Application Note AN-T-032

Sulfide and hydrogen sulfide in water

Accurate and inexpensive determination of H2S in water by potentiometric titration

Sulfides are sulfur compounds and are a common class of minerals. Inorganic sulfides are abundant when extracting metals such as copper, iron, lead, zinc, mercury, and the metalloid arsenic due to their high abundance in sulfide mineral ore. The sulfides are separated from the extracted materials and accumulate in the effluent where they affect water quality. They are malodorous (rotten egg smell) and are corrosive to sewage and water treatment plants (especially concerning concrete and iron).

In acidic water, sulfides react to form hydrogen sulfides, like H_2S gas, which are extremely toxic even at low levels. In addition, both sulfides and hydrogen sulfides occur naturally in thermal springs and could poison visitors through evaporation. Therefore, it is important to monitor the amount of sulfides and hydrogen sulfides (H_2S) in wastewater treatment facilities or municipal water supplies in general.

This Application Note presents a trace level hydrogen sulfide analysis method in water by potentiometric titration. Specifically, the determination of H_2S in water by titration is done with silver nitrate using an Ag Titrode with Ag_2S coating on an OMNIS system.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on spiked groundwater samples. The water is spiked with sodium sulfide.

Immediately after the sample is bottled, it is preserved with sodium hydroxide to prevent the sulfide ions from forming volatile hydrogen sulfides.

EXPERIMENTAL

The determinations are carried out on an OMNIS Advanced Titrator equipped with an Ag Titrode with an Ag_2S coating (Figure 1). The Ag_2S coating lowers the detection limit and ensures a fast response.
Before the sulfide titration, the sample is purged with nitrogen gas in order to remove any remaining oxygen. The samples are then titrated with standardized silver nitrate until after the equivalence point. An exemplary titration curve of spiked groundwater is given in Figure 2.

Figure 1. OMNIS Advanced Titrator equipped with an Ag Titrode with silver sulfide coating.

RESULTS

This method offers very accurate and reproducible results despite the low concentration of sulfide in the sample and low titrant concentration, as displayed in Table 1.

Table 1. Results for the H2S concentration measured by potentiometric titration of a water sample (n = 3).

