O_2 in natural gas production, storage, transportation and distribution

Benefits at a glance

- Measurement ranges from 0-10 ppmv to 0-20%
- No interference from high levels of H_2O, CO_2 and H_2S
- Rapid analysis using quenched fluorescence method
- Reliable in harsh environments
- Low cost of ownership due to minimal maintenance
- See product data sheets for hardware specifications

Natural gas production

Natural gas is extracted using several methods such as hydraulic fracturing (fracking) or traditional drilling. Produced gas can be fairly dry or gas can be "associated" with liquid products such as oil, water and natural gas liquids (NGLs). The gas will be separated from liquids, and transported to a gathering site where it will typically flow through a pipeline to a gas processing plant.

The crude oil will be held in storage tanks after some additional separation, and in many cases, those tanks will use vapor recovery units (VRU). The VRU recovers the vapors, which form in the tank overhead space, and pump it back to the gas system.

If the processing plant is a fairly long distance from the production area, compressors will be employed to move the gas. All of the equipment described here has the potential to leak air and introduce oxygen into the pipeline. This can be especially true with compressors and VRU's.

Measurement of oxygen

Oxygen must be controlled in natural gas pipelines primarily to prevent corrosion. Oxygen may combine with H_2O, CO_2 and H_2S to form carbonic acid or sulfuric acid which is corrosive to carbon steel. This requirement usually translates into "custody transfer" specifications which can be as low as 10 parts per million volume (ppmv) of O_2 depending on the parties involved and the application. Since natural gas may contain H_2O, CO_2, and H_2S at very high concentrations, the measurement method must be immune to those contaminants. It should also have a rapid response in order to help detect where leaks are coming from as quickly as possible. Natural gas pipelines are often remotely located, where low maintenance is key and false alarms are costly.

Endress+Hauser's solution

Endress+Hauser introduced quenched fluorescence (QF) technology to the natural gas industry in the early 2000's. No other competing system measures oxygen in natural gas better and faster that the Endress+Hauser's quenched fluorescence oxygen analyzer. They are demonstrably faster, more accurate, more stable, immune to CO_2, H_2S H_2O and other contaminants, and require very little maintenance. The sensors do not degrade due to exposure to high levels of oxygen.

Validation

Endress+Hauser oxygen analyzers can be calibrated in the field using a 2-point calibration method. The analyzers can be calibrated in the factory if the analyzer is equipped with optional pressure compensation. Validation can be performed using a binary gas blend of oxygen in a nitrogen background. A detailed procedure and recommended setup for performing validations is available from Endress+Hauser.

Endress+Hauser
People for Process Automation

Application data			
Target components	O_2	O_2	O_2
Typical measurement ranges	0-10 to 0-1000 ppmv	0-1 to 0-5%	0-10 to 0-20%
Lower limit of detection	0.5 ppmv	20 ppmv	300 ppmv
Typical accuracy at 20°C	±5% of reading	±3% of reading	±2% of reading
Typical repeatability	±1% of reading	±1% of reading	±1% of reading
Measurement update time	Default 30 seconds - programmable sampling rate		
Principle of measurement	Quenched fluorescence (QF)		
Sample flow rate	Typical 1.0 slpm (2.1 scfh)		
Recommended calibration	2-point calibration in oxygen-free environment (nitrogen) and a second span point (cylinder gas). Validate with O_2 in N_2 reference (cylinder gas).		

Accuracy specification applies to concentrations up to 300 ppmv.

Typical stream composition			
Component	**Minimum (Mol%)**	**Typical (Mol%)**	**Maximum (Mol%)**
Hydrogen sulfide (H_2S)	0	2-4 ppmv	20
Moisture (H_2O)	0	30-80 ppmv	1
Carbon dioxide (CO_2)	0	2	100
Nitrogen and oxygen (N_2+O_2)	0	1	20
Methane (C1)	0	90	100
Ethane (C2)	0	7	20
Propane (C3)	0	3	15
Butanes (C4)	0	<2	5
Pentanes plus (C5+)	0	<1	3

The process stream composition must be specified for proper assessment, calibration and measurement performance. This includes the normal or typical composition, as well as the expected variation (min./max.) for each component (including the measured analyte). Deviations from the typical composition table will be reviewed by Endress+Hauser for suitability.