Application Note AN-I-036

Sodium content in water using an ion-selective electrode

Fast, accurate, and selective determination in mineral water and leachate according to AOAC 976.25

Groundwater naturally occurs by means of precipitation, and it gathers dissolved minerals as it filters and passes through the soil. Typically, groundwater is used as a source for drinking water and irrigation purposes.

Rain and snow can also leach various substances, such as sodium salts, from landfills into groundwater. This so-called leachate is considered hazardous to the environment and can contaminate groundwater reserves.

This Application Note describes sodium analysis in water (mineral water as well as leachate) using the separate sodium-selective electrode, also known as the Na-ISE. All samples in this study were determined by standard addition. The method is based on the standard AOAC 976.25.

INTRODUCTION

The standard addition (STDADD) is recommended for undefined or complex sample matrices. In the standard addition method, a defined amount of the ion of interest is added to a known volume of sample (in several steps). The unknown concentration can be calculated from the resulting potential differences between the sample and the sample with added standard solution. This calculation is performed automatically by modern ion meters or software such as OMNIS.

SAMPLE AND SAMPLE PREPARATION

The analysis is demonstrated on mineral water and leachate.

No sample preparation is required.

EXPERIMENTAL

An OMNIS Advanced Titrator and an OMNIS Dosing Module equipped with a separate sodium-selective electrode were used to measure sodium in water samples (Figure 1).

To a reasonable amount of sample, ISA solution consisting of $c(CaCl_2)$ = 1 mol/L is automatically added and the standard addition is carried out with the sodium standard solution $\beta(Na^+)$ = 200 mg/L or $\beta(Na^+)$ = 2000 mg/L, respectively. The mineral water is measured without ISA addition, as this is not necessary if the concentration in the sample solution is <50 mg/L Na^+.

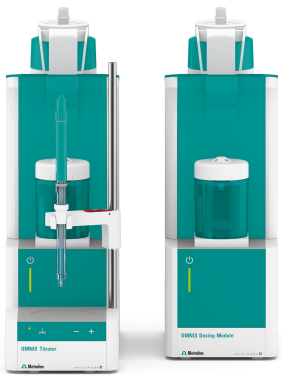


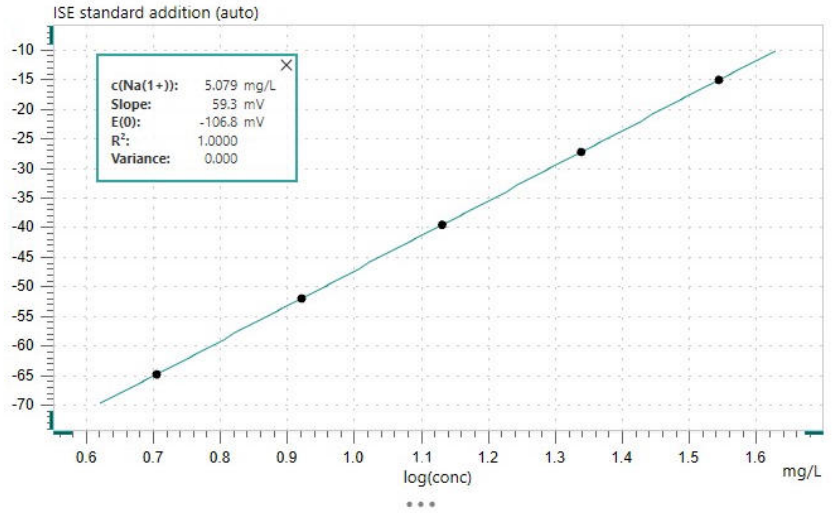
Figure 1. OMNIS Advanced Titrator and OMNIS Dosing Module equipped with Na-ISE for the determination of sodium.

RESULTS

Standard addition provides accurate and reproducible results with SD(rel) < 2.0% as shown in Table 1. An example of standard addition is shown in Figure 2.

Table 1. Results for sodium in mineral water and leachate by standard addition.

Sample (n = 6)	Mean value	SD(abs)	SD(rel) in %
Mineral water	5.08 mg/L	0.00 mg/L	0.1
Leachate	151.1 mg/kg	0.4 mg/kg	0.3



	Volume increment / mL	Potential / mV	Potential difference / mV	Temperature / °C
Sample		-64.9		25.4
Increment 1	0.684	-52.1	12.8	25.4
Increment 2	1.132	-39.6	12.5	25.5
Increment 3	1.947	-27.3	12.3	25.6
Increment 4	3.505	-15.1	12.2	25.7

Figure 2. Standard addition of mineral water with four increments made with 200 mg/L sodium.

CONCLUSION

Results of sodium measurement in water with the sodium ion-selective electrode are fast, reproducible, and accurate. In principle, this method can be used for any type of wastewater or sewage water for different sodium concentrations. Appropriate dilution or clarification (e.g., filtration or centrifugation) may be required prior to analysis.

Handling the Na-ISE is user friendly and there is no need to condition the electrode, which means it is immediately ready for use. Furthermore, this method conforms to AOAC 976.25.

The analytical system presented in this application offers users flexibility combined with high-end software. The measuring range of the separate polymer Na-ISE lies between 5×10^{-6} mol/L and 1 mol/L Na^+ (corresponds to approximately 0.11 mg/L Na^+) and is suitable for a wide range of different samples, from foodstuffs to pharmaceutical products and cosmetics.

As well as improving the precision and speed of sodium determinations, OMNIS delivers results that are equal to or better than other established titration systems.

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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

OMNIS Dosing Module without stirrer

Dosing module for connection to an OMNIS Titrator for extending the system to include an additional buret for titration/dosing. Can be supplemented with one magnetic stirrer or rod stirrer for use as separate titration stand. Freely selectable cylinder unit with 5, 10, 20 or 50 mL.

Separate polymer membrane electrode, Na

Sodium-selective electrode with polymer membrane. This ISE has to be used in combination with a reference electrode and is suitable for:

- ion measurements of Na+ in aqueous solutions
- ion measurements in small sample volumes (minimum immersion depth 1 mm)
- titrations in aqueous solutions

Thanks to a robust/break-proof plastic shaft made of PVC, this sensor is mechanically very resistant.