Device selection & Suitability- Selection & Installation, Certification

By
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Environnement SA/PCME
Overview of topics covered

- Introduction
- European approach to CEMS
- CEMS overview
  - Gas sampling introduction
  - Gas analyser introduction
- Particulate introduction
  - Sample conditions, Technologies, configurations
- Installation sample location
- Certification-Gas and Particulate
- US experience certifying Particulate Monitors on Coal fired power plants
  - Drivers, Effect of Wet FGD on particulate
  - PS-11 certification and Procedure 2 approach
  - Comparison with European calibration and EN14181 approach
  - US certification and what we learnt
- Closing statement and Summary
Who are Environnement SA, and PCME?

PCME are a UK Manufacturer of Particulate & Flow Monitors.

✓ Established in 1990.
✓ Experience in hundreds of applications with more than 35,000 particulate monitors world-wide.
✓ ISO 9001 and ISO 14001

Our aim is to improve environmental performance and satisfy the regulatory requirements through continuous monitoring.
Drivers Europe
(Device Selection & Suitability)

Green and Clean?
- ETS, European Directives 2010/75/EU, Consent Decree Title V
- MAT’s, Industry Specific BAT Conclusions MACT

Process Optimisation?
- Installation Commissioning Calibration
- On-going QA OMA (UK)
- Type approvals. EN15267-3 QAL1

Cost savings?
- Performance Standards EN14181
- Or US EPA PS-11

BECAUSE WE HAVE TOO!

Legislation
- Industry Emission Directive (IED) 2010/75/EU

Continuous Emission Monitoring System
Device Selection & Suitability

Dust, $T^\circ$, flow, HCl, SO$_2$, NO, NO$_2$, NO$_x$, N$_2$O, CO, CO$_2$, HC, CH$_4$, TOC, H$_2$O, H$_2$S, O$_2$, Hg, NH$_3$, HF...

Scrubber

In situ analysis
Particulate monitoring
Flow measurement

Furnace, boiler, turbine...

Process control

Data acquisition

Dilution sampling
Heated line

Dry
Multigas Analyzers
Analyzers

Sampling
Typical CEMS Overview
Device Selection & Suitability

Stack
- Gas
- Flow, Temperature, Pressure
- Dust

Shelter
- Gas Composition
- Temperature
- Pressure
- Flow

Control Room
- Processing
- Display
- Communication

Legend:
- 4/20mA
- Digitals
- Ethernet/Comms
- Fluidic
- Comms
Sampling overview
(Device Selection & Suitability)

✅ Dry
Great solution for multi-gas water soluble gas
And corrosive gas applications.
Do not use if measuring NH3

✅ Hot Wet-Heated
Good solution for multi-gas including corrosive
and soluble gas applications.

✅ Hot Wet-Coolers
Good solution for traditional combustion
Applications.

✅ Dilution
Good solution for zoned area, combustion
Applications.

All ESA sampling methodologies.
Analyser overview
(Device Selection & Suitability)

✅ Single Gas.
(NDIR, FID, Chemi, UV etc etc).

✅ Multi-Gas
(IR GFC, FTIR, FTUV, or combined technologies).
(Rack Mount, Wall Mount, Close Coupled)

Many technologies and packaging of ESA analysers.
Particulate-Process conditions
(Device Selection & Suitability)

- **Dry**-The dust tends not to stick easily to Electrodynamic based systems so air purge is not required unless over 50mg/m³. Optical based systems will require air purge.

- **Humid**-The dust will stick to probe and optical based systems so air purge is required.
- Or insulated Electrodynamic probes can be considered.

- **Wet**-The water droplets will interfere on all in-situ dust measurement systems so extractive dust monitoring system will be required.

**Consider the Dust load, Stack Diameter, Temperature and Velocity then decide product offering**
Particulate Technology overview
(Device Selection & Suitability)

✔ Electrodynamic.
(Bag Filter, Cyclones, Dryers not ESP.)

✔ Dynamic Opacity

✔ Opacity.
(Large stacks & high concentration.
Mainly used outside Europe
suitable for US EPA PS1 applications)
Will require air purge and maintenance

✔ Pro-Scatter
  ✔ Forward Scatter
  ✔ Back Scatter.
(Many applications including ESP)
requires air purge.

ESA/PCME offer a unique and most comprehensive range of technologies.
A single channel Particulate Monitor
(Device Selection & Suitability)

Stand alone or Controller for convenient measurement

Control Room | Convenient Location | Stack

4/20mA
Digitals
Ethernet/Comms
Multi Channel or Mass Particulate measurement
(Device Selection & Suitability)

Stack

Flow, Temperature, Pressure

Convenient Location

Outputs
✓ Particulate
✓ Velocity
✓ Pressure
✓ Temperature
✓ Mass particulate emission

Control Room

4/20mA
Digitals
Ethernet/Comms
Installation

For selection of a suitable monitoring location CEN 15259 is used across Europe.
A combination of certification and application determine choice of particulate monitor.

