Gas Analysis of H_2S, CH_4, CO_2 and O_2 in Biogas Plants

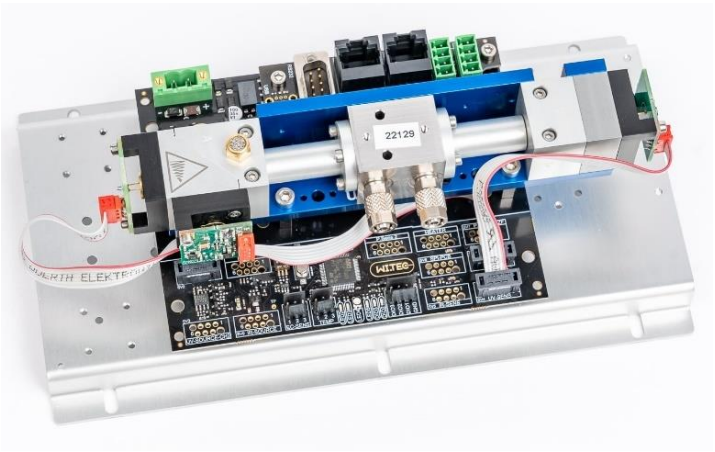
Biogas consists mainly of methane (CH_4), carbon dioxide (CO_2) and hydrogen sulphide (H_2S). H_2S measurement is a major challenge in biogas analysis. Wi.Tec-Sensorik GmbH has developed a highly accurate and long-term stable H_2S gas sensor for this area of application based on UVLED technology.

Hydrogen sulphide (H_2S) is an undesirable component of biogas, which is mainly produced during the processing of animal waste. The utilisation of biogas is restricted by this component and must therefore be removed at all costs. In particular, combustion in gas engines is impaired by H_2S and can lead to the destruction of the engines (SO_2 formation).

H_2S is also toxic and harmful to the environment. The measurement of this component is therefore an important task and a prerequisite for the environmentally friendly utilisation of biogas. There is therefore a considerable need for reliable H_2S measurement technology to promote the use of biogas plants. Although the electrochemical gas sensors currently in use fulfil some requirements, chemical decomposition processes mean that they are not stable in the long term and require little maintenance. With an innovative approach (NDUV technology) based on UV light-emitting diodes (UV LEDs), Wi.Tec-Sensorik GmbH has succeeded in developing a practical H_2S gas sensor (ULTRA.sens®) as part of a DBU research project.

NDUV ULTRA.sens® H_2S

Hydrogen sulphide has a broad absorption band in the UV range between 160 nm and 260 nm, meaning that H_2S gas measurements can be carried out at different wavelengths. Wi.Tec uses a long-term stable gas discharge lamp (EDL) for the measurement at 204 nm, with which concentrations in the trace range are possible (0-100ppm H_2S). At a wavelength of approx. 230 nm, H_2S concentrations in a measuring range of 0-2000 ppm and measuring ranges in the vol % range can be realised. Miniaturised UV LEDs are suitable as radiation sources here, as they have a significantly lower power consumption and do not need to be thermostated. This is particularly advantageous for portable gas analysers. Furthermore, the UVLED can be modulated electronically. The service life of the UVLED can be significantly extended thanks to a variably adjustable pulse-width ratio. A service life of >5 years can therefore be realised without any problems, even in continuous operation. Compared to electrochemical gas sensors, there is no consumption with this physical process, so that maintenance-free operation is possible over a long period of time. This is of great benefit to the user (cost of ownership).



NDIR INFRA.sens® CH_4 / CO_2

The highly selective gas analysis is carried out using NDIR technology (INFRA.sens®). The INFRA.sens® utilises the known absorption bands for methane and carbon dioxide in the 3µm - 5µm range. The radiation source is a blackbody radiator that can be modulated in the frequency range of 1-10Hz. To achieve optimum linearity, a 20 mm long analyser cuvette (AK20) is used, which is coated with a special gold layer. The gold coating has a high reflectivity and leads to an optimum signal level on the detector side. The gold coating also protects against corrosion. The IR detector is located on the opposite side and consists of 4 elements. Interference filters are used to filter out the gas-specific spectral components for the respective detectors. The interference filters have a very narrow bandwidth and an efficient blocking factor. This leads to a very high selectivity and negligible cross-sensitivities to other gas components. The CH_4 and CO_2 concentrations (e.g. 0-100 vol.%) are recorded simultaneously in an INFRA.sens.

The entire signal processing takes place in an electronic evaluation unit (base board), which is located below the optical unit. Data is transmitted via an RS232 interface. CAN interface, MODBUS (option) and analogue output 0-10V (option) are also available.

Oxygen-Measurement O_2

This set-up also includes an electrochemical (EC) oxygen sensor (galvanic cell) for measuring the oxygen concentration in the gas mixture. The O2.sensD has a measuring range of 0-25 vol.% O_2 and is very selective for oxygen, even in the presence of other gases in high concentrations. Compared to physical gas sensors, the service life of electrochemical gas sensors is limited due to the chemical reactions in the sensor. The service life is therefore specified in vol.%-h. The typical sensor lifetime is >500,000 vol.%-h. In the presence of 10-20 vol.% oxygen, the calculated service life is approx. 3-6 years. The O2.sensD can communicate with the INFRA.sens electronics via an I^2C interface. Compared to analogue transmission, the I^2C interface ensures loss-free and high-resolution measured value transmission.

Spezifikationen

General features	
Ranges	0-2000ppm, 0-25.000ppm H_2S 0-100 vol.% CH_4 0-100 vol.% CO_2 0-25 vol.% O_2
Gas flow	0.1-1.5 l/min.
Dimensions	225mm x 125mm x 81mm (NDUV) 225mm x 125mm x 74.4mm (NDIR)
Weight	580g 520g
Lifetime	10.000h-100.000h (NDUV) depends on data rate > 40.000h (NDIR) >500.000Vol.%·h (EC)
Warm-up time	<5min. initial <45min. full specification
Response time t90	1.5s-15s (NDIR) 5-300s (NDUV) adjustable <5s (EC)
Detection limit	<5ppm H_2S <0.01 vol.% CH_4 < 0.01 vol.% CO_2 <0.1 vol.% O_2
Linearity error	<1% F.S.
Supply voltage	15-30 VDC
Power consumption	<8W@24VDC
Output signal	RS232, Modbus or CANbus
Operating temperature	5-45°C
Air pressure	300-1200 hPa (mbar)
Ambient Humidity	<95% rel. Humidity

https://www.witec-sensorik.de/nduv-h2s/

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