

Measuring Reduced Sulfur in Refining Applications

Applied Analytics Application Note No. AN-014



Application Summary

Analytes: **Reduced Sulfur (H₂S, COS, CS₂)**

Detector: **OMA-300 Process Analyzer**

Process Stream: **flare gas, emissions**

Typical Measurement Range: **0-300 ppm**

Introduction

As stipulated by legislation in the 2010's — c.f. US EPA 40CFR60 Subpart Ja — petrochemical refineries are required to monitor emitted concentrations of H₂S, COS, and CS₂. These three chemicals are defined collectively as **Reduced Sulfur (RS)**.

This new monitoring requirement necessitates an instrument which can measure 3 or more chemical analytes simultaneously. Most instruments require special sample conditioning or additional hardware to perform these measurements synchronously.

The OMA-300 Process Analyzer measures H₂S, COS, and CS₂ simultaneously by virtue of full-spectrum dispersive UV spectrophotometry. This out-of-the-box multi-component analysis is a much smoother installation experience than installing a paper tape detector with special RS sample preparation system or a complex GC system.

The introduction of the RS measurement requirement illustrates the forward-looking value of the OMA. If you already owned an OMA to measure H₂S in flare gas, a simple software calibration would have implemented COS and CS₂ measurements at no additional cost. With 5 total software benches for multi-component analysis, the OMA provides the flexibility to easily implement future measurement requirements without upgrading the system or incurring additional costs.

OMA Benefits

- » Continuously measures RS concentration (individual measurements of H₂S, COS, and CS₂) using dispersive UV-Vis absorbance spectrophotometer
- » Totally solid state build with no moving parts — modern design for low maintenance
- » 5 total software benches allow addition of up to 2 more chemical analytes for future requirements
- » Easily reprogram measurement ranges at any time via ECLIPSE software — no 'application lock' (sample system dependent)

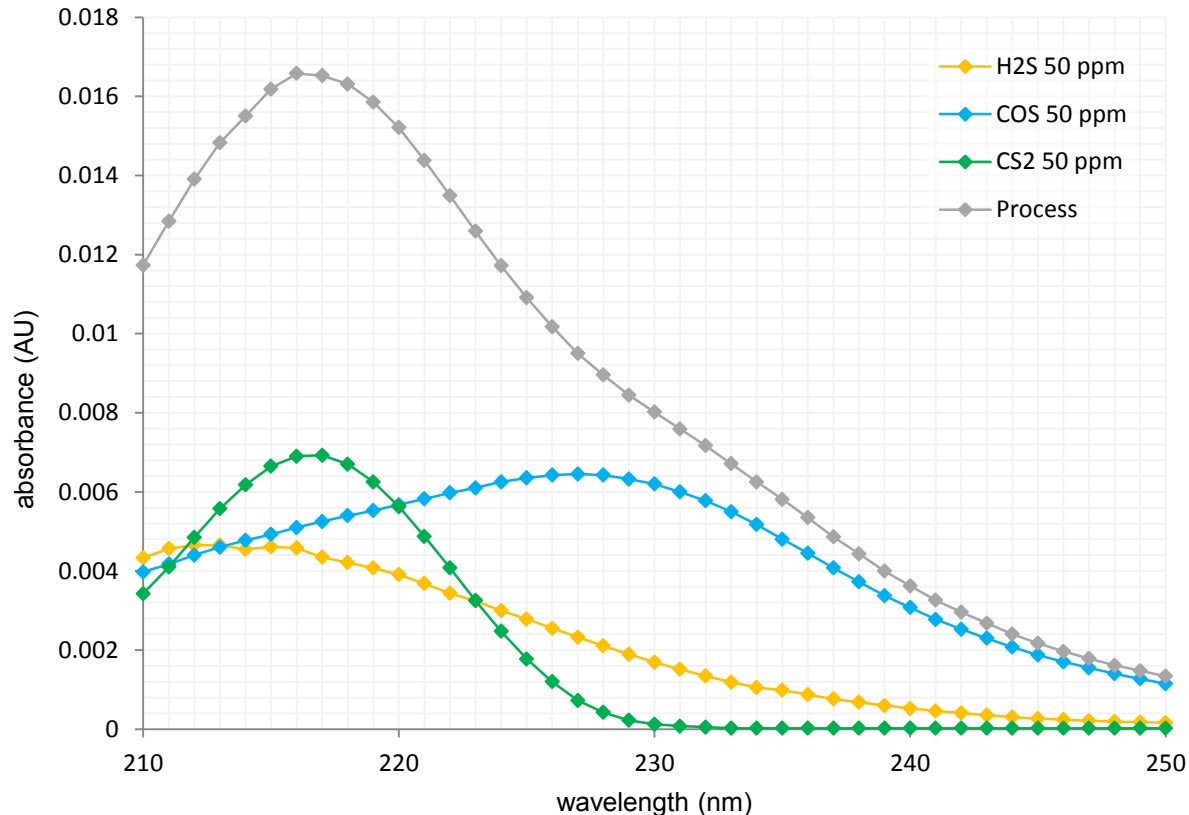
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Reduced Sulfur Analyte Absorbance Curves

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 spectra above, each diamond represents a single photodiode and data point. The nova II registers absorbance at each integer wavelength to produce the raw data that is visualized as an absorbance curve.

After being calibrated on full spectra of pure, precise-concentration samples of each analyte, 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 absorbance curves 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 RS 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 liquid phase 0-10 mg/L: ±0.1 mg/L 0-100 mg/L: ±1% full scale or 0.1 mg/L* gas phase 0-10 ppm (@10 bar): ±0.1 ppm 0-10 ppm (@1 bar): ±1 ppm 0-100 ppm: ±1% full scale or 1 ppm* 0-10,000 ppm: ±1% full scale 0-100%: ±1% full scale |
| | COS 0-200 ppm: ±2% full scale or 4 ppm* |
| | CS₂ 0-200 ppm: ±2% full scale or 4 ppm* |
| | *Whichever is larger. |

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Further Reading

| Subject | Location |
|--|---|
| 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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