Increasing performance and Quality assurance features
US experience certifying Particulate Monitors on Coal fired power plants

An Improved Forward Scatter monitoring technique for Wet applications using the PCME Stack 181WS
Regulatory Drivers for PM Monitoring of Electric Generating Units (EGU) sources

- Consent decrees with federal, state or local regulators for compliance with particulate emission limits
- Compliance Assurance Monitoring to fulfill Clean Air Act (CAA) Title V requirements
- In the case of wet FGD EGU stacks, Site can seek relief from state and local opacity limits and associated reporting.
  - Wet FGD are a good particulate removal device.
  - Opacity is also not suitable for use after Wet FGD as it does not have the sensitivity for lower ELV’s and water droplets interfere.

- Compliance with particulate emission limits in the Mercury Air Toxics Standards (MATS) rule
  - PM limit for existing bituminous coal fired EGU’s
    - 0.03 lbs/mmBTU - Approx 26 mg/m³ on wet basis, CO2 of 11%, at stack temperature of 130°F (54°C).
    - PS-11 is used for Particulate (much lower sensitivity than Opacity)
MATS PM Compliance requirements for Wet FGD Sources

- Installation and certification of a PM CEMS according to 40CFR60 Appendix B PS-11 and quality assurance as per Appendix F Procedure 2
- Reference method testing using metals or filterable particulate mass MATS method 5
Effect of Wet FGD on Particle Size

- Wet Spray Tower FGD’s (common in US EGU’s) generally remove large, high mass particles very well but are not efficient at removing small particles.

Shaded areas are based on US EPA & E.H. Peechan, "Particulate Matter Controls" June 2002 & are believed to represent one minus the typical removal efficiency of Spray Tower Wet FGD’s.
PCME QAL181-WS
For Wet Stack Particulate Monitoring

- Continuous, Direct, Temperature Regulated Extractive Sampling System.
- Two modes of sampling
  - Isokinetic (flow signal required modbus or 4/20mA).
  - User defined sampling velocity with automatic flow control.
- ProScatter™ An improved Forward Scatter monitoring technique for high accuracy measurements.
- Low Limit of Detection and dynamic measurement range.
- Range of probe materials and lengths to suit sample conditions.
- Easy to install and maintain on site.
US EPA PS-11 & Procedure 2 Approach (Certifying the system-On site only!)

Allow 2-4 weeks minimum as a settling period

PS-11 Correlation Test
Daily Zero and Upscale check <±4% of range
Quarterly Absolute Correlation Audit using audit filters (three values)
RRA: (Relative Response Audit) 3 Run Calibration check
RCA: (Relative Correlation Audit) 12 Run Calibration check

7 Day Drift Check <±2% of range

Initial calibration

On going QA

RRA

RCA

3 years

1 year

Time

PS-11

Procedure 2

Upscale particulate achieved by detuning plant (removing precipitator banks, turning off FGD pumps)
European EN14181 Approach
(Certification pre purchase plus Calibration on site!)

PURCHASE & Install QAL1 equipment!

Calibration
QAL 2 – EN 13284-1 (Europe)

Annual Surveillance Test
(5 Run Calibration check)

AST includes yearly Linearity check using
Audit Filters

QAL 2
Every 3-5 years

QAL1 certified
Commissioning
Initial calibration
On going QA
AST
QAL 2

EN14181 QAL 1

Allow 2-4 weeks minimum as a settling period

QAL3 Zero and Span checks using internal filter.
Linearity checks using external reference materials Audit Filters (Five values)

Zero and Span Checks
(use of control charts)

Internal Filter or use of reference materials Audit Filters

1 year

3-5 years

EN15267-3 testing by national accreditation laboratories TUV or MCERTS
Provides ‘Peace of mind’ that equipment has been tested by a third party prior to purchase and installation
Summary of Fifteen Calibrations in the US MATS Method 5B

### PS-11 Correlation Curve Coefficients

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• Plant configurations
  - All had Wet FGD & Electrostatic Precipitators
  - Slopes clustered in two groups
    - 0.24 to 0.42
    - 0.81 to 0.91
• Why the difference?
• Can almost consider factory preset curves
My Preference

✔ European approach

Why

✔ Equipment that has been tested by national accredited laboratories (TUV & MCERTS) to EN15267-3 with QAL1 as defined by EN14181 provides ‘Peace of Mind’ that the equipment has been tested by an independent third party prior to purchase, installation and commissioning.
Device selection & Suitability - Selection & Installation, Certification

Summary

**Monitoring Choice**

- Use Quality suppliers with experience
- Install commission calibrate to SRM on-going QA spares support
- Purchase Certified Equipment TUV/MCERTS
- Comply with legislation
- Consider specification range sensitivity response size
- Review application requirements sample point and reporting

Comply with legislation

Use Quality suppliers with experience

Install commission calibrate to SRM on-going QA spares support

Purchase Certified Equipment TUV/MCERTS

Review application requirements sample point and reporting

Consider specification range sensitivity response size
Any Questions

Thank You