Sulfur Recovery Unit Acid Gas Analysis

Applied Analytics Application Note No. AN-020

Application Summary

Analytes: **H_2S** (hydrogen sulfide), **NH_3** (ammonia), **CO_2** (carbon dioxide)

Detector: OMA-300 Process Analyzer + MicroSpec IR Analysis Module

Process Stream: acid feed gas to sulfur recovery unit

Introduction

H_2S is an extremely dangerous chemical which occurs naturally in fossil fuels and is removed through refining processes. The sulfur recovery unit (SRU) of a refinery converts the H_2S to elemental sulfur which can be stored or sold off. A critical point in this process is the furnace which combusts H_2S in order to sustain a 2:1 stoichiometric ratio of H_2S:SO_2 in the subsequent catalytic reaction. The amount of available oxygen in the furnace is carefully controlled to ensure this ratio for the next step. The efficiency of the entire SRU therefore hinges on the ability to continously measure the required amount of oxygen (i.e. “air demand”) in the furnace.

While tail gas analysis measures the H_2S:SO_2 ratio after the furnace to calculate air demand correction, a feed forward analysis system measures the H_2S concentration in the acid feed gas before the furnace to preemptively adjust air demand based on the real-time feed gas H_2S level. While tail gas analysis provides the most accurate air demand calculation, this measurement occurs after the furnace. Feed forward analysis allows for air demand control with no process lag by immediately detecting sudden changes in acid feed gas composition and preventing any losses in SRU efficiency.

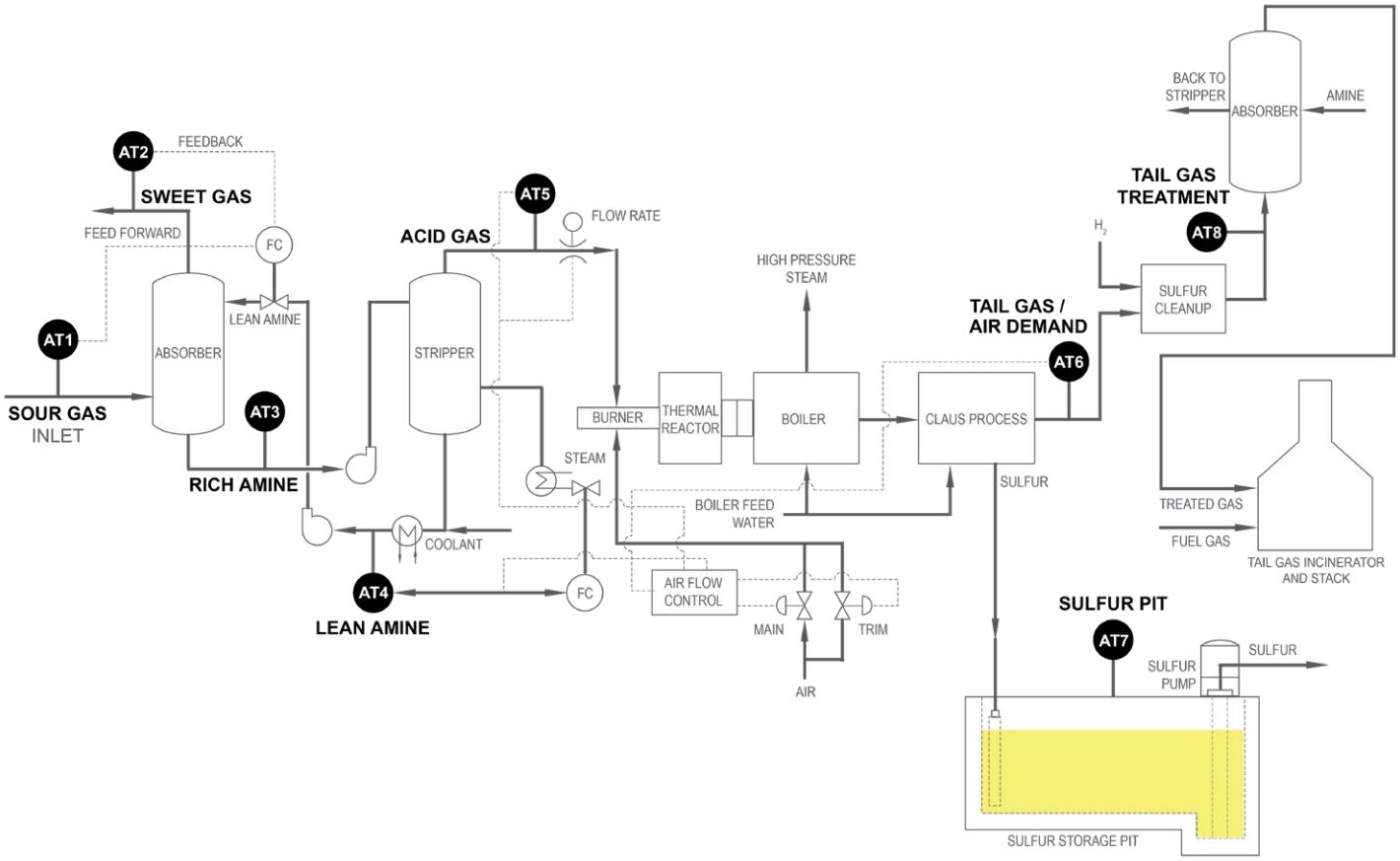
The OMA system continuously measures 0-100% H_2S concentration in the acid feed gas to provide real-time feed forward control. This system provides the perfect complement to the TLG-837 Tail Gas Analyzer for total SRU air control.

