Application Bulletin 83/6 e

Sodium analysis by ion-selective electrode

Industry sector

Chemical; pharmaceuticals; food & beverage; personal care & cosmetics

Keywords

Sodium; Na-ISE; separate ion-selective electrode; separate polymer membrane electrode; polymer membrane ISE; Na; standard addition; direct measurement; STDADD; water; wastewater; table salt; baby food; milk powder; potato chips; 6.0508.100; S01; S010; S04; S040; S07; S070; S12; S122

Summary

This Application Bulletin describes sodium determinations in different matrices using the separate sodium-selective electrode, also known as Na-ISE. The electrode consists of a plastic shaft (PVC), a polymer membrane, and is filled with an internal buffer containing NaCl.

The ion-selective polymer membrane of the electrode is made of polyvinylchloride (PVC), plasticizer, and ionophore including additive. It is not necessary to condition the PVC membrane—the polymeric membrane is immediately ready for use.

In the first section of this document, the working principle and some general tips are given for electrode handling and for the determination of sodium. In the second part, practical examples are used to demonstrate how determinations can be performed using either direct measurement or the standard addition technique. Sodium was determined in several matrices: table salt, water, leachate, potato chips, and baby food (milk powder).

Instruments and accessories

- Ion Meter or Titrator with the modes MEAS CONC and/or STDADD
- Stirrer
- Buret

Electrodes

Separate polymer Na-ISE	6.0508.100
LL ISE reference electrode	6.0750.100
Pt1000 temperature sensor	6.1110.100

Working principle

Polymer membrane

The ionophore within the polymer membrane is responsible for the selectivity, i.e., it is able to selectively take up Na^+ ions.

The molecular structure of the ionophore is adapted to the coordination number and size of the sodium ion. During measurement, Na^+ ions diffuse from the sample solution into the polymer membrane resulting in a concentration gradient and a membrane potential.

The polymer is lipophilic—water or ions with a hydrated shell cannot penetrate the membrane. In aqueous solutions, sodium ions are also surrounded by a hydrated shell, but this is removed by the energy gain upon inclusion in the ionophore.

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 mostly recommended for the analysis of water (ultrapure, rain, ground, surface, and drinking water) and for acidic samples containing fluoride, fluoroborate, or fluorosilicate ions.

The separate polymer Na-ISE can be used within a pH range of 3 to 12 and a temperature range of 0 °C to 40 °C without adversely affecting the results or the electrode material.

ISA (Ionic Strength Adjustor) solution

The addition of an ISA solution to «fix» the ionic strength is not necessary when the concentration in the sample solution range is <50 mg/L Na^+.

At higher concentrations, the sample matrix will determine whether an ISA solution is required. A pH adjustment with TISAB (Total Ionic Strength Adjustment Buffer) solution is not necessary.

However, it is recommended that the polymer membrane ISE be used primarily in the pH range of 3 to 12, as prolonged use outside this range may shorten the life of the electrode.

General tips

For optimal measurement results, the following points are essential to follow:

