Application Note

Water measurement in molecular sieve dryer vessel outlet

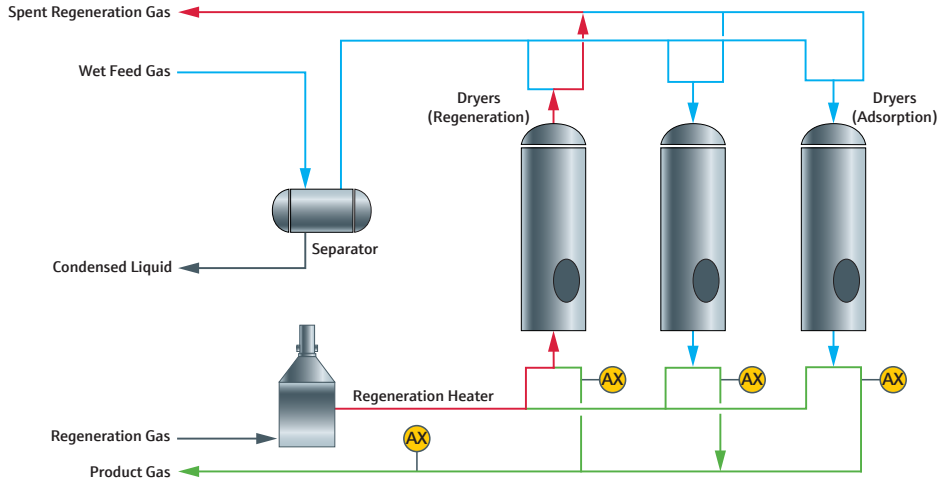
Industry:
Natural Gas Processing
Application Note 33701

Key Points

- Fast response to H_2O concentration changes
- Patented* Differential Spectroscopy technique measures H_2O at sub-ppm levels in natural gas
- Integrated permeation tube supports automated validation checks
- Laser-based measurement is highly selective and accurate for H_2O in natural gas

*www.spectrasensors.com/patents

Molecular sieve dehydration Sweet natural gas exiting an amine treatment unit is saturated with water vapor. Some water can be removed from the gas by passing it through a knock-out drum, compression and cooling. Molecular sieve dehydration must be used to obtain the very low H_2O concentration (<0.1 ppm) required in low temperature and cryogenic processes for NGL extraction and liquefied natural gas (LNG) production.



Molecular sieve dehydration system

Process control and optimization Three or four molecular sieve dryer vessels are typically operated in parallel with a piping system that allows a saturated adsorbent bed to be taken off line for regeneration with heated gas. Measuring the moisture level in the outlet gas from each dryer vessel enables the operator to rapidly detect moisture breakthrough in the adsorbent bed and switch gas flow to a vessel with a freshly regenerated adsorbent bed.

SpectraSensors' solution SpectraSensors tunable diode laser absorption spectroscopy (TDLAS) analyzers have proven highly effective for this critical measurement. TDLAS analyzers have an exceptionally fast response to changes in H_2O concentration, an important performance characteristic for detecting breakthrough in molecular sieve beds. SpectraSensors patented differential spectroscopy technique enables detection and quantitation of sub-ppm levels of H_2O in natural gas. An integrated permeation tube supports automated validation checks to verify the analyzer is operating properly during the extended periods of time when H_2O is not present in the outlet gas from a molecular sieve vessel. Laser and detector components are isolated and protected from process gas and contaminants avoiding fouling and corrosion and ensuring stable long-term operation and accurate measurements in the field.

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Application Data	
Target Components	H_2O Measurement in Molecular Sieve Dryer Vessel Outlet
Typical Measurement Ranges	0-10 ppm*
Typical Accuracy	±50 ppb at 0.5 ppm ±240 ppb at 10 ppm
Typical Repeatability	±0.03 ppm*
Measurement Response Time	1 to ~60 seconds*
Principle of Measurement	Differential Tunable Diode Laser Absorption Spectroscopy (H_2O scrubber included)
Validation	Integrated Permeation System

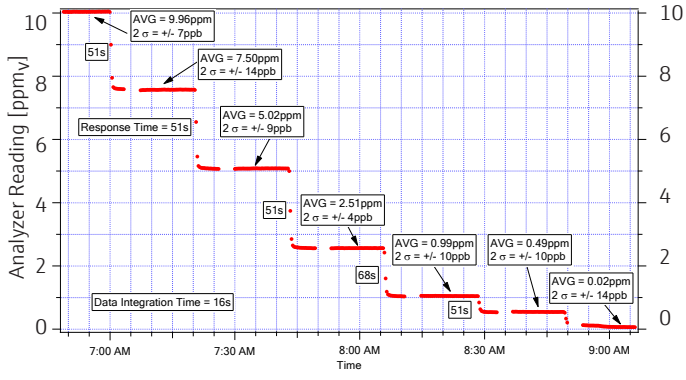
*Consult factory for alternate ranges.

Typical Background Stream Composition

Component	Minimum (Mol%)	Typical (Mol%)	Maximum (Mol%)
Water (H_2O)	0	< 1 ppm	10 ppm
Nitrogen (N_2)	0	0.1	3
Oxygen (O_2)	0	0	1
Methane (C_1)	60	75	100
Carbon Dioxide (CO_2)	0	0	3
Ethane (C_2)	0	15	20
Propane (C_4)	0	6	13
Butanes (C_4H_{10}) +	0	4	5

The background stream composition must be specified for proper calibration and measurement performance. Specify the normal composition, along with the minimum and maximum expected values for each component, especially water, the measured component. Other stream compositions may be allowable with approval from SpectraSensors.

Step test H_2O in natural gas The accompanying graph shows results of a Step test in which the concentration of H_2O was decreased from 10 ppm down to 0 ppm. Measurement repeatability at all concentrations is well within specifications (+/- 30 ppb).



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