System Benefits

- Continuously measures H_2S level in acid feed gas stream using UV-Vis spectrophotometer
- Totally solid state build with no moving parts — modern design for low maintenance
- Additional software benches for up to 4 more chemical analytes (e.g. NH_3)
- Ultra-safe fiber optic design with no sample gas inside analyzer unit — world’s safest solution for this application

Sulfur Recovery Unit Schematic

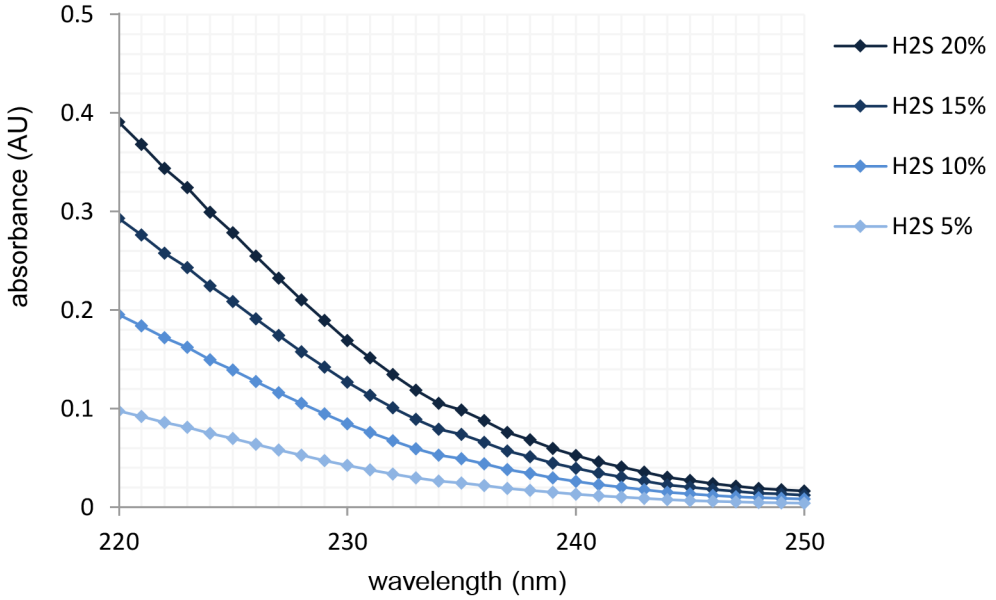
In the diagram below, the feed forward analysis point is identified by **AT5**.



