Electrofilter Protection by Fast Monitoring of CO in Flue Gas

In-situ Laser Gas Analyzer LDS 6 Monitors CO in Real-time

Electrostatic precipitators

Many industrial operations produce exhaust gases that contain dust, fly ash (unburned constituents), fumes (including fine elemental particles such as cadmium, sulfur and lead) and mist (such as coal tar), which cause an unwanted impact to human health and the environment. One widely used method of removing such contaminants from a gas stream is to use an electrostatic precipitator (ESP).

Basically, in an electrostatic precipitator the flue gas is sent through pipes having negatively charged plates which give the particles a negative charge. The particles are then routed past positively charged plates or grounded plates, which attract the negatively-charged particles. The particles stick to the positive plates until they are collected.

Provisions must be taken to avoid flammable gases to enter the filter, since the gas could be ignited by spars occurring between the electrodes.

Electrostatic precipitators are used in power applications as well as in other industries such as cement, pulp & paper, petrochemicals and steel.

Fast and continuous monitoring of the CO concentration in flue gases upstream an electrostatic filter is a key issue for safe filter operation because it prevents the filter from the danger of explosion caused by too high CO concentration.

The in-situ measuring principle is best suited for this task because it provides measuring data in real-time for immediate reaction.

The LDS 6 in-situ Laser Gas Analyzer offers all capabilities for this application. Installed upstream the filter, it delivers fast and accurate CO concentration data that can be further processed in a safety control circuit.

This Case Study presents details of this application.
Safe operation of electrostatic precipitators (ESP) requires fast CO monitoring

Application tasks
Particle emitting processes like cement manufacturing and waste incineration are using electrostatic precipitators (ESP, electro filter) to trap and eliminate solids in the flue gas. Within the same processes, CO can sometimes occur at critical levels. If the presence of CO in the electro filters exceeds a certain level (normally around 10%), electric sparks can provoke hazardous explosions and thus lead to an immediate shut down of the filter operation. Any filter shut down leads to unfiltered emissions and to contaminations of the plant surroundings. Moreover, the number of allowed filter shut-downs per year is often limited by legislative regulations and is constantly lowered. Avoiding too many filter shut-downs consequently secures compliance with the regulations as well as prevents forced production shut downs, which come along with significant financial losses.

CO measurements
Principally, the CO measurement for filter protection must be performed upstream the ESP filter. Conventional analyzer set-ups show a relatively long time-gap between measurement result and actual CO concentration before the filter. Therefore, in practice a big safety margin is applied: If a CO level of only 1-3% (far below the critical value) is detected, the electro filter is already shut down for explosion protection.

Additionally, the extractive analyzer is installed far before the ESP to compensate for the delay time of its sampling system. Along this relatively long flue gas line from the analyzer to the ESP, other plant units such as mills for the raw material are often installed where dilution of the flue gas by ambient air will occur. Therefore, the CO concentration measured upstream the dilution does not correspond any more to the actually lower CO levels in the ESP. A fast CO measurement close to the filter is required for safe and cost efficient operation, avoiding unfiltered emissions as well as too many filter shut-downs.

The analyzer LDS 6
LDS 6 (fig. 1) is a diode laser based in-situ gas analyzer for measuring specific gas components directly in a process gas stream.

LDS 6 consists of a central unit and up to three pairs of cross duct sensors in a transmitter / receiver configuration. The central unit is separated from the sensors by using fibre optics. Regardless how hostile the environment is, the analyzer can always be placed outside any hazardous areas. Measurements are carried out free of spectral interferences and in real-time enabling pro-activ control of dynamic processes. Full network connectivity via ethernet allows remote maintenance.

Key features include
• In-situ principle, no gas sampling
• Three measuring points simultaneously
• Temperature up to 1500 °C
• Ex-version available (option)

LDS 6 is designed for fast and non-intrusive measurements in many industrial processes. Measuring components include: O₂/temp., NH₃/H₂O, HF/H₂O, HCl/H₂O, CO/CO₂, low ppm H₂O, ...

Fig. 1: LDS 6 In-situ laser gas analyzer
Fast and reliable CO measurement using LDS 6

**Application solution**

LDS 6 is capable to measure CO directly in or before the ESP, see fig. 2. A pair of sensors is measuring in-situ and delivering data to the central unit, which can control up to three measurement points simultaneously. The connection between the sensors and the central unit is established by fibre optic cables which can be several hundred metres long.

Since LDS 6 is delivering the concentration data in real-time and with high accuracy, no big safety margin has to be applied. Therefore, the number of shut-downs can be minimized and a safe in-situ control of the filter status becomes available. LDS 6 is measuring CO concentration levels of higher significance, since the measuring point is much closer to the hazardous area. Therefore, in the case of too high CO concentrations close to the explosion endangered level, a fast and automatic shut-down of the filter is realized.

**User benefits**

The list of user benefits includes:

- Less shut-downs of the electro filters, leading to less unfiltered emissions.
- Minimizing the risk of forced production shut-downs due to an excess number of filter shut-downs.
- Eliminated risk of explosion due to safe CO level control.
- Higher CO values can be handled without risk.
- Significantly reduced environmental impact.

**LDS 6 advantages in ESP explosion protection**

The design of LDS 6 makes it an ideal analytical tool for the explosion protection of electrostatic precipitators, preferably in cement and hazardous waste applications:

- LDS 6 measures in real-time for high dynamic safety control. No time-consuming gas sampling is necessary, the measurements are performed in-situ. Therefore, the delivered values mirror the true CO values at the very points of interest.
- Up to three measurement points can be handled with only one analyzer.
- Highest reliability at lowest cost of ownership: no consumable parts, very low maintenance, no calibration is necessary in the field.
- No cross interferences due to highly specific single line absorption measurement and dynamic dust load compensation.
- The sensors are designed to withstand very rough industrial environments.

![Fig. 2: LDS 6 In-situ laser gas analyzer installed for ESP protection](image-url)
Measuring conditions

Typical measuring conditions for the electro filter control are given in table 1. The sensor installation can be adjusted for extremely high dust loads by a shorter optical path in the gas stream either by an off-centre mounting of the process flanges or by applying longer purging tubes. A optical path length shorter than 0.3 m can not be recommended due to dilution effects by the purging media.

If the ranges of typical values are kept unchanged, the application codes given in the last line of table 1 can be used for ordering the analyzer. In other cases, please use the given contact addresses for technical clarification.

User lists are available for different fields of application. Please contact the addresses below.

<table>
<thead>
<tr>
<th>CO measurements for explosion protection of ESP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas to be measured</td>
</tr>
<tr>
<td>CO measuring range before/in filter</td>
</tr>
<tr>
<td>CO resolution</td>
</tr>
<tr>
<td>Dust load</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Max. path length at dust load 20 g/Nm$^2$</td>
</tr>
<tr>
<td>at dust load 80 g/Nm$^2$</td>
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<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Required response time</td>
</tr>
<tr>
<td>Recommended purging mode</td>
</tr>
<tr>
<td>Purging media</td>
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<tr>
<td>MLFB application code</td>
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</tbody>
</table>

| Table 1: LDS 6 measuring conditions for ESP protection |

If you have any questions, please contact your local sales representative or any of the contact addresses below:

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