Application Note AN-T-025

Hydrogen peroxide content in aqueous solutions

Reliable and inexpensive determination according to ASTM D2180

Peroxides are often used for disinfection and water treatment purposes due to their antiseptic properties. Lower concentrations between 0.3–3% are used in households, while higher concentrations can be used for sterilization purposes.

Additionally, peroxides are utilized as oxidizing and bleaching agents. They are used for pulp and paper bleaching, as well as a mild whitener in laundry detergents and some cosmetic dental products.

Peroxides, perborates, and percarbonates can easily be determined by titration. This application note presents two titration methods for peroxide analysis. The first method is performed according to ASTM D2180, and is suitable for samples such as bleaching components or concentrated hydrogen peroxide solutions. The second method for the determination of traces of hydrogen peroxide is suitable for aqueous samples with concentrations as low as 0.4 mg/L.

SAMPLE AND SAMPLE PREPARATION

This application study is demonstrated on aqueous solutions containing various hydrogen peroxide concentrations ranging from 0.4 mg/L to 32%.
Samples with traces of H_2O_2 do not require any sample preparation. Samples with higher concentrations are diluted with deionized water. Both sample size and dilution factor should be chosen depending on the expected peroxide content. Ideally, an aliquot of the diluted sample results in an equivalence point of approximately 10 mL.

EXPERIMENTAL

The analysis is performed on an OMNIS Advanced Titrator equipped with a combined Pt ring electrode according to ASTM D2180. Before titration, the sample is acidified with sulfuric acid. In case of trace amounts, the sulfuric acid is modified to contain manganese sulfate as a catalyst. This modification allows a lower method detection limit.
Samples are titrated with potassium permanganate until after the equivalence point is reached. For samples with trace amounts of hydrogen peroxides, a lower titrant concentration is used.

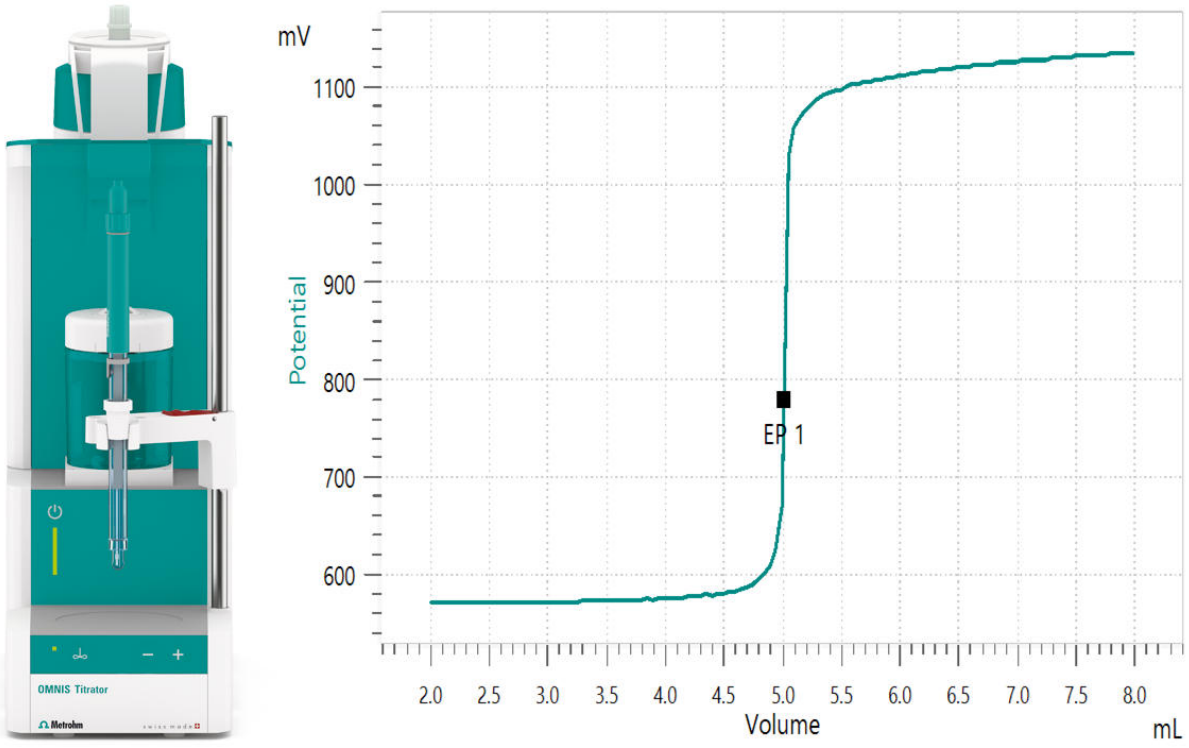

Figure 1. OMNIS Advanced Titrator and an example titration curve. (Left) OMNIS Advanced Titrator equipped with a digital Pt ring electrode for the determination of peroxides in aqueous solutions. (Right) A titration curve is displayed of sample no. 2 (Table 1) titrated according to ASTM D2180.

RESULTS

Sharp titration curves with a large potential difference are obtained for all tested samples and with both methods. This results in reproducible results as displayed in Table 1.

Table 1. Results of the peroxide determination in various aqueous solutions. Samples 1 and 2 are determined according to ASTM D2180, while samples 3 and 4 are determined according the modified method for trace amounts of peroxides.

No	n	Mean value	SD(abs)	SD(rel)
1	8	32.14%	0.03%	0.09%
2	3	85.82 mg/L	0.83 mg/L	0.97%
3	3	4.27 mg/L	0.01 mg/L	0.23%
4	5	0.40 mg/L	0.01 mg/L	2.50%

CONCLUSION

Titration is a fast and inexpensive method, allowing reliable determination of peroxides in aqueous solutions according to ASTM D2180. A modified method for trace concentrations permits accurate and reproducible peroxide determinations as low as 0.4 mg/L.

State-of-the-art OMNIS Titrators from Metrohm provide a whole new level of titration. The modular design of OMNIS Titrators offers complete application flexibility. The system can be expanded whenever necessary, allowing growth over time. With a resolution of 100,000 steps, maximum dosing accuracy can be achieved, further improving reproducibility.

Internal references: AW TI CH1-1296-012020; AW TI CH1-0350-0187

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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

dPt Titrode

Digital, combined platinum ring electrode for OMNIS with a pH glass membrane as reference electrode. This maintenance-free electrode is suitable for redox titrations when the pH value remains constant, e.g.:

- Iodometry
- Chromatometry
- Cerimetry
- Permanganometry

This electrode is stored in distilled water.
dTrodes can be used on OMNIS Titrators.