Measuring H2S and CO2 in Sweet Gas

Applied Analytics Application Note No. AN-059

Application Summary

Analytes:	**H_2S (hydrogen sulfide), CO_2 (carbon dioxide)**
Detector:	**OMA-300 Process Analyzer, MicroSpec IR Analysis Module**
Process Stream:	**Sweet Gas**
Typical Measurement Range:	**0-10 PPMV H_2S, 0-5% CO_2**

Introduction

H_2S and CO_2 are the most common unwanted species in natural gas. Many wells contain large concentrations of these two components. Removing H_2S and CO_2 is critically important for a plant for safety reasons and design requirements. As wells around the world become more sour, where possible this process has shifted from large plants to smaller units closer to the point of extraction to minimize both risk and expense. This has led to the use of many different sour gas treatment units to meet the specific demands of the location. These units take sour gas and remove the H_2S and CO_2 through a wide variety of techniques and produce sweet gas on the outlet. Plants rely on these units to bring the levels down to below 5 ppm H_2S and under 4% CO_2 for plant safety, export restrictions, and corrosion concerns.

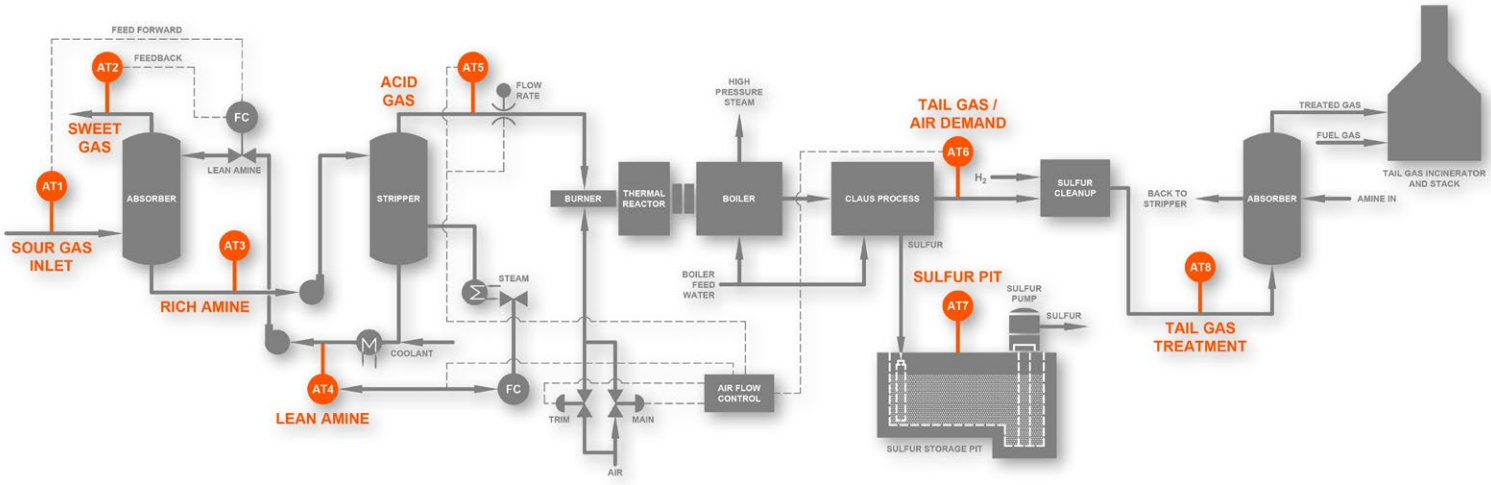
H_2S is an extremely toxic and dangerous gas. The hazards associated with the high levels of H_2S found in sour gas increase the risk of each job performed in areas where it is present, leading to more expensive safety measures and more difficult working conditions. It is important to ensure that H_2S is removed to within safe limits once it passes through the acid gas treatment unit and into areas that are not specifically engineered for high levels of acid gas. High levels of H_2S in the gas can also lead to sulfur stress cracking in pipes and H_2S and CO_2 generally increase corrosion throughout the plant. This decreases the life expectancy of equipment and increases the chances for an emission incident. Depending on the levels involved and specific local requirements, exotic materials are required to handle the corrosion potential on all equipment before H_2S can be confirmed to have been removed.

Sweet gas is also monitored as a specification for the final output of the process. Natural gas must meet specifications to be transported through pipelines for environmental safety, and protection of equipment. Sending off-spec gas downstream can have dramatic consequences, both in the plant and downstream of the plant. Elevated levels of H_2S will affect the lifetime of piping running from the plant to the export utility, which is a substantial capital investment. Additionally, releasing off-spec gas down the process pipe results in heavy fines. The Sweet gas analysis point is the first place where this can be picked up. If off-spec gas is discovered here, the plant can divert the gas to flare, or recycle it through the scrubbers to achieve a lower sulfur level. If it makes it to the export analyzers before this happens, it is harder to divert, and will result a larger amount of gas needing to be recycled or flared off to maintain the export specifications.

