Measuring H2S in Water

Applied Analytics Application Note No. AN-034

Application Summary

Analytes: **H_2S** (hydrogen sulfide)

Detector: **OMA-300 H_2S Analyzer**

Process Stream: **water**

Introduction

H_2S-in-water is a broad category of measurement applications ranging from petrochemical cooling water to residential water supply. As one of the most toxic chemicals known to man (with adverse health effects beginning at 20 mg/L) and a precursor to acid rain, H_2S is always an environmental concern when allowed to accumulate in water bodies. In industrial processes, the corrosive effects of H_2S in water often require control at much lower concentrations in order to protect equipment.

Providing direct, continuous analysis of H_2S concentration in liquid water, the OMA H_2S in Water Analyzer is a trusted solution for these applications. Utilizing a UV-Vis dispersive spectrophotometer, the OMA measures the absorbance curve of H_2S with no sensitivity to the water background, as water has no absorbance in the UV wavelength domain.

OMA Benefits

- Measures real-time H_2S concentration in a continuously drawn water sample
- Direct analysis of water in liquid phase
- Totally solid state build with no moving parts — modern design for low maintenance
- Auto Zero normalizes reading on current background water spectrum — no re-calibration ever required
- None of the hassles of paper tape: no consumables, no drive jamming, no sample dilutions for high range

OMA vs. Paper Tape

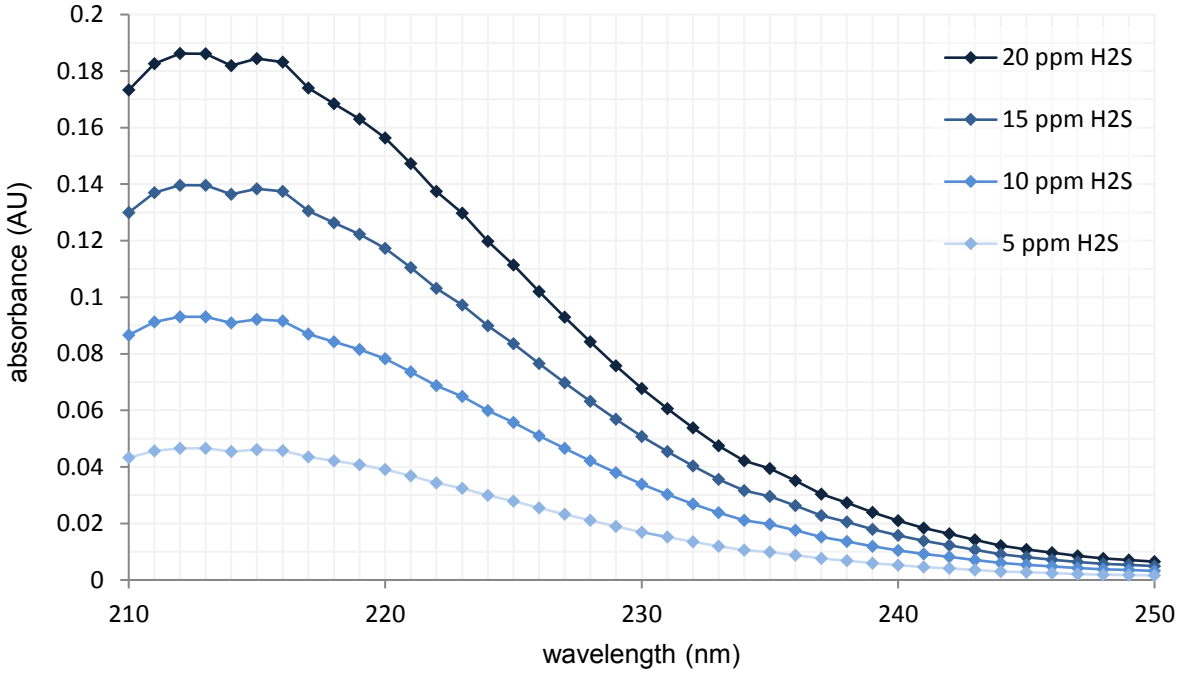
Lead acetate tape is a sensing mechanism developed in the 1940's which is still used commonly today, despite its many inconveniences and archaic design. The primary drawbacks reported by our customers who replaced these devices include: slow response (up to 3 minutes), tape drive jamming, monthly tape replacement and special disposal.

