Measuring Hydrogen Sulfide in Natural Gas

Applied Analytics Application Note No. AN-026

Application Summary

Analytes: **H_2S** (hydrogen sulfide)

Detector: OMA-300 H_2S Analyzer

Process Stream: natural gas

Introduction

Raw natural gas contains hydrogen suflide, the level of which varies by field. Due to its toxicity, flammability, and corrosivity, H_2S is an extremely important component to control at all stages of natural gas handling, from wellhead to the customer. The destructive effects of H_2S on equipment and pipelines along with the constant threat to personnel safety justify major investment in H_2S measurement technology.

The OMA H_2S Analyzer is a highly field-proven solution for fast-response H_2S measurement in several natural gas applications. Due to excellent accuracy and dynamic range, the OMA is the analyzer of choice both for high-level (e.g. wellhead gas) and low-level (e.g. sales gas pipeline) H_2S ranges.

Older technologies like GC and paper tape are being phased out due to the superior performance and ease of photometric H_2S analyzers. The OMA provides fast response measurement with less downtime than these alternatives for more effective control in a natural gas process. When compared against competing photometers, the OMA provides more accurate measurement at a wider concentration range due to the dispersive “full-spectrum” acquisition at high resolution.

OMA Benefits

- Continuously measures H_2S concentration in natural gas using dispersive UV-Vis absorbance spectrophotometer
- Totally solid state build with no moving parts — modern design for low maintenance
- Direct analysis of hot, wet, high-pressure sample using rugged flow cell
- 1,024-photodiode array allows accurate measurement of 0-10 ppm, 0-100%, or any range in between
- Superior performance to paper tape with far lower maintenance costs
- Decades of field-proven performance in natural gas analysis all over the world

Experienced OMA Applications in the Natural Gas Industry

» WELLHEAD GAS

The wellhead is responsible for handling the raw natural gas extraction out of the underground formation while preventing gas leaks or blowouts due to gas pressure. The wellhead gas is subsequently sent to some form of H_2S removal system (usually amine srubbers or scavenger beds). It is critical to continuously measure the H_2S concentration in the wellhead extracted gas stream because H_2S loading can range widely (typically 0-5%) and must be measured in order to properly operate the removal system according to the feed gas composition. Since the wellhead must operate reliably (often in remote locations) while handling up to 20,000 psi pressure, a reliable gas analyzer should be installed on the raw gas line to detect corrosion risks.

The OMA H_2S in Natural Gas Analyzer is perfectly suited for wellhead gas monitoring because (1) the system sustains accuracy even when H_2S concentration fluctuates rapidly with wide swings, (2) the system is automated for reliable unattended operation in remote environments, and (3) the system can analyze the high-pressure sample directly with flow cell rated up to 3000 psi and no sensitivity to moisture in the UV-Vis wavelength domain.

OMA FOR H_2S IN WELLHEAD GAS. ALASKA, USA.

» SALES GAS

The pipelines used to transport processed natural gas (sales gas) to customers are susceptible to severe corrosion damage when H_2S in the gas stream frees the iron content from the steel pipe interior surface. The most proactive method of preventing this dangerous and expensive pipeline damage is to continuously measure H_2S concentration in the sales gas pipeline and ensure that the level does not exceed a set threshold of concern.

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The OMA H_2S in Natural Gas Analyzer provides proven reliable H_2S monitoring in distribution pipelines with configurable alarms for the problematic concentration range. Real-time analysis along with rich trend data allows for optimal expenditure of H_2S removal resources (e.g. scavengers) and rapid response to upset conditions. With ±1 ppm accuracy at a 0-10 ppm range at high pressure, the OMA provides an ideal sales gas quality & H_2S safety assurance solution.

CUSTODY TRANSFER STATION

At the point where natural gas is transferred from one operator to another, e.g. from a producer to a regional distributor, a custody transfer station carefully manages the metered transmission of the gas stream. Since H_2S loading is an important parameter in sales gas quality, both operators implement an H_2S measurement method in order to verify and cross-reference the H_2S loading for smooth assurance of purchase specifications.

Deploying the OMA H_2S in Natural Gas Analyzers simplifies the custody transfer operation by automating the H_2S validation procedure. Compared to alternative high-maintenance methods, the OMA provides reliable set-and-forget H_2S measurement after a one-time calibration. Utilizing mirror OMA units on each side of a custody transfer station allows real-time cross-referencing and redundant H_2S readings for additional confirmation of proper analyzer operation.

OMA FOR H_2S AND ODORANTS IN A CUSTODY TRANSFER STATION. NEW YORK, USA.