- All solutions must be stored in plastic containers. Glass contains sodium, which can leach into the solution if stored for long periods. This can lead to a falsely high sodium level. It is not necessary to measure in plastic beakers. The analysis time is short and no significant amounts of sodium ions are released from any glass.
- The separate polymer Na-ISE should only be used in aqueous solutions.
- Avoid any fat or oil deposition or scratching of the membrane. It should neither be touched with bare hands nor cleaned with abrasive materials. It is also sensitive to mechanical shocks.
- Check that the measuring surface of the electrode is clean.
- Clean the electrode using the spray rinse and/or dip rinse after each measurement with deionized water.
- **Never** treat electrodes in ultrasonic baths as they may be damaged by such treatment.
- The separate polymer Na-ISE should neither be cleaned with nor stored in organic solvents (e.g., acetone, ethanol, etc.) as they attack and irreversibly destroy the polymer.
- Do not rub the electrode dry after rinsing.
- If the electrode does not respond properly after a long period of disuse (e.g., slow response times), the sensor should be rinsed with deionized water. A long membrane conditioning period before use is not necessary with the separate polymer Na-ISE.
- If the electrode is not going to be used for some time, it should be stored dry.
- The separate polymer Na-ISE should not be used below pH 3 because of the cross sensitivity of the H^+ ions, which then disturb the results.
- The separate polymer Na-ISE should not be used for longer periods of time at extreme pH values, as solutions with a pH below 3 or above 12 shorten the working life of the polymer membrane.
- Measure samples and calibration standards under identical measuring conditions. The temperature of the standard solutions and the sample solutions should be the same as far as possible, and the temperature should vary as little as possible during measurements.
- In order to guarantee reliable results, periodically execute a control measurement with a calibration standard (e.g., daily).
- It is not necessary to work with a double-junction reference electrode. An intermediate electrolyte is not required. A solution of c(KCl) = 3 mol/L as reference electrolyte provides the best results as regards accuracy and precision.
- There must be no air bubbles on the membrane surface before nor during the measurements.
- If a series of determinations is to be made, then the separate polymer Na-ISE should be stored in deionized water between the measurements rather than rinsing and drying it. In this way any Na^+ ions which may have diffused into the membrane in the previous determination can be rinsed out of it again. The working procedure described achieves better results with regards to accuracy and precision.
- The concentrations of the interfering ions which generate an analysis error of approximately 10% in a solution with $c(Na^+) = 10^{-3}$ mol/L are specified in the following table.

Table 1. Interfering ions for the Na-ISE.

Interferences
SCN^- and organic lipophilic ions (e.g. acetate) **must be absent.**
$c(K^+) < 2.6 \times 10^{-2}$
$c(Ca^{2+}) < 1.4 \times 10^3$
$c(Li^+) < 0.36$
$c(Mg^{2+}) < 6.1 \times 10^3$
$c(H^+) < 1.1$
$c(NH_4^+) < 1.6$

Choice of procedure

The choice of the procedure depends on the sample matrix, the number of samples to be analyzed, and the concentration range of the analyte in the samples.

- For samples with a complex or unknown matrix composition, standard addition is the procedure of choice.
- A direct measurement is recommended for samples with an unproblematic sample matrix, and for large sample series or online measurements.
- For low-concentration measurements, it is recommended to either use direct measurement after calibration, or to spike the sample to a higher sodium content. The reason for this is that the sensor may be at its limit of detection and outside of the linear range, giving results for the standard addition that are too high.

Sample preparation and parameters

The sample preparation and the parameters are mentioned in the section *Practical examples* or in the *Appendix*, respectively.

Direct measurement

Direct measurement is recommended for unproblematic samples and in the case of low-level sodium measurements (mg/L or µg/L range).

The ion activity in the sample is interpolated from a calibration curve. Plot the calibration curve using standard solutions. The expected ion activity in the sample should be in the middle of the concentration range of the standard solutions.

When using direct measurement, the following points must be considered:

- In general, standard solutions must have the same ionic background as the sample solutions. ISA should be used for such measurements.
- The addition of ISA solution before the measurement keeps the ionic strength constant so that the different contributions of the Na^+ to the ionic strength can be ignored.
- In general, the temperature of the standard and sample solutions should be as similar as possible, and the temperature should vary only minimally during measurements.
- To ensure reliable results, perform a control measurement with a calibration standard periodically (e.g., daily). Plot a new calibration curve if the deviation is considered unacceptable.

Standard addition (STDADD)

Standard addition 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). Normally, ISA/TISAB solutions are used. The unknown analyte concentration can be calculated from the resulting potential differences between the unaltered sample and the sample with added standard solution. This calculation is performed automatically by modern ion meters or software such as OMNIS.