Sample (n = 3)	H_2S value (mg/L)
Mean value	0.31
SD(abs)	0.01
SD(rel) in %	1.9

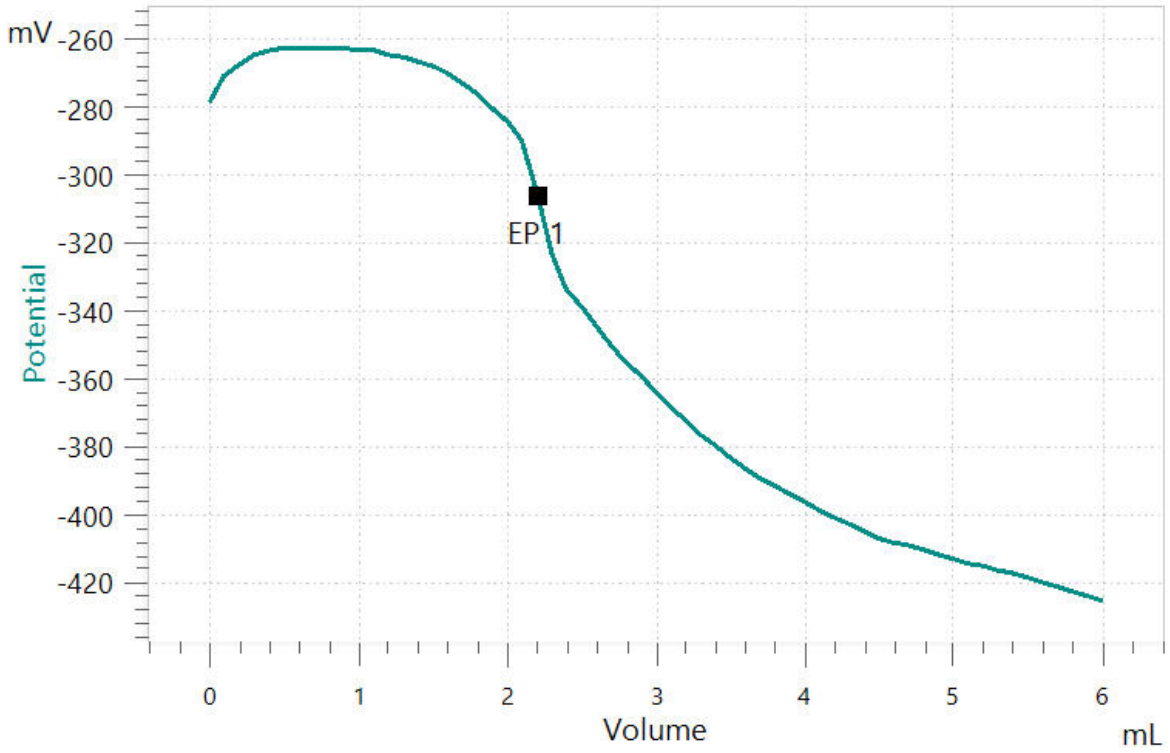

Figure 1. Exemplary titration curve of the potentiometric determination of hydrogen sulfide in a groundwater sample.

CONCLUSION

Titration is a fast, precise, and inexpensive hydrogen sulfide in water test method. It can accurately measure the hydrogen sulfide content down to as low as 0.31 mg/L. To measure higher hydrogen sulfide levels, the concentration of the titrant can be increased. Therefore, samples with high concentrations do not need to be diluted, which could falsify the results. This makes titration a versatile method for covering a large concentration range, in comparison to other methods such as photometry. Using an Ag Titrode with Ag_2S coating ensures a fast response time and a low detection limit. This electrode is additionally maintenance-free and uses a pH glass membrane as reference electrode. It can be simply stored in distilled water and is perfectly usable for the hydrogen sulfide in water analysis.

Internal reference: AW TI CH1-1300-032020

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CONFIGURATION

OMNIS Advanced Titrator with magnetic stirrer

Innovative, modular potentiometric OMNIS Titrator for stand-alone operation or as the core of an OMNIS titration system for endpoint titration and equivalence point titration (monotonic/dynamic). Thanks to 3S Liquid Adapter technology, handling chemicals is more secure than ever before. The titrator can be freely configured with measuring modules and cylinder units and can have a rod stirrer added as needed. If required, the OMNIS Advanced Titrator can be equipped for parallel titration via a corresponding software function license.

- Control via PC or local network
- Connection option for up to four additional titration or dosing modules for additional applications or auxiliary solutions
- Connection option for one rod stirrer
- Various cylinder sizes available: 5, 10, 20 or 50 mL
- Liquid Adapter with 3S technology: Secure handling of chemicals, automatic transfer of the original reagent data from the manufacturer

Measuring modes and software options:

- Endpoint titration: "Basic" function license
- Endpoint and equivalence point titration (monotonic/dynamic): "Advanced" function license
- Endpoint and equivalence point titration (monotonic/dynamic) with parallel titration: "Professional" function license

dAg Titrode with Ag2S-coating

Digital, combined silver ring electrode for OMNIS with a pH glass membrane as reference electrode. The silver ring is coated with sulfide (Ag_2S) to increase the sensitivity and result in a better limit of determination.

The maintenance-free electrode is suitable for precipitation titration with a constant pH value (titrant: silver nitrate), e.g.

- Chloride, Bromide, Iodide
- Sulfide
- Dihydrogen sulfide
- Mercaptane
- Cyanide

This electrode is stored in deionized water.

dTrodes can only be used with OMNIS titrators and titration modules with digital measuring interface.