Paper tape is particularly unsuitable for water analysis because these systems cannot perform direct analysis of liquid water — they absolutely require the H_2S to be stripped into the gas phase for analysis. By comparison, the OMA only needs a headspace sample conditioner if the water is particularly opaque. For a typical H_2S-in-water application, the OMA provides a much simpler and less expensive solution than paper tape.

H_2S Absorbance Curve and OMA Calibration

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 OMA measures 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.

Experienced Applications for the OMA H_2S in Water Analyzer

» COOLING WATER

The enormous amount of water consumed by oil refining operations is mostly used for cooling purposes, where heat exchangers transfer the heat from a fuel process stream to the colder water. These heat exchangers have to withstand heavy throughput and eventually suffer leaks.

The presence of H_2S in the cooling water is a strong indication of a heat exchanger leak. Fast detection of the leak alerts the operator when to switch to an alternate heat exchanger and/or perform maintenance on the leaking heat exchanger.

Using the OMA H_2S in Water Analyzer, the refinery can optimize time between heat exchanger maintenance through continuous online monitoring of H_2S leaks into the cooling water stream. Easily configurable 4-20 mA alarms and set-and-forget operation make the OMA highly suitable for this application.

» DRINKING WATER SUPPLY

Depending on the source of the local drinking water, there may be a significant level of 'total sulfide' (H_2S and HS^-) present. H_2S has adverse health effects at levels above 20 mg/L but has an unpleasant odor even at ppb levels, making any amount of H_2S highly undesirable in drinking water. Water plant managers use methods including air stripping and chlorine injection to remove H_2S and meet quality standards, but a method of total sulfide monitoring in the cleaned water is needed to optimize chlorine usage and verify water safety.

The OMA H_2S in Water Analyzer measures low ppm levels of both H_2S and HS^- simultaneously in drinking water. At a pH of 7.0, almost half of the H_2S exists as the HS^- ion, so this multi-component capability is critical for an accurate reading of total sulfide.

» STRIPPED SOUR WATER

In a refinery, sour water must be cleaned of its sulfide content before being recycled or released to the environment. This cleaning process is known as "stripping" because it flows gas (air or steam) through the sour water to strip H_2S and NH_3 out of the water. To verify that the sour water is being effectively stripped, online analysis is required in the stripped water stream.

Sour water is often too opaque to transmit a light signal, thus requiring the headspace sampling system to strip the analyte chemicals out of the liquid and into a gas phase sample. The OMA H_2S in Water Analyzer measures H_2S (and optionally, NH_3) in the headspace gas of the stripped sour water and performs an extremely accurate correlation to the concentration(s) in liquid.