There are two types of standard addition in OMNIS:

- STDADD ISE dos
- STDADD ISE auto

The quickest and recommended method is the automatic standard addition (mode: « STDADD ISE auto »). For exact results, the potential difference ΔU should be at least 12 mV per standard addition and at least three standard additions should be performed (i.e., total ΔU at least 36 mV).

If exactly defined volumes of the standard additions are required but maximum ease of operation is also desired, the mode « STDADD ISE dos » is recommended. There the individual standard addition volumes can be defined (see manual of the device in use or the online help found in the software).

The calculation of the result is automatically carried out by OMNIS applying an iteration procedure.

When using standard addition, the following points must be considered:

- Stirring is necessary during additions. Additions without continuous stirring lead to false results.
- The addition of ISA solution before the measurement keeps the ionic strength constant so that the different contributions of the Na^+ to the ionic strength can be ignored.
- If the total volume added during standard addition is more than 10% of the initial solution volume, the standard should be dissolved in ISA to prevent a dilution effect of the ionic background. Alternatively, try to reduce the sample size or use a stronger standard solution. If the added volume is too large, there is a risk of dilution error and the linearity can no longer be guaranteed, resulting in incorrect data.
- The volume of the spiking solution should not exceed 25% of the sample volume. The concentration of the

spiking solution should be as high as possible. This is in order to avoid errors due to dilution effects.

- To ensure accurate evaluation of the standard addition, the following standard concentrations (c_{std}) for different buret volumes (V_{buret}) as a function of the sample concentration (c_{smpl}) are recommended (**Table 2**). Thereby any sample dilution should be considered (e.g., dilution with TISAB).

Table 2. Ratio of the standard concentration and sample concentration, dependent on the buret volume.

Volume buret [in mL]	Ratio [c_{std} : c_{smpl}]
5	40 : 1
10	20 : 1
20	10 : 1
50	5 : 1

Example factor determination

Sample concentration, c_{smpl}:	100 mg/L
Sample size:	10 mL
Addition of ISA:	20 mL
Addition of deionized water:	10 mL
Auxiliary solution volume:	30 mL
Total volume:	40 mL
Buret volume, V_{buret}:	10 mL
Factor from Table 1 (c_{std} : c_{smpl}):	20

Considering the dilution with ISA and deionized water, the initial sample concentration is 25 mg/L. Therefore, the optimal recommended concentration of the standard is: 25 mg/L × 20 = 500 mg/L.

Practical examples

Reagents

The following reagents and recommended concentrations are used to prepare the sodium standard and ISA solution.

- Sodium chloride, NaCl, ≥ 99.8%
- Calcium chloride dihydrate, $CaCl_2 \cdot 2\ H_2O$, ≥ 99.0%

Solutions

- All solutions must be stored in plastic containers. If sample solutions are stored in glass, then the sodium content in these solutions increases with time (see *General Tips* for explanation).
- It is recommended that solutions are not stored for more than three months. Poor quality solutions can result in a low electrode slope or false results.

Sodium standard solution 2000 mg/L	$\beta(Na^+)$ = 2000 mg/L 5.084 g NaCl is weighed into a 1 L volumetric flask. 500 mL deionized water is added and the sodium chloride is dissolved while swirling. Then, the flask is filled up to the mark with deionized water.
ISA solution	$c(CaCl_2)$ = 1 mol/L 14.70 g $CaCl_2 \cdot 2\ H_2O$ is weighed into a 1 L volumetric flask. 500 mL deionized water is added and the calcium chloride dihydrate is dissolved while swirling. Then, the flask is filled up to the mark with deionized water.
Sodium standard solution 200 mg/L	$\beta(Na^+)$ = 200 mg/L 100 mL $\beta(Na^+)$ = 2000 mg/L is added to a 1 L volumetric flask and filled up to the mark with deionized water.

