



Application Note AN-CS-021

Sodium in sodium bicarbonate and sodium phosphates compounded injections

IC assay method validation performed according to USP

Patients may be unable to use commercially available medical formulations for many reasons and therefore require specific compounded formulations [1]. Compounded injections of sodium bicarbonate are sterile solutions for correcting metabolic acidosis and other conditions requiring systemic alkalization [2]. Compounded injections of sodium phosphates (a mixture of monobasic and dibasic phosphates [3]) serve as a phosphate source to either prevent or

correct hypophosphatemia in patients with restricted oral intake. After dilution, these injections can be administered intravenously as electrolyte replenishers. Ion chromatography (IC) with suppressed conductivity detection is the standardized way to accurately quantify sodium in these solutions [4,5]. The Metrosep C Supp 2 column was evaluated as an alternative column [6,7] in cooperation with the U.S. Pharmacopoeia (USP).

SAMPLES AND STANDARDS

For the equivalence investigation of the Metrosep C Supp 2 - 250/4.0 column, compounded injections were prepared from the respective sodium salts.

Anhydrous salts from different manufacturers were used.



Figure 1. Instrumental setup including a 930 Compact IC Flex with the IC Conductivity Detector MB (L) and the 919 IC Autosampler plus (R).

For **sodium bicarbonate compounded injections**, 8.4 g of sodium bicarbonate was dissolved in 100 mL sterile Water for Injection [4]. Further manual dilution was performed using ultrapure water (100-fold dilution) to achieve a nominal concentration of 0.23 mg/mL. Sample stock solutions for the **sodium phosphates compounded injections** were prepared from 24 g of monobasic sodium phosphate and 14.2 g of dibasic

sodium phosphate – both dissolved in 100 mL sterile Water for Injection. Both solutions were further diluted in ultrapure water (100-fold) to a nominal concentration of 0.92 mg/mL sodium. All samples were prepared as individual duplicates. A single-point calibration with 0.250 mg/mL of sodium, prepared from sodium chloride in ultrapure water, was used.

The samples were injected directly into the ion chromatograph (**Figure 1**) and analyzed using the method parameters given in the respective USP monograph (**Table 1**). Cationic components were

isocratically separated on a Metrosep C Supp 2 - 250/4.0 column which contains the alternative packing material L97 (**Figure 2**).

Table 1. IC method parameters as per the USP monographs «Sodium Bicarbonate Compounded Injection» [4] and «Sodium Phosphates Compounded Injection» [5].

Column with L97 packing	Metrosep C Supp 2 – 250/4.0
Eluent	8 mmol/L methanesulfonic acid (MSA)
Flow rate	1.0 mL/min
Column temp.	30 °C
Injection volume	10 µL
Detection	Conductivity with sequential suppression

EXPERIMENTAL

A Metrohm Suppressor Module for cation suppression, regenerated with a solution of sodium carbonate and sodium bicarbonate (70 mmol/L each), was used to reduce the background noise in the chromatograms. The conductivity signal was detected

after sequential suppression. For the column equivalency study, system suitability (e.g., repeatability, tailing factors) and sample recoveries were evaluated (**Table 2**).



Figure 2. Chromatogram for sodium in a sodium bicarbonate compounded injection containing 0.231 mg/mL sodium (100% recovery).

Sodium bicarbonate and sodium phosphates compounded injection samples, made from the sodium salts from different manufacturers, were analyzed for their sodium content (**Figure 2**) within less than 12 minutes. The IC assay for sodium was conducted according to USP General Chapter <621>, Chromatography [6] and fulfilled all suitability and

acceptance criteria. Sodium eluted after approximately six minutes as a symmetric peak (tailing factor <1.8). The peak area was highly reproducible (<1.4 % RSD for five replicates, **Table 2**). Recoveries for the sodium content were determined in the range of 98–102%, within the acceptance criteria of USP.

Table 2. Selected performance characteristics.

Performance characteristics	Acceptance criteria	Results
Tailing factor	Tailing factors (asymmetry) for the sodium peak is NMT 2.0	1.39–1.79
Repeatability	Relative standard deviation for the sodium peak area in the standard solution is NMT 2.0% for five replicates	0.3–1.3%
Accuracy	Average % recovery should be 95.0–105.0% of the manufacturer's CoA value	98–100% sodium in sodium bicarbonate 98–102% sodium in sodium phosphates

CONCLUSION

The presented IC method with the **Metrosep C Supp 2** column that contains the **alternative packing material L97** is a robust, reliable, and validated method

suitable to quantify sodium in both **sodium bicarbonate and sodium phosphates compounded injections** according to USP requirements.

REFERENCES

1. USP General Chapter <797>. <https://www.usp.org/compounding/general-chapter-797> (accessed 2023-03-27).
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3. Fresenius Kabi USA, LLC. *Sodium Phosphates Injection USP*. [dailymed](#). (accessed 2022-07-15).
4. U.S. Pharmacopeia. USP-NF Sodium Bicarbonate Compounded Injection. *Monograph*. https://doi.org/10.31003/USPNF_M10963_04_01.
5. *Sodium Phosphates Compounded Injection*. https://doi.org/10.31003/USPNF_M10964_06_01.
6. *621 Chromatography*. https://doi.org/10.31003/USPNF_M99380_01_01.
7. *1225 Validation of Compendial Procedures*; General Chapter; U.S. Pharmacopeia/National Formulary: Rockville, MD. https://doi.org/10.31003/USPNF_M99945_04_01.

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CONFIGURATION



930 Compact IC Flex Oven/SeS/PP/Deg

The 930 Compact IC Flex Oven/SeS/PP/Deg is the intelligent Compact IC instrument with **column oven**, **sequential suppression**, **peristaltic pump** for suppressor regeneration and built-in **degasser**. The instrument can be used with any separation and detection methods.

Typical areas of application:

- Anion or cation determinations with sequential suppression and conductivity detection



919 IC Autosampler plus

The 919 IC Autosampler plus fulfills the requirements of laboratories with medium sample numbers. It enables automation of the full range of Metrohm IC instruments.



IC Conductivity Detector MB

Compact and intelligent high performance conductivity detector for intelligent IC instruments. Optimized for microbore columns. Outstanding temperature stability, the complete signal processing within the protected detector block and the latest generation of DSP – Digital Signal Processing – guarantee the highest precision of the measurement. No change of measuring ranges (not even automatic ones) is required, due to the dynamic working range.

Typical areas of application:

- Anion or cation determinations with chemical suppression, sequential suppression or without suppression and conductivity detection
- Optimized for microbore (2 mm) applications, ideally suitable for coupling techniques (IC-MS or IC-ICP/MS)

Specification at a glance:

- 0–15000 $\mu\text{S}/\text{cm}$ without range switching
- Cell volume: 0.3 μL
- Ring-shaped electrodes made of stainless steel X2CrNiMo17-12-2 (316 L), compatible with MSA
- Maximum operating pressure: 10.0 MPa (100 bar)
- Cell temperature: 20–50 $^{\circ}\text{C}$ in increments of 5 $^{\circ}\text{C}$
- Temperature stability: 0.001 $^{\circ}\text{C}$
- Baseline noise: 0.2 nS/cm typical for sequential suppression
- Capillaries: ID 0.18 mm

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