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Combustion Optimization by Fast Excess Air Control

In-situ Laser Gas Analyzer LDS 6 Monitors O₂ in Real Time

In combustion control, fast and continuous monitoring of the excess air content is a key issue for efficient plant operation. It is done by measuring the O₂ concentration in the combustion zone.

The in-situ measuring principle is best suited for this task because it provides measuring data directly from the combustion zone and in real-time for immediate reaction.

The **LDS 6 in-situ laser gas analyzer** offers all capabilities for this application. It delivers fast and accurate O₂ concentration data directly from the combustion that can be further processed and used for combustion control.

This Case Study presents details of this application.

Excess air value and combustion efficiency

Combustion is the conversion of primary chemical energy contained in fuels into heat through the process of oxidation at high temperatures. The oxygen required for the combustion is supplied as part of the combustion air that is fed to the process. In ideal (stoichiometric) combustion the amount of oxygen supplied to the process is sufficient to burn all combustibles completely. In real combustion, however, an excess volume of oxygen (air) must be supplied due to insufficient mixing of fuel and oxygen. This additional air volume is called Excess Air.

The excess air value is an important parameter for an optimal combustion process and economic plant operation.

Application task

A very important factor when optimizing a combustion process is the amount of excess air in the combustion zone, resulting in residual oxygen concentration in the flue gas.

The combustion is efficient if the fuel is burnt out to a very high extent. If too much air is fed into the combustion zone, unnecessary cooling - connected also with increased NO_x emissions - is taking place. In the opposite case, i.e. under conditions of an oxygen shortage, an increase of CO emissions would be the consequence. Additional drawbacks would be the existence of unburnt fuel and enhanced corrosion of the vessel walls and steam tubes.

For these reasons, optimizing and continuously adjusting the amount of excess air is important for keeping the combustion process efficient.

Monitoring the oxygen concentration directly in the combustion zone provides an important contribution to control the entire process.

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 fiber 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 proactive 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
- Ex-version available (option)

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

Application solution

By using LDS 6 for in-situ measurements directly in the hot combustion zone, the oxygen concentration is derived almost in real time.

The sensor pair is measuring in a path length of several meters, resulting in highly representative measurement values directly from the combustion zone.

The robust sensors of LDS 6 are connected via fiber optic cables to the central unit, which can be located several hundred meters away from the measuring point.

User benefits

The prompt determination of excess air value means:

- Higher process efficiency, since less excess air has to be heated up
- Cost savings by decreased consumption of electric power on combustion air and flue gas fans
- Less NO_x emissions, less volume flows and therefore less costs for gas-cleaning

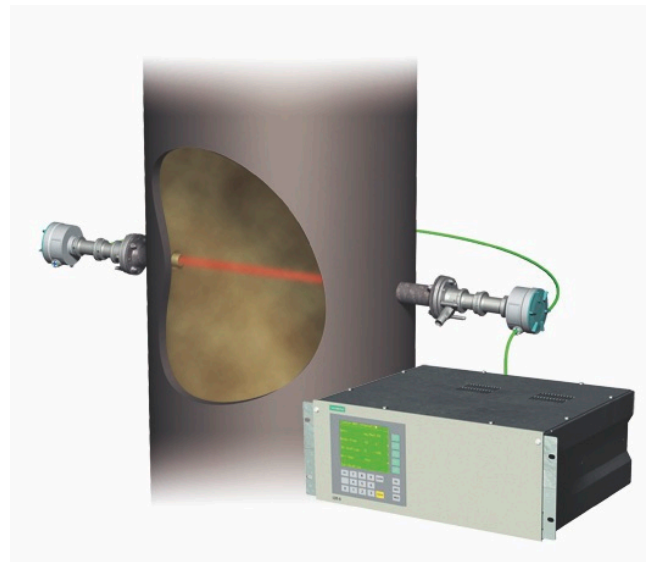


Fig. 1: LDS 6 in-situ laser gas analyzer

LDS 6 advantages for combustion control

The design of LDS 6 makes it an ideal analytical tool for control of combustion processes:

- No gas sampling - the measurements take place in-situ.
- All channels measure in real time for high dynamic process control.
- Up to three measurement points can be controlled simultaneously with only one instrument.
- Line-of-sight measurement across the combustion zone to derive highly characteristic measurement values.
- Highest reliability and lowest cost of ownership: no consumable parts.
- Very low maintenance demands, no calibration necessary in the field.
- No cross interferences due to highly specific single absorption line measurement and dynamic dust load compensation.
- The sensors are designed to withstand very rough industrial environments.
- Large temperature range.

Measuring conditions

Typical measuring conditions for the combustion control are given in table 1.

If the ranges of typical values are kept unchanged, the MLFB codes given in the last line of table 1 can be used for ordering the analyzer. In other cases, please contact your regional sales representative, or email analyticmarketing.sc.i-ia@siemens.com.

Please notice that the O₂ measurement is calibrated above 600 °C. At lower temperatures, the read-out O₂ value cannot be guaranteed. In order to avoid misreadings an external temperature controller can be used.

Notice

User lists are available for different fields of application. Please contact Siemens directly for more information.

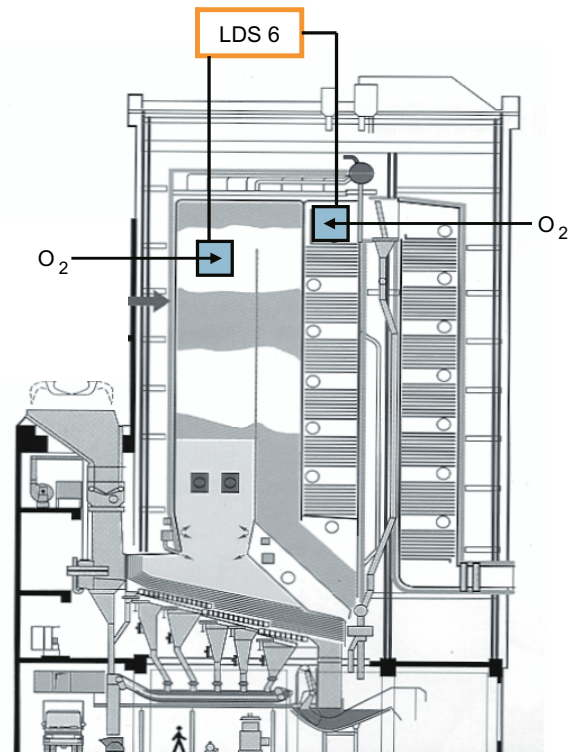


Fig. 2: LDS 6 measuring position for excess air control

O ₂ measurements for Combustion Control	
Gas to be measured	O ₂
O ₂ measuring range	0 ... 21 % Vol.
O ₂ repeatability	± 0.3 % Vol. ¹⁾
Required process temperature for O ₂ measurement	600 ... 1200 °C
Dust load before filter	< 20 g/Nm ³
Typical optical path length	2 ... 6 m
Pressure	Ambient
Required response time	Approximately 10 s
Recommended purging modes	Air or steam, elevated flow None
- Process side	
- Sensor side	
MLFB gas code	A
MLFB application code	B

¹⁾ at 1 m, 600 °C

Table 1: LDS 6 measuring conditions for combustion control

The information provided in this Case Study contains descriptions or characteristics of performance which in case of actual use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective features shall only exist if expressly agreed in the terms of contract. Availability and technical specifications are subject to change without prior notice. All product designations may be trademarks or product names of Siemens AG or supplier companies whose use by third parties for their own purposes could violate the rights of the owners.