) into the sensor rod. This check can be used to audit linearity and check for any instrument malfunction.



Audit unit for ElectroDynamic sensor

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[2] SITA Tees Valley Ltd, Haverton Hill Rd, Billingham, Cleveland, TS23 1PY UK