Sodium in table salt by means of direct measurement

Sample

- Table salt, NaCl

Solutions

- Sodium standard solution, $\beta(Na^+)$ = 2000 mg/L
- ISA solution

Sample preparation

100 mg of table salt is weighed into a 200 mL volumetric flask and dissolved in 100 mL deionized water. Then, the flask is filled up to the mark with deionized water.

Standard preparation

It is highly recommended to prepare all standard solutions directly in-situ using Metrohm devices with the Sodium standard solution $\beta(Na^+)$ = 2000 mg/L. The following table shows the preparation for each 40 mL—ready to measure—standard solution.

To obtain the same ionic background as for the measurement itself, it is important to prepare all standard solutions with ISA.

Standard	1	2	3	4	5	6
Addition of $\beta(Na^+)$ = 2000 mg/L [in mL]	1	2	3	4	5	6
Addition of deionized water [in mL]	19	18	17	16	15	14
Addition of ISA	20 mL					
Final volume	40 mL					
Concentration [in mg/mL]	**50**	**100**	**150**	**200**	**250**	**300**

Analysis

Calibration

The prepared—ready to measure—standard solutions (1 to 6) are stirred, and the potential of each standard is measured. Between each measurement, the electrode is thoroughly rinsed with deionized water and stored before measuring the next standard.

Sample

20 mL of ISA is added to 20 mL of sample solution and the potential is measured. Between each measurement, the electrode is thoroughly rinsed with deionized water and stored before measuring the next standard. The dilution factor of the sample must be considered for the result calculation.

Parameters

Calibration

Mode	CAL Conc
Stirring rate	8
Calibration standards	6 (50, 100, 150, 200, 250 and 300 mg/L)
Signal drift	0.5 mV/min
Min. waiting time	30 s
Max. waiting time	215 s

Sample

Mode	MEAS Conc
Stirring rate	8
Measuring parameters	Drift-controlled measurement
Signal drift	0.5 mV/min
Min. waiting time	10 s
Max. waiting time	215 s

Calculations

Sodium calibration

The calibration is automatically calculated by OMNIS after the « CAL CONC » command is done. The calibration data can be found in the sample list under the calibration curves.

The « CAL WRITE » command offers an additional option of writing the calibration data directly to the electrode.

Sodium content

$$Na^+ = MEAS\ Conc_{Final} \times d_f$$

Na^+:	Sodium content in mg/L in prepared sample solution
MEAS $Conc_{Final}$:	Final measured value of the « MEAS CONC » command in mg/L
d_f:	Dilution factor of the sample

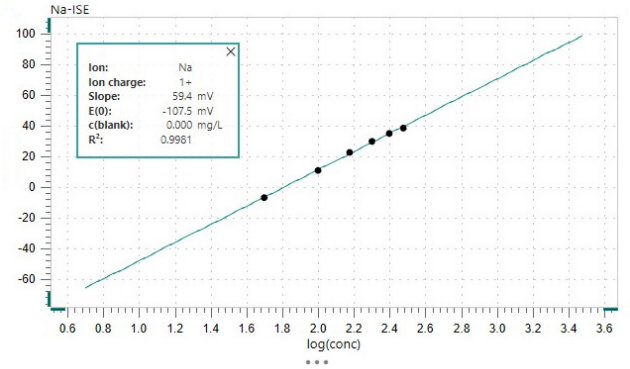
All relevant conversions can be made from this value, such as sodium % in a NaCl sample:

$$Na^+_{NaCl} = \frac{MEAS\ Conc_{Final} \times d_f}{m_s \times 50}$$

Na^+_{NaCl}:	Sodium content in % in a NaCl sample
MEAS $Conc_{Final}$:	Final measured value of the « MEAS CONC » command in mg/L
d_f:	Dilution factor of the sample
m_s:	Sample size of sample preparation in g
50:	Conversion factor for %

Example

Calibration



Subsample name	Concentration / mg/L	Potential – End value / mV	Temperature / °C
Sodium standard solution	50.000	-6.8	25.9
Sodium standard solution	100.000	10.9	26.0
Sodium standard solution	150.000	22.7	25.9
Sodium standard solution	200.000	29.9	26.0
Sodium standard solution	250.000	35.1	26.0
Sodium standard solution	300.000	38.6	26.0

Figure 1. Calibration curve of six standard solutions with 50 mg/L, 100 mg/L, 150 mg/L, 200 mg/L, 250 mg/L and 300 mg/L sodium.

