



Application Note AN-S-399

IC assay for fluoride in sodium fluoride and acidulated phosphate topical solution

Column equivalency study according to U.S. Pharmacopoeia

Sodium fluoride and acidulated phosphate topical solution products are used for dental hygiene to prevent cavities on teeth. Fluoride is a mineral that helps to strengthen the enamel on teeth, making them more resistant against decay by acids and bacteria.

Pharmaceuticals such as these anticavity products require strict quality control. Therefore, it is necessary to determine any impurities in

such products as well as the appropriate contents of the active substances. This Application Note outlines the **fluoride IC assay** as described in the USP Monograph Sodium Fluoride and Acidulated Phosphate Topical Solution [1] using the Metrosep A Supp 1 column and suppressed conductivity detection. The column equivalency study was carried out in cooperation with the U.S. Pharmacopoeia.

SAMPLES AND STANDARDS

A dentalcare product (topical solution) with a nominal concentration of 1.23% sodium fluoride was investigated for its fluoride content. The samples were diluted in ultrapure water in two steps to obtain a nominal concentration of 0.5 µg/mL fluoride.

The system suitability solution contained 1.1 µg/mL sodium fluoride and 0.5 µg/mL of sodium chloride in ultrapure water, as described

in the respective USP monograph [1]. The solution was prepared by volumetric dilution of 1000 mg/L standard solutions of fluoride and chloride using micropipettes and 100 mL volumetric flasks.

The quantification of the results was performed based on a single point calibration with a 1.1 µg/mL fluoride standard.

EXPERIMENTAL

The samples were injected directly into the ion chromatograph (Figure 1) without further sample preparation and analyzed using the method parameters given in the USP monograph (Table 1). Anionic components were separated isocratically on a Metrosep A Supp 1 - 250/4.0 column containing the alternative packing material L46. The conductivity signal was detected after sequential suppression.



Figure 1. Instrumental setup including a 930 Compact IC Flex with IC Conductivity Detector and a 919 IC Autosampler plus.

Table 1. IC method parameters as per USP monograph «Sodium Fluoride and Acidulated Phosphate Topical Solution» [1].

Column with L46 packing	Metrosep A Supp 1 - 250/4.6
Eluent	150 mg/L of anhydrous sodium carbonate and 1.0 mL/L of 1 N sodium hydroxide
Flow rate	1.0 mL/min
Column temp.	30 ° C
Injection vol.	20 µL
Detection	Conductivity with sequential suppression

RESULTS

Fluoride and chloride were analyzed in diluted topical solutions according to the USP General Chapter Chromatography [2]. A column equivalency study was performed, and all acceptance criteria (e.g., repeatability, resolution, tailing factor, and accuracy) were fulfilled according to the USP General Chapter Validation of Compendial Procedures [3]. Resolution between the fluoride and chloride peaks was exceptional (11.6) using the Metrosep A Supp 1 - 250/4.6 column (packing material L46).

Fluoride eluted as a symmetric peak (tailing factor 1.2) with high repeatability. The relative standard deviation for the fluoride peak area in the system suitability solution was calculated at 1.2% (Table 2, Figure 2).

Figure 3 shows that the fluoride content was accurately reflected in the declared label for the analyzed samples (99.8% recovery).

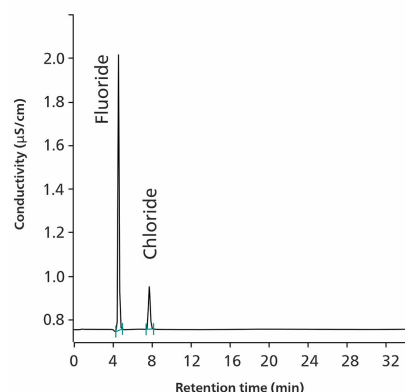


Figure 2. Chromatogram of the system suitability solution containing 1.1 µg/mL sodium fluoride and 0.5 µg/mL sodium chloride.

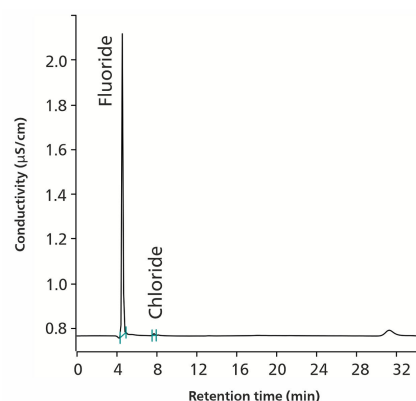


Figure 3. Chromatogram of a topical solution containing 1.065 µg/mL fluoride (99.8% recovery) and traces of chloride (not quantified).

Table 2. Selected performance characteristics from the system suitability study.

Performance characteristics	Acceptance criteria	Results
Resolution	>1.5 between fluoride and chloride peaks	11.6
Tailing factor	Tailing factor (asymmetry) for the fluoride ion peak is <2.0	1.2
Repeatability	Relative standard deviation for the fluoride ion peak area in the standard solution is <2.0% for five replicates	1.2%

CONCLUSION

The presented IC method for **Fluoride in Sodium Fluoride and Acidulated Phosphate Topical Solution** with the **Metrosep A Supp 1** column (packing material L46) is officially included into the USP [1]. Robustness and reliability of the

method was demonstrated within the column equivalency study following the USP General Chapters for Chromatography and Validation of Compendial Procedures [2–3].

REFERENCES

[1] U.S. Pharmacopeia. USP-NF Sodium Fluoride and Acidulated Phosphate Topical Solution. Monograph. https://doi.usp.org/USPNF/USPNF_M76520_06_01.html.

[2] 〈621〉 Chromatography.

[DOI:10.31003/USPNF_M99380_01_01](https://doi.org/10.31003/USPNF_M99380_01_01)

[3] 〈1225〉 Validation of Compendial Procedures; General Chapter; U.S. Pharmacopeia/National Formulary: Rockville, MD. [DOI:10.31003/USPNF_M99945_04_01](https://doi.org/10.31003/USPNF_M99945_04_01)

Internal references: AW IC AE6-0121-092021;

AW IC AE6-0122-092020

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CONFIGURATION



930 Compact IC Flex

930 Compact IC Flex 是智能型的**无抑制** Compact IC 仪器。该仪器可使用各种分离和检测方法。

典型的应用范围:

- 阴离子或阳离子测定,无抑制的电导检测
- 使用 UV-VIS 或安培检测的简单应用



Metrosep A Supp 1 - 250/4.6

Metrosep A Supp 1 - 250/4.6 是一种可通用的阴离子柱,具备中等容量及特殊选择性。使用此柱可处理那些浓度差别较大的样品。比如可在含有 150 g/L 氯化钠的溶液中测定 4 µg/L 的硫酸盐。它的另一个优点就是,在硝酸盐之后淋洗出溴化物。尤其在分析羰基卤化物时,A Supp 1 - 250/4.6 表现出优秀的分离性能。压力波动、经常更换淋洗液,以及较大的样品通量,这些甚至较长时间都不会影响该柱的分离效率。它是研发实验室和常规实验室的 «工作狂人»。