

Measuring H₂S in Hydrogen Recycle Gas

Applied Analytics Application Note No. AN-035



Application Summary

Analytes: **H₂S (hydrogen sulfide)**

Detector: **OMA-300 H₂S Analyzer**

Process Stream: **hydrogen**

Typical Range: **0-10 ppm**

Introduction

In one part of the petroleum refining process, low-octane naphtha is converted to high-octane 'reformates,' which can then be used to increase the octane of fuel blends. This process occurs in the Catalytic Reforming Unit, where various reactions consume the naphtha feedstock and produce more complex hydrocarbons including aromatics.

These reactions remove hydrogen atoms from the hydrocarbon molecules, thus producing large amounts of H₂ gas which gets stripped out of the reformates stream in a hydrogen separator. The recovered 'hydrogen recycle gas' is a valuable utility for many processes, including mixing back into the naphtha feedstock to the Catalytic Reforming Unit. (While hydrogen is a byproduct of the catalytic reforming reactions, it is also necessary in the feed to hydrocrack paraffins and protect the catalyst from polymer formation.)

Use of the H₂ recycle gas is complicated by the formation of H₂S in the reformer if the naphtha feedstock is not completely desulfurized. Catalysts are poisoned by exposure to H₂S, especially the platinum- and rhenium-containing catalysts commonly used in the Catalytic Reforming Unit. To protect the catalysts and reduce reforming inefficiency, a method of monitoring the H₂S in the hydrogen recycle gas is required.

The OMA H₂S Analyzer uses a high-resolution UV-Vis spectrophotometer to measure real-time H₂S concentration in the hydrogen recycle gas stream. This measurement is an ideal application for the OMA because the hydrogen background has no absorbance in the UV wavelength domain. Additionally, the OMA is built for direct measurement of the hot, high-pressure sample in the rugged optical flow cell, allowing for a simpler sample handling system.

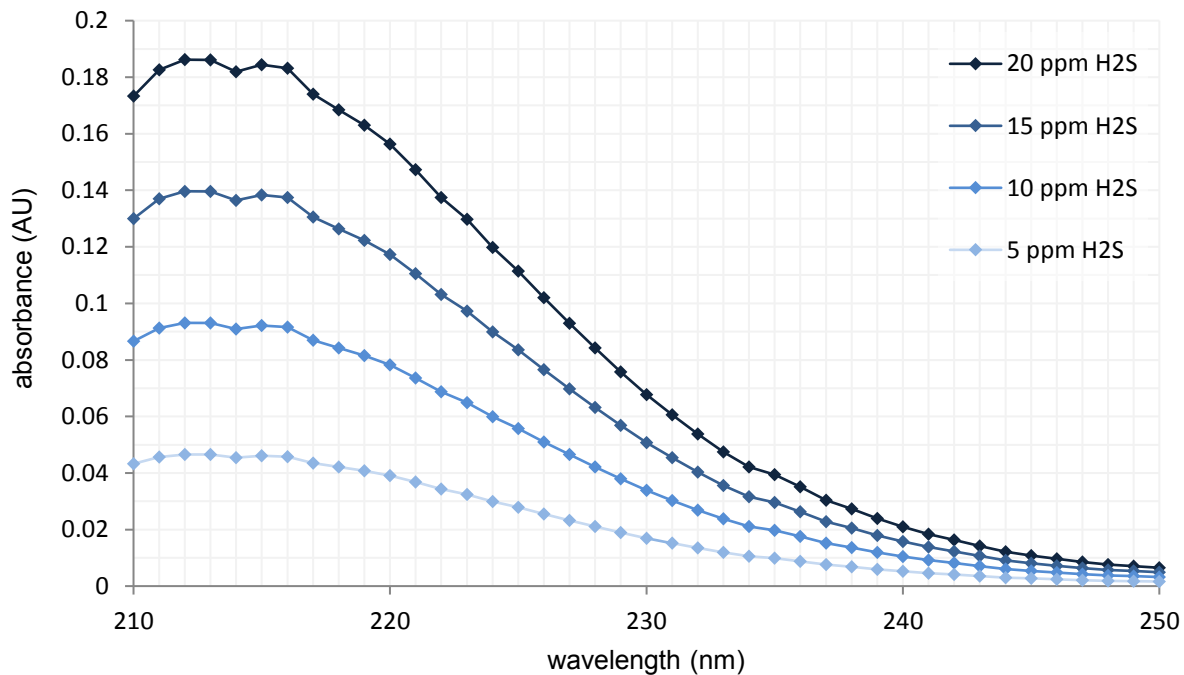
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H₂S Absorbance Curve

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 H₂S absorbance curve. After being calibrated on a full spectrum of pure H₂S, 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 H₂S 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.

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

For technical details about the OMA-300 Process Analyzer, see the data sheet:

http://www.a-a-inc.com/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.

Subject to modifications. Specified product characteristics and technical data do not serve as guarantee declarations.

Application Data	
Performance Specifications	
Accuracy	<i>Custom measurement ranges available; example ranges below.</i>
	H₂S 0-10 ppm: ±1 ppm 0-100 ppm: ±1% full scale or 1 ppm* 0-10,000 ppm: ±1% full scale
*Whichever is larger.	

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Further Reading

Subject	Location
OMA-300 H ₂ S Analyzer Brochure	http://www.a-a-inc.com/documents/OMAH2S.pdf
OMA-300 Process Analyzer Data sheet	http://www.a-a-inc.com/documents/AA_DS001A_OMA300.pdf
Advantage of Collateral Data Technical Note	http://www.a-a-inc.com/documents/AA_TN-202_CollateralData.pdf



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