Slope in mV	E(0) in mV	c(blank) in mg/L	R^2	Variance
59.4	-107.5	0.000	0.998	0.687

Comments

The sodium content of the sample is usually given in % (g/100g) or mg/kg. These values can be easily calculated from the measured sodium content in the prepared sample solution by including the sample size.

Sodium in mineral water with automatic standard addition

Sample

- Mineral water, sodium content of 5 mg/L

Solutions

- Sodium standard solution, β(Na^+) = 200 mg/L

Sample preparation

No sample preparation is required.

Analysis

Sample

40 mL of mineral water is added to a sample beaker and the standard addition is carried out with the sodium standard solution. After measuring the concentration for the last increment, the electrode is rinsed well with deionized water.

Parameters

Sample

Mode	STDADD ISE auto
Stirring rate	8
Auxiliary solution volume	Total volume of ISA and deionized water
Number of additions	4
Delta U	12 mV
Dosing rate	Fast
Stop volume	Buret volume
Signal drift	0.5 mV/min
Min. waiting time	10 s
Max. waiting time	215 s

Calculations

Sodium linear regression

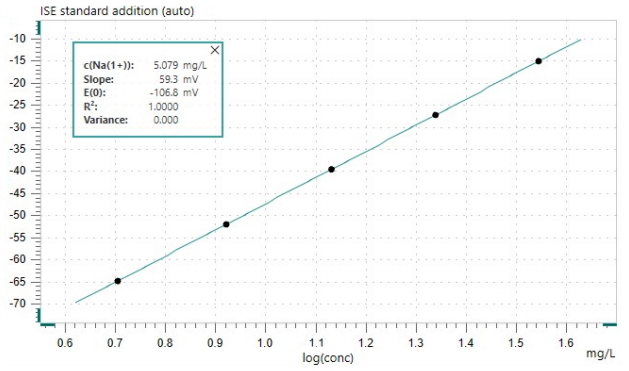
The linear regression is automatically done/executed by OMNIS after the « STDADD ISE auto » command is finished. The data can be found in the sample list under calibration curves.

Sodium content

The sodium content can be displayed by OMNIS with the command variable « SampleConcentration.Result."STDADD ISE auto" ».

Example

Sample



	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 β(Na^+) = 200 mg/L.

Slope in mV	E(0) in mV	R^2	Variance
59.3	-106.8	1.000	0.000

Comments

The addition of an ISA solution is not necessary when the concentration in the sample solution range is <50 mg/L Na^+.

As with direct measurement, it is also possible to accurately measure very low concentrations using the standard addition.

In principle, this method can be used for any type of tap water or mineral water. Carbonated water must be degassed beforehand to ensure accurate volumetric measurement.

Sodium in leachate with automatic standard addition

Sample

- Leachate (from Herisau, Switzerland)

Solutions

- Sodium standard solution, β(Na^+) = 2000 mg/L
- ISA solution

Sample preparation

No sample preparation is required.

Analysis

Sample

20 mL of ISA is added to 20 mL of sample solution, and the standard addition is carried out with the sodium standard solution. After measuring the concentration for the last increment, the electrode is rinsed well with deionized water.

