APPLICATION NOTE

Chemical Industry

Management of gas burning process in chemical plant

- Measurement of residual gases in process plant
- Continuous ultrasonic measurement of volume flow and caloric value of hydrocarbon gases
- Measuring accuracy independent of gas density

1. Background

Residual hydrocarbon gases arise as a side product from many chemical processes. In many cases these gases are burned in boilers to generate steam. The composition of the residual gases however is not constant and may change from pure hydrogen gas to heavier hydrocarbon gases as a function of the process they evolved from. If there is no residual gas available, natural gas provided from the grid may be used to fire the boiler. Thus, the caloric value of the gas varies strongly and the burner of the boiler has to be adjusted to the changing gas composition so as to guarantee an optimal burning of the gas with minimal emissions.

2. Measurement requirements

In order to optimise the burning process the measurement has to fulfill two requirements. The First requirement is the adjustment of the burner to the gas composition to have an oxygen/fuel (lambda) ratio of 1 to 1.2. Traditionally, this is measured by a lambda sensor in the exhaust gas. This measurement however requires maintenance and re-calibration. A better solution is to measure directly the caloric value of the fuel gas. The second requirement is a repeatable gas flow measurement independent of gas properties. This is of particular importance since the density of the gas alters with its changing composition.

3. KROHNE solution

Both measurement requirements can be solved with the OPTISONIC 7300. The 2-beam ultrasonic flowmeter provides an accurate measurement of the volume flow of gas independent of the gas density. The special damping technology of its titanium sensors ensures a highly accurate measurement of the ultrasonic transit time which is directly proportional to the velocity of sound. It also entails an integrated molar mass calculation (according to the formular shown at the right). It requires input of the adiabatic index and the temperature. The first is entered via the menu, the second is provided by an external temperature sensor connected to the flowmeter's 4-20 mA input.

The molar mass of a gas can be determined according to the following

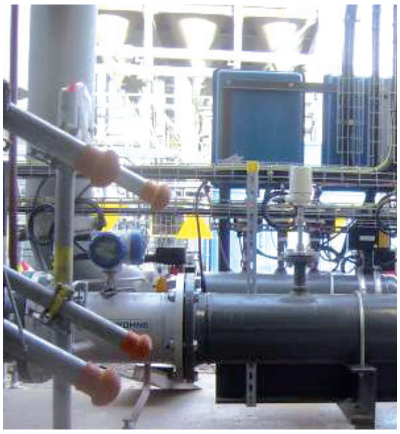
$$M = \frac{\gamma R T_{actual}}{VoS^2}$$

γ = adiabatic index, pre-set value into the flow meter electronics
R = molar gas constant, approximately 8.3145 J mol^{-1} K^{-1}.
T_{actual} = Gas temperature in Kelvin.
VoS = velocity of sound of the gas to be measured

4. Customer benefits

The customer benefits from an optimised burning process. On the basis of highly accurate measuring results, the burner control can be adjusted according to the caloric value of the residual gas composition so as to minimize emissions (e.g. of NOx) and improve energy efficiency.

The customer stands to gain from a maintenance free installation as the OPTISOSNIC 7300 has no moving parts that would affect the gas flow. Thus, unlike lamda sensors, the OPTISONIC 7300 offers a much better long term stability and repeatability. Besides this, gas properties such as density and pressure don't have an impact on the quality of the measurement. Without any obstructions, there is also no pressure loss influencing the process. It is an additional value that there is no separate flow computer needed as the OPTISONIC 7300 is available as integrated solution.



OPTISONIC 7300 at chemical plant

5. Product used

OPTISONIC 7300 Ultrasonic gas flow meter

- Excellent accuracy and long term stability
- nominal size: DN100…DN600 / 4"…24"
- High performance over a wide measurement range
- Diagnostics to validate flow meter and process
- Low investment, low operational costs
- Titanium transducers

Contact

Would you like further information about these or other applications?
Do you require technical advice for your application?
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