Clean air ensured – Off gas monitoring in mineral wool production

Case Study · September 2011

The customer

The customer is one of the world’s leading producers of mineral wool – a material that improves the quality of life for millions of people and helps to alleviate environmental problems, such as the greenhouse effect, smog and acid rain. Mineral wool insulation gives us pleasant indoor environments by keeping out the freezing cold. In hot climates, stone wool helps to keep indoor temperatures comfortably cool.

The challenge

Stone wool or mineral wool is made from thin fibers of a combination of volcanic rock, limestone, and coke at a temperature of about 1,600 °C. The molten solution is then poured onto a high speed spinning drum causes the liquid to fly out, elongate and cool to form fine, intertwined fibers with a typical diameter of 6 to 10 μm.

By the spinning process the volume is enlarged by a factor of 100. The process of mineral wool production is similar to the production of cotton candy. After the spinning process, the fibers are then bonded together with a resin binder. The wool is collected on a belt conveyor in the spinning chamber. In the subsequent step, mineral wool is pressed and cured into large uniform slabs. To achieve the expected property of the final product, resins and glue are added. During the subsequent curing at high temperatures, these resins emit a process gas containing NH₃. This must be monitored for environmental reasons.

Before the product can be worked out and cut to standard dimensions, it must be cooled down. Within this cooling process, NH₃ is still being released; therefore NH₃ in the process gas has to be monitored, again for environmental reasons.
The solution

In this plant, the customer operates 3 lines of production, see Fig. 1. Two of these lines use the raw material – mainly volcanic stone – as a feedstock. Producing mineral wool on these two production lines ends up in producing some “lost” material as well. This waste material consists of off cuts, process start-up losses etc. The third line is the “recycle line” on which the waste material is remelted and hence brought back into the production cycle.

For the melting process, there are two ovens:

- A standard gas oven, fed with the natural volcanic rocks, coke and the additional materials required for the production.
- An electric oven is fed with the recycling material from the plant (mineral wool waste, paper labels, packing material etc.).

Consequently there is nearly no waste leaving the production process. According to the customer’s anti-pollution policy and environmental responsibility, also gaseous emissions need to be minimized. The off-gases from the production – furnace, spinning chamber, curing oven – are cleaned in filters and pass after-burners before they enter the chimney.

NH₃ emissions are monitored in the off gas from the spinning machine as well as from the curing and subsequent cooling process.

The electric oven is classified by the local authority and the environmental rules as an incinerator. HF and HCl emissions need to be monitored to avoid negative environmental impacts.

For safety reasons, the standard gas oven is monitored for eventual CO peaks. As this measurement is critical for safety, two redundant systems are applied. Fig. 3 is a schematic of the production process and shows the measurement locations as well. The different measuring tasks on the three production lines sum up to a total of 14 measuring points for the in-situ measurement.
The benefit

The Laser in-situ measurement with LDS 6 grants a nearly maintenance free measuring system. The only interfaces to the process are the process windows which need to be kept clean as a preventive maintenance task. In no situation any corrosive or harmful gas is in contact with the analyzer. The in-situ design furthermore alleviates the need for a sampling system further increasing availability and reliability.

The system design of LDS 6 allows operating up to three sensor pairs with one analyzer. This allows a very economic solution, as the sensors share the central electronic. Thanks to the fast measurement cycle, even when multiplexing three sensor signals, the measurement values are provided nearly in real time.

Fig. 3 Production process and location of the measurements

Fig. 4 Spinning Line 2 - NH₃ measurement
Table 1  Conditions for the measurement in the mineral wool production

<table>
<thead>
<tr>
<th>Gas to be measured</th>
<th>( \text{NH}_3 / \text{H}_2 \text{O} )</th>
<th>( \text{O}_2 )</th>
<th>( \text{HF} / \text{H}_2 \text{O} )</th>
<th>( \text{HCl} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>0 ... 130 ppm / 0 ... 10 %</td>
<td>0 ... 21 %</td>
<td>0 ... 55 ppm / 0 ... 30 %</td>
<td>0 ... 120 ppm</td>
</tr>
<tr>
<td>Gas temperature</td>
<td>80 ... 350 °C</td>
<td>600 ... 1 200 °C</td>
<td>140 ... 300 °C</td>
<td>140 ... 300 °C</td>
</tr>
<tr>
<td>Optical path length</td>
<td>0.6 ... 0.8 m</td>
<td>3 m</td>
<td>0.7 m</td>
<td>0.7 m</td>
</tr>
<tr>
<td>Pressure</td>
<td>1 060 hPa</td>
<td>-5 ... +5 hPa</td>
<td>1 035 hPa</td>
<td>1 035 hPa</td>
</tr>
<tr>
<td>Dust concentration</td>
<td>10 ... 60 mg/Nm³</td>
<td>&lt; 50 mg/Nm³</td>
<td>&lt; 50 mg/Nm³</td>
<td>&lt; 50 mg/Nm³</td>
</tr>
<tr>
<td>Detection limit</td>
<td>( \text{NH}_3 ): 0.8 ... 2.2 ppm ( \text{H}_2 \text{O} ): 2 000 ppm</td>
<td>0.1 ... 0.15 %</td>
<td>HF: 0.8 ... 1.1 ppm ( \text{H}_2 \text{O} ): 500 ppm</td>
<td>4.5 ... 8.0 ppm</td>
</tr>
<tr>
<td>Purging medium</td>
<td>Instrument air</td>
<td>Nitrogen</td>
<td>Instrument air</td>
<td>Instrument air</td>
</tr>
</tbody>
</table>

Get more information

For additional information please contact:
E-Mail: processanalytics.automation@siemens.com

© Siemens AG 2011

Subject to change without prior notice