Parameters

Sample

Mode	STDADD ISE auto
Stirring rate	8
Auxiliary solution volume	Total volume of ISA and deionized water
Number of additions	4
Delta U	12 mV
Dosing rate	Fast
Stop volume	Buret volume
Signal drift	0.5 mV/min
Min. waiting time	10 s
Max. waiting time	215 s

Calculations

Sodium linear regression

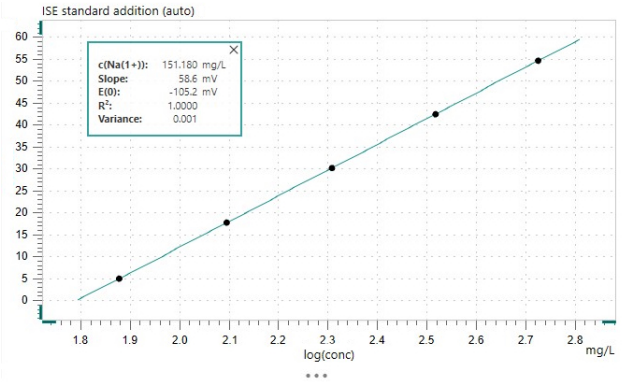
The linear regression is automatically done/executed by OMNIS after the « STDADD ISE auto » command is finished. The data can be found in the sample list under calibration curves.

Sodium content

The sodium content can be displayed by OMNIS with the command variable « SampleConcentration.Result."STDADD ISE auto" ».

Example

Sample



	Volume increment / mL	Potential / mV	Potential difference / mV	Temperature / °C
Sample		4.9		25.2
Increment 1	1.048	17.7	12.8	25.2
Increment 2	1.805	30.1	12.4	25.1
Increment 3	3.245	42.4	12.3	25.2
Increment 4	6.354	54.6	12.2	25.2

Figure 3. Standard addition of leachate with four increments made with β(Na^+) = 2000 mg/L.

Slope in mV	E(0) in mV	R^2	Variance
58.6	-105.2	1.000	0.001

Comments

Leachate is underground water that continues to move downward under the force of gravity. Rain can wash various substances, such as sodium salts, from landfills into groundwater.

In principle, this method can be used for any type of wastewater or sewage water. Appropriate dilution or clarification (e.g., filtration or centrifugation) may be required prior to analysis and it is recommended that the interfering ions from **Table 1** are observed.

Sodium in baby food (milk powder) with automatic standard addition

Sample

- Baby food, milk powder, sodium content of 2540 mg/kg

Solutions

- Sodium standard solution, β(Na^+) = 2000 mg/L
- ISA solution

Sample preparation

Approx. 50 g of baby food (milk powder) is weighed into a 1 L volumetric flask. 500 mL deionized water is added and the sample is dissolved while swirling. Then, the flask is filled up to the mark with deionized water.

Analysis

Sample

20 mL of ISA is added to 20 mL of sample solution, and the standard addition is carried out with the sodium standard solution. After measuring the concentration for the last increment, the electrode is rinsed well with deionized water.

Parameters

Sample

Mode	STDADD ISE auto
Stirring rate	8
Auxiliary solution volume	Total volume of ISA and deionized water
Number of additions	4
Delta U	12 mV
Dosing rate	Fast
Stop volume	Buret volume
Signal drift	0.5 mV/min
Min. waiting time	10 s
Max. waiting time	215 s

Calculations

Sodium linear regression

The linear regression is automatically done/executed by OMNIS after the « STDADD ISE auto » command is finished.

The data can be found in the sample list under calibration curves.

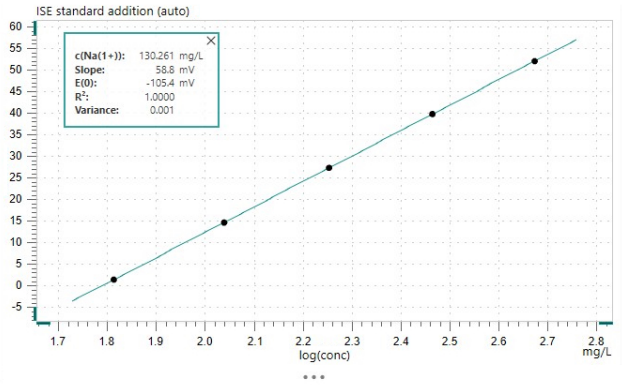
Sodium content

$$Na^+ = \frac{\text{Sample Conc}_{\text{Result}} \times 1000}{m_s}$$

Na^+:	Sodium content in mg/kg
Sample $Conc_{Result}$:	Command variable « SampleConcentration.Result."STDADD ISE auto" »
1000:	Conversion factor for mg/kg
m_s:	Sample size of sample preparation in g

