DETERMINATION OF INORGANIC CATIONS IN WATER SAMPLES

INTRODUCTION

The method allows determination of mass concentrations of ammonium, lithium, sodium, potassium, magnesium, calcium, strontium and barium cations in samples of natural, potable and waste water by the capillary electrophoresis method.

MEASURING METHOD

The capillary electrophoresis method for evaluation of cation mass concentration is based on migration and separation of cations in electric field due to differences in their electrophoretic mobility. Identification and quantitative evaluation of the analyzed cations is performed indirectly by detecting UV absorption at 254 nm wavelength.

CONCENTRATION RANGES

Ranges of measurable concentrations for analyzed cations are given in Table 1.

Table 1. Measurement ranges for cations

Cations	Samples	Measurement range, mg/l
Ammonium	Potable, natural and waste water	0.5–5000
Lithium	Natural and waste water	0.02–2.0
	Potable water	0.015–2.0
Sodium	Potable, natural and waste water	0.5–5000
Potassium	Potable, natural and waste water	0.5–5000
Magnesium	Potable, natural and waste water	0.25–2500
Calcium	Potable, natural and waste water	0.5–5000
Strontium	Potable, natural and waste water	0.5–50.0
Barium	Potable, natural and waste water	0.05–5.0

Introduction of samples with sodium concentrations above 200 mg/l results in distortion of shapes of ammonium and potassium spikes, which, however, does not hinder quantitative evaluation of their concentrations.

EQUIPMENT AND REAGENTS

The following equipment and reagents are used in measurements:

- The CAPEL Capillary Electrophoresis System with high–voltage positive polarity;
- Reference cation content standard solutions: K (1 mg/ml), NH_4^+ (1 mg/ml), Na (1 mg/ml), Li (1 mg/ml), Mg (1 mg/ml), Ca (1 mg/ml), Sr (1 mg/ml), Ba (1 mg/ml);
- Distilled water;
- Tartaric acid, Analytical Grade;
- Benzimidazole, High Purity Grade;
- 18–Crown–6, Analytical Grade;
- Sodium hydroxide, Ultra Pure Grade;
- Hydrochloric acid, Ultra Pure Grade.

Data acquisition, collection, processing and output are performed using a personal computer running under WINDOWS® 95/98/ME/NT/2000 operating system with installed Chrom&Spec® for WINDOWS® software package for acquisition and processing of chromatography data.

PREOPERATIONAL PROCEDURES

Preoperational procedures include: selection and preparation of samples, preparation of the capillary to operation, preparation of auxiliary and calibration solutions, and calibration of the CAPEL Capillary Electrophoresis System.

Samples of natural, potable or waste water should be collected in compliance with ISO 5667 Standard. Volume of the sample should be at least 100 ml. The taken sample (no less than 50

ml) should be filtered through a cellulose–acetate filter; the first portion of the filtrate must be discarded. The sample must be analyzed within 24 hours.
The system is calibrated by measuring signals of calibration solutions.
Stability of the calibration characteristics is checked directly before sample measurement by recording an electropherogram of one of the calibration mixtures.

MEASUREMENT PROCEDURE

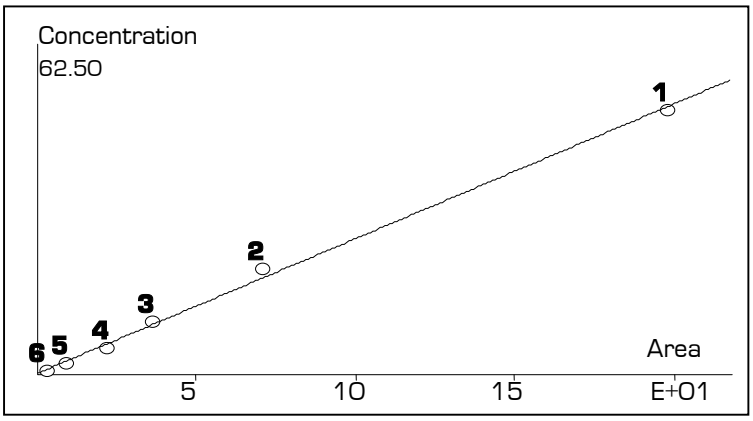
No less than two specimens should be analyzed for each sample queued. If the measured cation concentrations exceed the upper limit of the calibration curve, it is necessary to pre–dilute the sample with distilled water.

DATA PROCESSING

Chrom&Spec® for WINDOWS® software outputs a report of mass concentrations (in mg/l) of analyzed cations of NH_4^+, Li, Na, K, Mg, Ca, Sr and Ba in the analyzed solution.

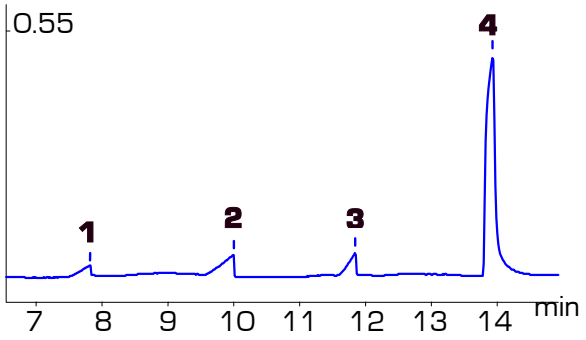
EXAMPLE OF REAL ANALYSIS

Calibration curve:
Ammonium



Component	Equation	RSD, %	Correlation, r
NH_4^+	**Q=0.255A+0.1**	7.5	0.998
Li	**Q=0.047A**–0.03	3.5	0.999
Na	**Q=0.192A+0.6**	7.7	0.998
K	**Q=0.442A+0.4**	8.2	0.998
Mg	**Q=0.077A+0.6**	10.7	0.997
Ca	**Q=0.144A+0.5**	8.12	0.998
Sr	**Q=0.313A+0.03**	7.2	0.998
Ba	**Q=0.375A+0.3**	5.8	0.999

Sample: water sample from the Sunozhka River.
Buffer solution 6 mM Benzimidazole, 2.5 mM Tartaric acid, 2.0 mM 18–Crown–6
Capillary tube L_{EFF}/L_{TOTAL} = 50/60 cm, ID = 75 μm.
Sample introduction 150 mbar*s.
Operating voltage +10 kV
Detection 254 nm, indirect



Measurement results:
1 – K (15.3 mg/l)
2 – Na (18.4 mg/l)
3 – Mg (5.2 mg/l)
4 – Ca (101.7 mg/l)

03AE01021