» AMINE SCRUBBER OUTLET GAS

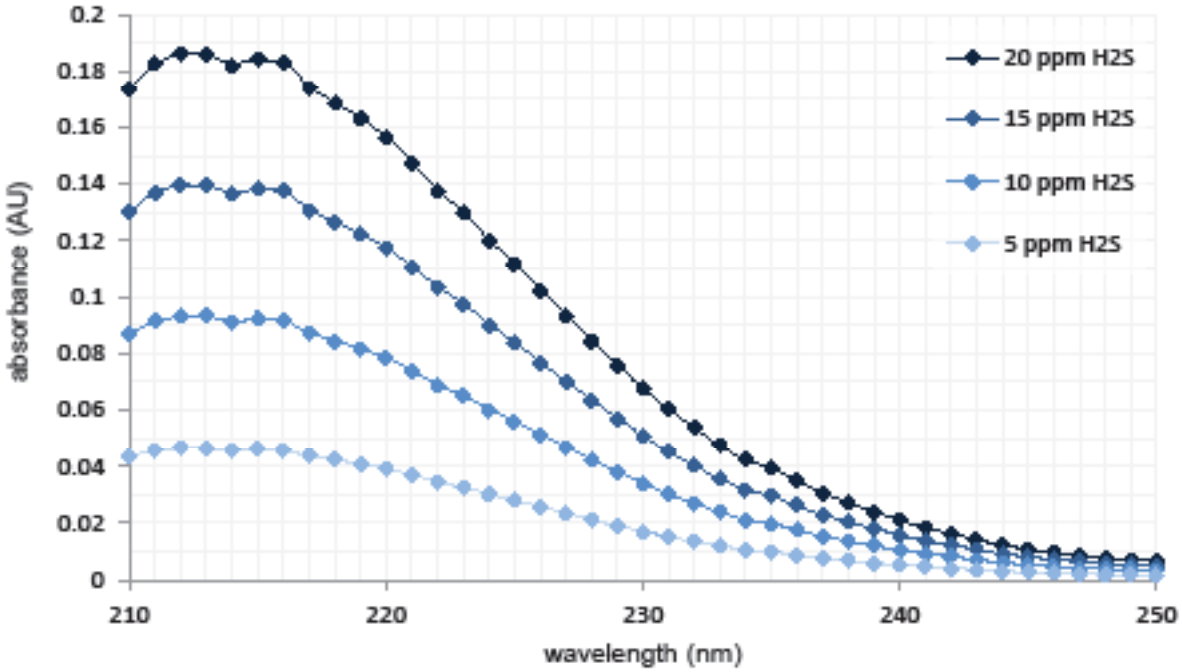
The best way to ensure H_2S scrubbing efficiency of the amine treating is to measure H_2S in the outlet gas of the scrubber, particularly in conjunction with lean amine / rich amine analysis for optimization of the amine regenerator. H_2S measurement in the raw gas (wellhead gas) determines how much processing a particular feedstock requires for adequate H_2S removal, and the measurement point in the scrubber outlet gas indicates if the scrubber has performed within specification.

OMA H_2S Analyzers provide a full-featured suite of solutions for total amine scrubber control, including monitoring the scrubber inlet gas, outlet gas, lean (fresh) amine, and rich (saturated) amine. With low cost of ownership and automated performance for unattended operation, these analyzers lead to significant savings on amine scrubber operation and power costs. Excellent accuracy at low ppm concentrations make OMA the natural choice for measuring H_2S breakthrough in a scrubber outlet or downstream from any removal system.

H_2S Absorbance Curve

Any single photodiode measurement is vulnerable to noise, signal saturation, or unexpected interference. This susceptibility to error makes a lone photodiode data point an unreliable indicator of one chemical's absorbance.

As accepted in the lab community for decades, the best way to neutralize this type of error is to use collateral data in the form of 'confirmation wavelengths,' i.e. many data points at many wavelengths instead of a single wavelength:



In the figures above, each diamond represents a single photodiode and data point. The nova II registers absorbance at each integer wavelength within the 210-250 nm measurement range and produces an H_2S absorbance curve. After being calibrated on a full spectrum of pure H_2S, the OMA knows the absorbance-concentration correlation for each measurement wavelength; the system can average the modeled concentration value from each wavelength to completely eradicate the effect of noise at any single photodiode.

The OMA visualizes the H_2S absorbance curve in this manner and knows the expected relation of each data point to the others in terms of the curve's structure. This curve analysis enables the OMA to automatically detect erroneous results at specific wavelengths, such as when a single photodiode is saturated with light. The normal photometer, with a single data point, is completely incapable of internally verifying its measurement.

Additional Measured Chemicals

The OMA H_2S Analyzer has additional measurement benches available for adding up to 4 more analytes; these are limited to chemicals in the natural gas which are measurable by UV-Vis spectroscopy, including COS, CS_2, and R-SH (odorants). Measurement of CO_2 can easily be implemented by integrated MicroSpec IR modules which read into the OMA interface.

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The specifications below represent performance of the OMA-300 Process Analyzer in a typical natural gas application.

For technical details about the OMA-300 Process Analyzer, see the data sheet:
http://aai.solutions/documents/AA_DS001A_OMA300.pdf

All performance specifications are subject to the assumption that the sample conditioning system and unit installation are approved by Applied Analytics. For any other arrangement, please inquire directly with Sales.

Application Data		
Performance Specifications		
Accuracy	*Custom measurement ranges available; example ranges below. Accuracy specifications represent headspace gas sample analysis validated with span gas.*	
	H_2S	0-10 ppm: ±1 ppm 0-100 ppm: ±1% full scale or 1 ppm* 0-10,000 ppm: ±1% full scale
		*Whichever is larger.

Further Reading

Subject	Location
OMA-300 H2S Analyzer Brochure	http://aai.solutions/documents/OMAH2S.pdf
OMA-300 Process Analyzer Data sheet	http://aai.solutions/documents/AA_DS001A_OMA300.pdf
Advantage of Collateral Data Technical Note	http://aai.solutions/documents/AA_TN-202_CollateralData.pdf
Multi-Component Analysis Technical Note	http://aai.solutions/documents/AA_TN-203_MultiComponentAnalysis.pdf

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