Example

Sample



	Volume increment / mL	Potential / mV	Potential difference / mV	Temperature / °C
Sample		1.4		24.8
Increment 1	0.938	14.6	13.2	24.8
Increment 2	1.572	27.3	12.7	24.9
Increment 3	2.794	39.7	12.4	25.1
Increment 4	5.346	51.9	12.3	25.3

Figure 4. Standard addition of baby food (milk powder) with four increments made with β(Na^+) = 2000 mg/L.

Slope in mV	E(0) in mV	R^2	Variance
58.8	-105.4	1.000	0.001

Sodium in potato chips with automatic standard addition

Sample

- Potato chips

Solutions

- Sodium standard solution, β(Na^+) = 2000 mg/L
- ISA solution

Sample preparation

Approximately 15 g of ground potato chips are weighed into a 1 L volumetric flask which is then filled up to the mark with deionized water. The sample is dissolved while swirling until a stable suspension with minimum settling is obtained.

The use of a plastic volumetric flask or the transfer of the sample solution into a plastic container afterwards is recommended.

The sample should be filtered through a pleated filter prior to measurement for more accurate results.

Analysis

Sample

20 mL of ISA is added to 20 mL of sample solution, and the standard addition is carried out with the sodium standard solution. After measuring the concentration for the last increment, the electrode is rinsed well with deionized water.

Parameters

Sample

Mode	STDADD ISE auto
Stirring rate	8
Auxiliary solution volume	Total volume of ISA and deionized water
Number of additions	4
Delta U	12 mV
Dosing rate	Fast
Stop volume	Buret volume
Signal drift	0.5 mV/min
Min. waiting time	10 s
Max. waiting time	215 s

Calculations

Sodium linear regression

The linear regression is automatically done/executed by OMNIS after the « STDADD ISE auto » command is finished. The data can be found in the sample list under calibration curves.

Sodium content

$$Na^+ = \frac{\text{Sample Conc}_{\text{Result}} \times 1000}{m_s}$$

Na^+: Sodium content in mg/kg

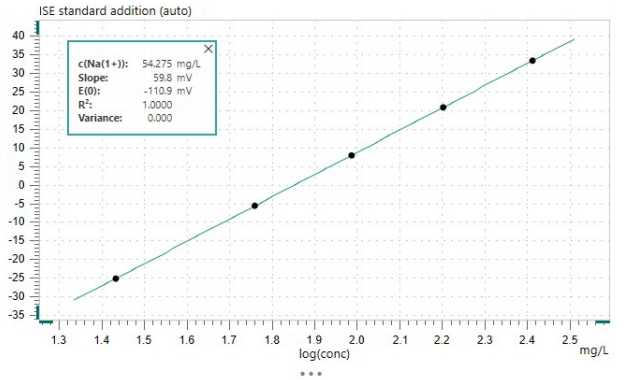
Sample $\text{Conc}_{\text{Result}}$: Command variable « SampleConcentration.Result."STDADD ISE auto" »

1000: Conversion factor for mg/kg

m_s: Sample size of sample preparation in g

Example

Sample



	Volume increment / mL	Potential / mV	Potential difference / mV	Temperature / °C
Sample		-25.2		24.9
Increment 1	0.627	-5.7	19.6	25.0
Increment 2	0.846	7.9	13.5	25.1
Increment 3	1.405	20.8	12.9	25.1
Increment 4	2.438	33.3	12.5	25.2

Figure 5. Standard addition of potato chips with four increments made with β(Na^+) = 2000 mg/L.