Read more in Application Note AN-027: Stripped Sour Water

» WASTEWATER

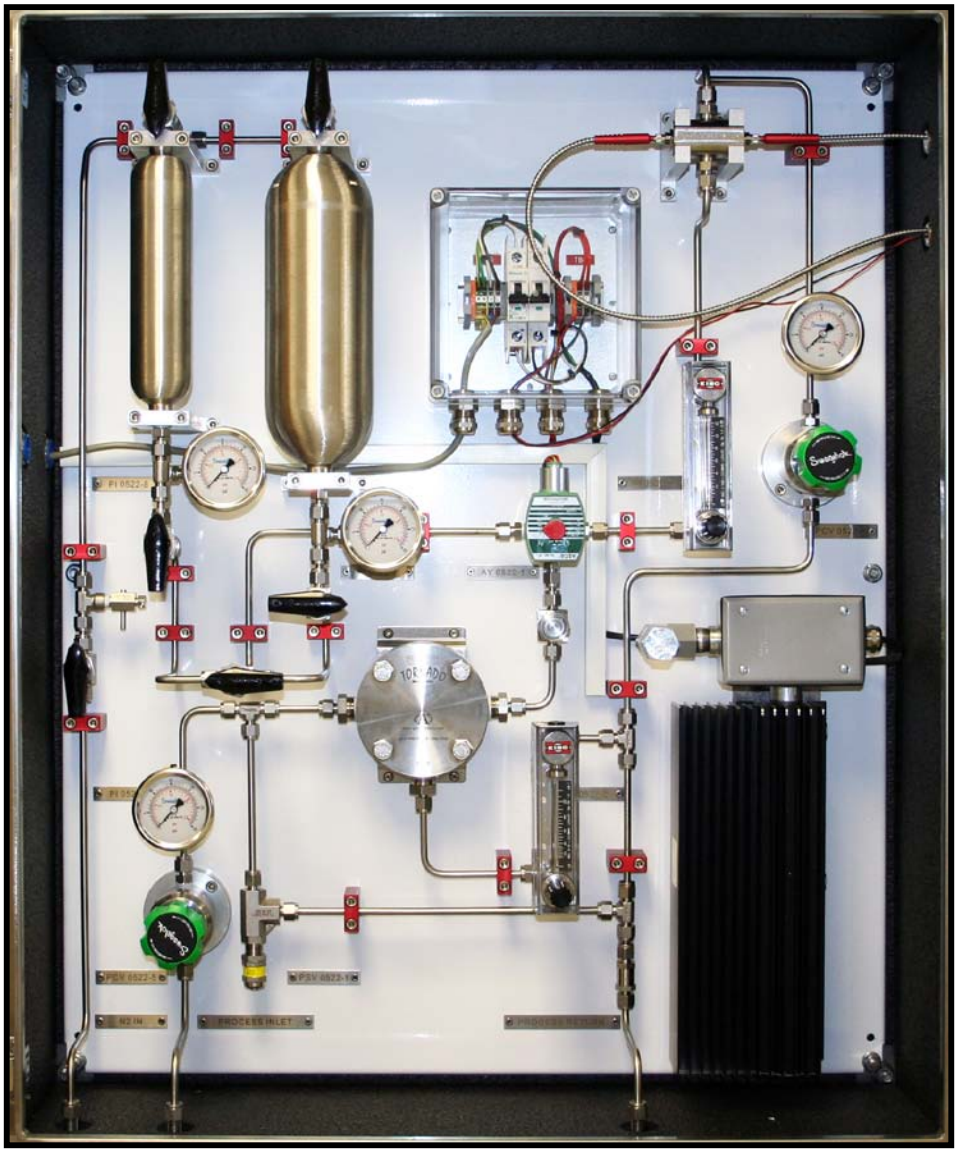
Wastewater treatment costs can be reduced if pipelines are protected from corrosion due to rising sulfide loading and if the injection of chlorine (to break down H_2S) can be optimized. Since the pH of the water determines how much of the H_2S is presently dissociated to ions, additional measurement of the ions would provide a much more accurate reading of sulfide loading in the water.

In wastewater analysis, the ability of the OMA to measure both H_2S and its ions provides a much more accurate picture of sulfide loading, especially since pH meters are notoriously unreliable in sour water.

Read more in Application Note AN-028: Measuring H2S and Ions in Wastewater

Example Sample Conditioner for H_2S in Water

The system pictured below was installed with an OMA-300 analyzer to monitor H_2S (0-5 mg/L) and sulfide ions (0-5 mg/L) in a basal water treatment process in Alberta, Canada.



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

Application Data		
Performance Specifications		
Accuracy	*Custom measurement ranges available; example ranges below.*	
	H_2S	0-10 ppm: ±0.5 ppm 0-100 ppm: ±1% full scale or 0.5 ppm* 0-10,000 ppm: ±1% full scale
		*Whichever is larger.

Further Reading

Subject	Location
OMA-300 H2S 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
Multi-Component Analysis Technical Note	http://www.a-a-inc.com/documents/AA_TN-203_MultiComponentAnalysis.pdf

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