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:



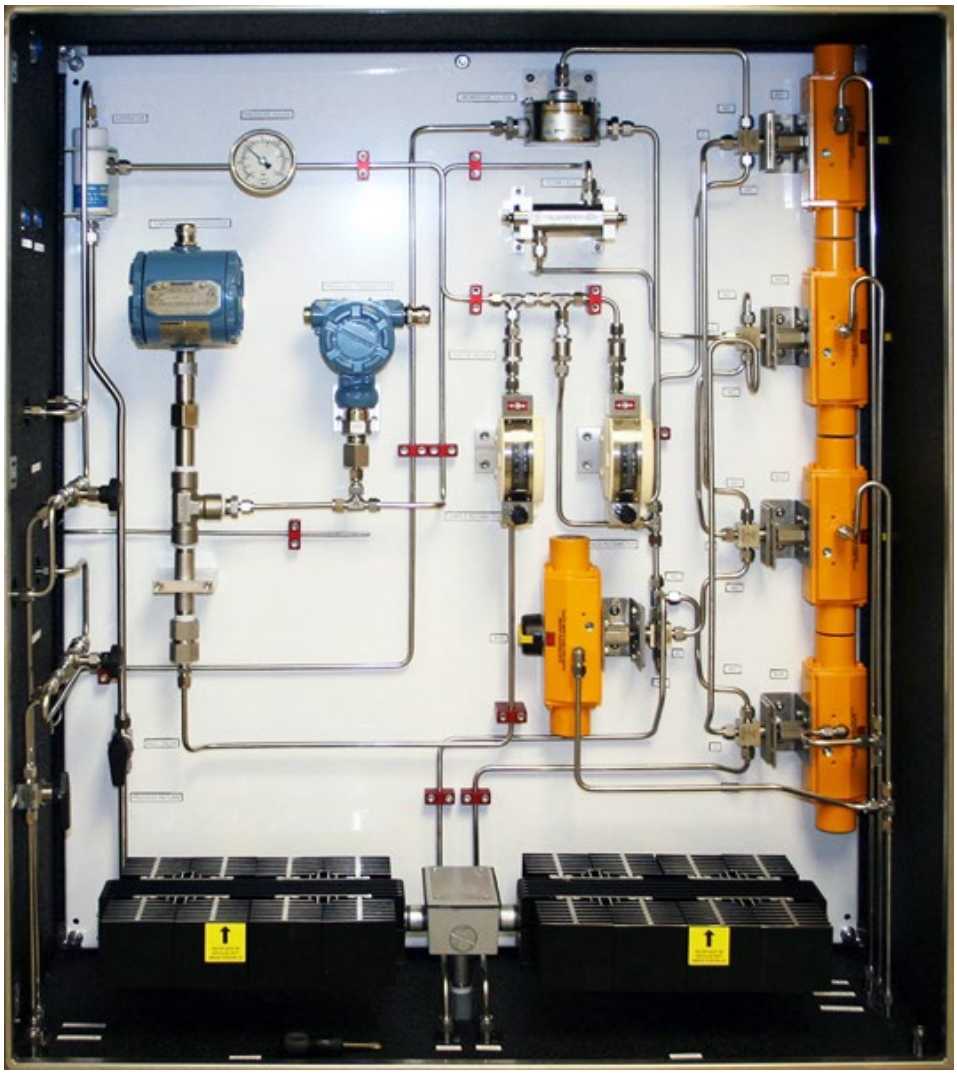
In the figures above, each diamond represents a single photodiode and data point. After being calibrated on a full spectrum of pure H_2S, the OMA knows the absorbance-concentration correlation for each measurement wavelength; the system averages the modeled concentration value from each wavelength to 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 is critical at the high level H_2S analysis involved with acid feed gas streams. At very high concentrations, the absorbance will be very high, and a photodiode at a high-absorbance wavelength (e.g. 215 nm) may not register any light at all. Fortunately, the low-absorbance wavelengths (e.g. 240 nm) will be used to validate the curve and reject error.

Example Acid Feed Gas Sample Condtioner

The system pictured below was built to monitor 0-100% H_2S in SRU acid feed gas. Key features for this high level H_2S application include:

- SS316 fittings & Kalrez gaskets for extreme corrosion resistance
- Heating to 80 C



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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**	0-100%: ±1% full scale
		NH_3	0-50%: ±1% full scale
	MCP-200 (NDIR)	**CO_2**	0-50%: ±2% full scale

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
TLG-837 Tail Gas Analyzer Data sheet	https://aai.solutions/documents/AA_DS004A_TLG837.pdf
Advantage of Collateral Data Technical Note	https://aai.solutions/documents/AA_TN-202_CollateralData.pdf
Multi-Component Analysis Technical Note	https://aai.solutions/documents/AA_TN-203_MultiComponentAnalysis.pdf

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