Slope in mV	E(0) in mV	R^2	Variance
59.8	-110.9	1.000	0.000

References

Monograph: Electrodes in potentiometry, 8.108.5088

Leaflet: Manual for ion-selective electrodes, 8.109.8042

Separate polymer membrane electrode, Na, 6.0508.100

AOAC method 976.25 (1990), Nutritionally related components. Sodium in foods for special dietary use. Ion-selective electrode method.

L. Ciba Direct potentiometric determination of sodium in silicic acid and water glass Chem. Analit. Warsaw 36 (1991) 163–166 (Polnisch) Ref.: Fresenius J. Anal. Chem. 343 (1992) 446.

E. Florence Determination of sodium in salted foods using an ion-selective electrode Analyst 111 (1986) 571–573 Ref.: Fresenius Z. Anal. Chem. 326 (1987) 480.

S. A. H. Khalil, G. J. Moody, J. D. R. Thomas Ion-selective electrode determination of sodium and potassium in blood and urine Anal. Lett. 19 (1986) 1809–1830 Ref.: Fresenius Z. Anal. Chem. 327 (1987) 636.

E. Rabe Zur Natrium- und Kaliumbestimmung mit ionensensitiven Elektroden Z. Lebensm. Unters. Forsch. 176 (1983) 270–274.

S. K. Srivastava, S. Kumar, C. K. Jain Determination of sodium by ion-selective potentiometry Analyst 109 (1984) 667–668.

G. Schwedt Analytische Chemie: Grundlagen, Methoden und Praxis Georg Thieme Verlag, Stuttgart, New York, 1995.

M. Otto Analytische Chemie VCH Verlagsgesellschaft mbH, Weinheim, New York, Basel, Cambridge, Tokio, 1995.

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Metrohm International Headquarters

Appendix

Sample preparation suggestions for further application examples

1. Sodium in spinach (salted cream spinach) with automatic standard addition

Sample preparation

Approximately 10 g of spinach (package information: 1% NaCl) is weighed into a 250 mL sample beaker. 100 mL deionized water is added and the sample is dissolved while stirring for 15 min. The sample is quantitatively filtered into a
200 mL volumetric flask through a folded filter, and the filter is rinsed thoroughly with deionized water. Then, the flask is filled up to the mark with deionized water (dilution factor 20).

The use of a plastic volumetric flask or the transfer of the sample solution into a plastic container afterwards is recommended.

ISA

$c(CaCl_2) = 1$ mol/L

Standard solution

Sodium standard solution, $\beta(Na^+) = 2000$ mg/L

Analysis

30 mL of ISA is added to 10 mL of sample solution, and the standard addition is carried out with the sodium standard solution. After measuring the concentration for the last increment, the electrode is rinsed well with deionized water.

Remark

The same parameters can be used as for the method «*Sodium in mineral water with automatic standard addition*» described in this Application Bulletin.

2. Sodium in urine with automatic standard addition

Sample preparation

Approximately 5 mL of urine is poured into a 200 mL volumetric flask. 100 mL of deionized water is added and the sample is dissolved while swirling. Then, the flask is filled up to the mark with deionized water (dilution factor 40).

The use of a plastic volumetric flask or the transfer of the sample solution into a plastic container afterwards is recommended.

ISA

$c(CaCl_2) = 1$ mol/L

Standard solution

Sodium standard solution, $\beta(Na^+) = 2000$ mg/L

Analysis

20 mL of ISA is added to 20 mL of sample solution, and the standard addition is carried out with the sodium standard solution. After measuring the concentration for the last increment, the electrode is rinsed well with deionized water.

Remark

The same parameters can be used as for the method «*Sodium in mineral water with automatic standard addition*» described in this Application Bulletin.