The OMA system continuously measures 0-10 ppm H_2S and 0-5% CO_2 concentrationin the sweet gas stream. The analyzer provides real-time data on how this unit operation is functioning, allowing for seamless control of acid gas treatment units. This system pairs nicely with the export natural gas analyzer to ensure the quality of your product.

Sulfur Recovery Unit Schematic

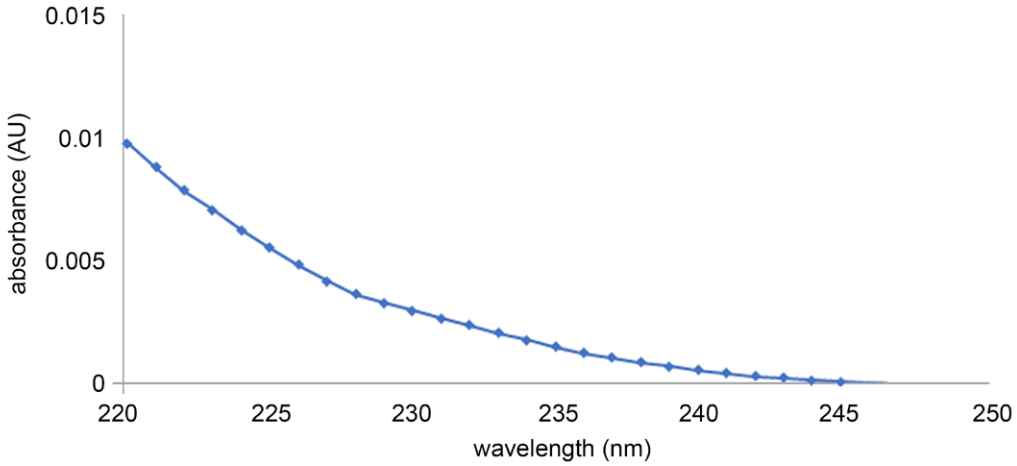
In the diagram below, the sweet gas analysis point is identified by **AT2**. H_2S and CO_2 are measured at AT2 in the stream leaving the absorber.



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.

Example Sweet Gas Sample Conditioner

The system is built to monitor 0-10 ppm H_2S and 0-5% CO_2 in sweet gas. Key features for this low level H_2S and CO_2 application include:

- SS316 fittings & viton gaskets for corrosion resistance
- Standard Heating to 40 degrees C to prevent condensation and maintain analyzer at a constant temperature.
- Liquid filtration to remove carryover and condensate.
- Aromatic trap setup prevents BTEX compounds from interfering with the measurement.
- Integrated MCP-200 analyzer housed in an explosion proof enclosure.

The specifications below represent performance of the OMA-300 Process Analyzer with integrated MicroSpec modules in the feed forward SRU application.

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

For technical details about the MicroSpec MCP-200 IR Modular Analyzer, see the data sheet:
https://aai.solutions/documents/AA_DS003A_MCP200.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.*		
	OMA-300 (UV-Vis)	**H_2S**	0-10 PPMV
	MCP-200 (NDIR)	**CO_2**	0-5%

Further Reading

Subject	Location
OMA-300 H2S Analyzer Brochure	https://aai.solutions/documents/OMAH2S.pdf
OMA-300 Process Analyzer Data sheet	https://aai.solutions/documents/AA_DS001A_OMA300.pdf
MicroSpec MCP-200 Infrared Analyzer Data sheet	https://aai.solutions/documents/AA_DS003A_MCP200.pdf

www.aai.solutions

Headquarters
Applied Analytics, Inc.
Burlington, MA, USA
sales@aai.solutions

North America Sales
Applied Analytics North America, Ltd.
Houston, TX, USA
sales@appliedanalytics.us

Brazil Sales
Applied Analytics do Brasil
Rio de Janeiro, Brazil
vendas@aadbl.com.br

Europe Sales
Applied Analytics Europe, AG
Genève, Switzerland
sales@appliedanalytics.eu

Middle East Sales
Applied Analytics Oil & Gas Operations, L.L.C.
sales@appliedanalytics.ae

India Sales
Applied Analytics (India) Pte. Ltd.
sales@appliedanalytics.in

Asia Pacific Sales
Applied Analytics Asia Pte. Ltd.
Singapore
sales@appliedanalytics.com.sg

China Sales
Applied Analytics China Limited
China
sales@appliedanalytics.cn