AAETI
Anil Agarwal Environment Training Institute
PM CEMS – Maintenance & Calibration
PM CEMS—maintenance & calibration

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Particulate measurement devices

• Why calibration is required

Optical, electro-dynamic and tribo-electric monitors are indirect measuring methods. They detect an optical effect – not the dust concentration.

Because of the big variety of dust characteristics, for optical dust monitors it is not possible to measure the dust concentration directly.

To get a mass concentration output signal in mg/m³ every single dust monitors has to be calibrated by gravimetric measurement equipment.
PM CEMS Calibration

Different dust characteristics in terms of:

- Colour
- Size
- Surface
- Reflexion ability
- Density ...

Examples of dust structures

Asbest dust
Coal dust
Domestic dust
PM CEMS calibration

The relation between particle size and mass:

<table>
<thead>
<tr>
<th>Particle size</th>
<th>Diameter</th>
<th>Area</th>
<th>Mass</th>
<th>Relation Mass / Area:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>8</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Gravimetric measurement

Calculation of a regression function (quadratic or linear formula)

\[ \text{Concentration} = cc2 \cdot mA^2 + cc1 \cdot mA + cc0 \]

Implementation into the dust monitor or in an emission measurement computer
Gravimetric measurement

Requirements:

- Distance to the dust monitoring level at least 500 mm above in flow direction
- No mutual influencing of dust meter and calibrating device.
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Isokinetetic sampling

For dust gravimetric comparison according VDI 2066 the gas must be extracted in such a way that the gas velocity in the extraction tube and the gas velocity in the stack are the same.

Homogeneous infiltration.
Big and little particles follow the gas stream.
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- Non-iso kinetic sampling

Gas flow too high.
Big particles cannot follow the gas stream = Concentration to low.

Air flow too low
In relation to much big particles are sucked off = Concentration to high.
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- Vdi 2066
  Profile measurements has to be considered.

Calibration is performed under different plant operation and conditions to achieve different dust load.

Relationship between dust concentration in mg/m³ and monitor output in mA
When evaluating a series of gravimetric dust measurements in accordance to VDI 2066, 95% of the measured extinction values have to be within the tolerance range Y3 and Y4 of the actual dust concentration Y.

The extinction value established over a long period of time has a 95% probability of falling inside the confidence range which is defined by Y1 and Y2.
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The relation between:

- concentration in mg/m³
- and monitor output in mA

changes proportional with the changes in the average particle size.
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Because the average particle size often increases with the concentration (sometimes with the plant load), a non-linear upward rising calibration curve is normal (the black curve).

This has to be respected in the data processing system – means: quadratic curves have to be used. (Requirement of EN14181)
Accessories

Linearity Filter Set

- Filterholder
- Device Filter
Accessories
Adjustment Stand

- Comissioning
- Maintenance

A = distance flange - flange
MAINTENANCE
CASE 1: Cement Plant

MODEL: SB100
Scattered light (dry gas)

Where
Cement Plant after E-filter (Germany)

Dust Meas. Range
0 … 50mg/m³
CASE 1: Cement Plant
CASE 1: Cement Plant
CASE 1 : Cement Plant
CASE 1: Cement Plant
CASE 2 : AT COAL POWER

Where
Coal Power Plant in Prunerov after E-filter (Ceska Republika)

Meas. Range Transmission  0 … 200mg/m³
Meas. Range Scatt.Light    > 200 mg

Task
Control the E-filter work for a higher efficiency
CASE 2: AT COAL POWER
CASE 2: AT COAL POWER
CASE 2 : AT COAL POWER
CASE 2: AT COAL POWER
CASE 3: STEEL INDUSTRY

DUSTHUNTER SP100
Scattered light forward
CASE 3: STEEL INDUSTRY
CASE 3 : STEEL INDUSTRY
CASE 3: STEEL INDUSTRY
CEMS MAINTENANCE (QAL3)
EN 15267 - Performance criteria and test procedures

Maintenance intervals

— The maintenance interval shall be derived from the shortest interval between the requisite maintenance work operations. This also includes manual zero and span point checks.

— The maintenance interval is important for QAL3 according to EN 14181:
  • It defines the time span between QAL3 readings

Maximum allowable maintenance intervals

<table>
<thead>
<tr>
<th>Field test duration</th>
<th>Maximum allowable maintenance interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months</td>
<td>1 month</td>
</tr>
<tr>
<td>6 months</td>
<td>3 months</td>
</tr>
<tr>
<td>12 months</td>
<td>6 months</td>
</tr>
<tr>
<td>24 months</td>
<td>12 months</td>
</tr>
</tbody>
</table>
CEMS MAINTENANCE

Ensure support resources for the CEMS

- Training for maintenance staff
- Training on different Level
CEMS MAINTENANCE

Ensure support resources for the CEMS

Target: System availability > 95%

Support requirements:

▸ full support (engineering, installation, commissioning and start-up)
▸ availability of consumables on-site
▸ availability of critical spare parts from stock (local supplier organization)
▸ QAL3 zero and span without test gases
▸ training
▸ maintenance concept (e.g. Remote access)
Centerpiece is the SICK Meeting Point Server. It serves as the operator.

By means of the SICK Meeting Point Router customers can request with „OneClick“ the support from SICK Remote Service Center.
CEMS MAINTENANCE

Ensure support resources for the CEMS

Maintenance Manual

Preventive Maintenance
# CEMS MAINTENANCE

Ensure support resources for the CEMS

## Maintenance Intervals

<table>
<thead>
<tr>
<th>Maintenance items</th>
<th>refer to</th>
<th>w₁</th>
<th>q₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td></td>
<td></td>
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<tr>
<td>Check if measured values are plausible in the control room</td>
<td></td>
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<tr>
<td>Check if control cycle is (zero/span) valid (control room or recorder)</td>
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<tr>
<td>Check if there is any error message (control room)</td>
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<tr>
<td>Check mechanical damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check attachments and conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection unit with integrated purge air supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning or replace the filter insert and housing of the purge air supply, part no. 5306091</td>
<td>→ S. 14, §3.2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External purge air unit (option)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the hoses and ring nozzles</td>
<td>→ S. 17, §3.2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace the filter insert and check housing of the purge air supply, part no. 5306091</td>
<td>→ S. 16, §3.2.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Many thanks for the attention

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