Petrochemical industry
Magnos28 measures in high sulphur gas before desulfurization unit

Combustion of highly viscous oil residues in a refinery power plant. Efficient and environmental friendly power supply of a refinery.

Measurement made easy

Introduction
The combustion of residues from refinery processes can effectively be used as an alternative fuel to supply power, process steam, usable heat and process water for the refinery.

Thus, an energy circulation is created which efficiently takes care of environmental aspects and lowers operational costs in the refinery.
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The combustion process
The refinery residues, the so called black material like Bitumen and other long-chained hydrocarbons with a high viscosity have to be liquefied and cracked to smaller hydrocarbons at 260°C in a Visbreaker, before they enter the boiler. The following combustion process is controlled by monitoring \( \text{O}_2 \) and \( \text{CO}_2 \), usually using in-situ measurement technique.

DeNOx
In a first step of flue gas treatment \( \text{NO}_x \) is reduced from 600 mg/Nm³ in a SCR process at 360°C (high-dust installation). At the outlet \( \text{NO}_x \) and \( \text{NH}_3 \) are measured, where \( \text{NH}_3 \) indicates the efficiency of the SCR process and \( \text{NO}_x \) is merely monitored. Note: Sometimes \( \text{NO} \) is also measured before DeNOx for controlling purposes.

Flue Gas De-sulfurization (FGD)
Downstream of the SCR the flue gas is then cooled down in two steps, passing an air preheater and a quench cooler. Purpose of the preheater is to heat fresh air before it enters the combustion process in the boiler, thus increasing the efficiency of combustion. The quench cooler effectively reduces the flue gas temperature to ca. 55 °C by direct dosing of water. The flue gas then enters the electro filter for dust removal and the scrubber for desulfurization. Upstream of the FGD, right before the quench cooler there are important gas measurement points for \( \text{SO}_2 \) and \( \text{O}_2 \) reference value. At this point \( \text{SO}_2 \) concentrations are significantly high with values greater than 5 g/Nm³.

Stack emissions
In a last step the cleaned saturated gas is drawn through a steam gas heater and introduced into the stack, where the emissions of \( \text{SO}_2 \), \( \text{NO}_x \), \( \text{CO} \) and \( \text{O}_2 \) are measured and reported.

Measuring task – measuring \( \text{O}_2 \) before Flue Gas De-sulfurization
Upstream of the FGD, along with \( \text{SO}_2 \), the reference value of \( \text{O}_2 \) for calculating normalized emissions is measured. Special requirements for the analytical equipment at this measurement point are drift stability, as calibrations are only done every 4 weeks, and robustness. Robustness at this point is especially important, since \( \text{SO}_2 \) concentrations are greater than 5g/Nm³ and \( \text{SO}_3 \) formation has to be expected.

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ABB solution: Magnos28
The Magnos28 represents the future of paramagnetic oxygen measurement, leveraging ABB’s pioneering technology leadership and over 75 years of innovation in the field of continuous gas analysis. This exciting product completely rethinks paramagnetic oxygen analysis, replacing the glass dumbbell with a revolutionary new silicon sensor, the microwing, and automating historically manual manufacturing processes leading to levels of quality and reproducibility beyond anything that is currently available on the market.

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Revolutionary new microwing technology
The Magnos28 introduces a fundamental revision of the sensor design. The patent-pending microwing replaces the glass dumbbell with its circuit path, mirror, mounting and taring weights as an all-in-one device without any additional attachments. Applying the latest semiconductor based production technologies, multiple sensors are manufactured on a wafer slice – a completely new approach to magnetomechanical oxygen measurement. Absolutely reproducible silicon sensor elements, the microwing, are the basis for a product which promises greatly improved repeatability and precision. The microwing sensor reacts very accurately to oxygen concentration changes due to its very low mass, high width-to-thickness ratio and optimized magnetic field distribution in the measurement position.
Refined for challenging applications
Magnos28 provides reliability and robustness in this measurement environment. Neither glue nor lead solders, which could react with the gas matrix, interfere with the reliability of the measurement. Sensitive parts of the internal chamber like the pole shoes are protected by specially selected coatings.

As a result, excellent measurement properties are achieved with improved drift stability even in the presence of high SO2 concentrations. Cross sensitivity behavior to other gases like CO2 is under control, as Magnos28 measures the pure magnetic properties of dia- and paramagnetic gases – matching the physical values almost without deviation.

Summary of measurement points and ABB offer

<table>
<thead>
<tr>
<th>Sample point</th>
<th>Components</th>
<th>Analyzer / principle</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion process</td>
<td>O₂ , CO</td>
<td>AZ40, Magnos28, Uras26</td>
<td>In situ extractive</td>
</tr>
<tr>
<td>DeNOx</td>
<td>NH₃ 25 ppm</td>
<td>LS25, LS4000</td>
<td></td>
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<tr>
<td></td>
<td>NOₓ 600 mg/Nm³</td>
<td>Limas21 UV</td>
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<tr>
<td></td>
<td>NO₂ 100 mg/Nm³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flue Gas De-Sulfurization (FGD)</td>
<td>SO₂ 5250 mg/Nm³</td>
<td>Limas21 UV</td>
<td>Quartz cell</td>
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<tr>
<td></td>
<td>O₂ 4.5 Vol%</td>
<td>Magnos28</td>
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</tr>
<tr>
<td>Stack Emissions</td>
<td>SO₂ 175 mg/Nm³</td>
<td>Uras26</td>
<td>EN15267</td>
</tr>
<tr>
<td></td>
<td>NO₂ 100 mg/Nm³</td>
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<tr>
<td></td>
<td>CO 5 mg/Nm³</td>
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<tr>
<td></td>
<td>O₂ 5 Vol%</td>
<td>Magnos28 or electrochemical cell</td>
<td>EN15267</td>
</tr>
</tbody>
</table>

Table 01: Measurement points in a refinery’s power plant