

Effect of eluent composition and column temperature on IC column retention times

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Summary

This work was carried out with a Metrosep C 2 – 150 separation column, the following eluent parameters being investigated: nitric, tartaric, citric and oxalic acid concentration and concentration of the complexing anion of dipicolinic acid (DPA). The aim was to determine the effect of these parameters plus that of the column temperature on the retention times of alkali metals, alkaline earth metals, ammonium and amines using ion exchange chromatography with non-suppressed conductivity detection.

Due to similar affinities for the ion exchange column, transition metals are difficult to separate with the classical nitric, tartaric, citric and oxalic acid eluents. Partial complexation with the dipicolinate ligand significantly shortens the retention times and improves the separation efficiency. However, too strong complexation results in a rapid passage through the column and thus in a complete loss of separation. Apart from a change in the elution order of magnesium and calcium at high DPA concentrations, other non-amine cations are only slightly affected by the eluent composition.

Irrespective of the tartaric acid and nitric acid concentration in the eluent, an increase in column temperature shortens the retention times and slightly improves the peak symmetries of organic amine cations, particularly in the case of the trimethylamine cation. In contrast, an increase in column temperature in the presence of DPA concentrations exceeding 0.02 mmol/L increases the retention time of the transition metals.

Depending on the separation problem, variation of the pH value, the use of a complexing agent and/or an increase in column temperature are powerful tools to broaden the scope of cation chromatography.

Introduction

In ion chromatography the selectivity of the column is of paramount importance. Demanding separation problems require the possibility to change the retention times and sometimes even the elution order of specific compounds. The effect of varying eluent compositions and column temperatures on the retention time of cations was investigated for the Metrosep C 2 – 150 column. The present study focuses on alkali metals, alkaline earth metals, transition metals and organic amines. Conductivity detection was used for all experiments performed. Different concentrations of tartaric, citric, oxalic, dipicolinic and nitric acid in ultrapure water (resistivity < 18 MΩ cm) have been tested.

This communication evaluates to what extent the eluent composition and the column temperature influence the retention times of different cations on the Metrosep C 2 – 150 column.

System setup

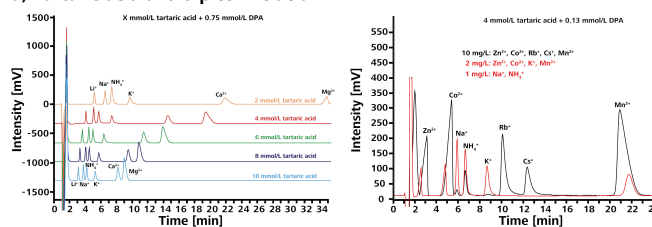
- 818 Advanced IC Pump
- 819 Advanced IC Detector
- 820 IC Separation Center
- 830 Advanced IC Interface
- 838 Advanced IC Sample Processor
- Metrosep C 2 – 150



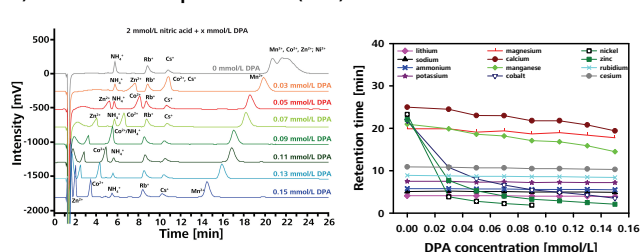
Eluent composition

Flow: 1 mL/min, column temperature: 25 °C, detector temperature: 30 °C

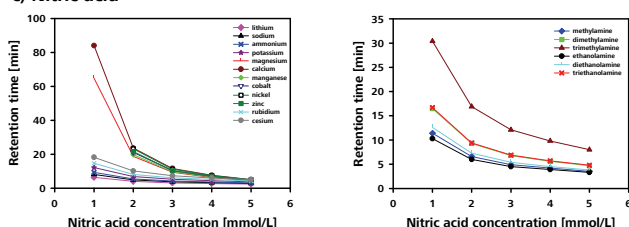
a) Tartaric acid and dipicolinic acid



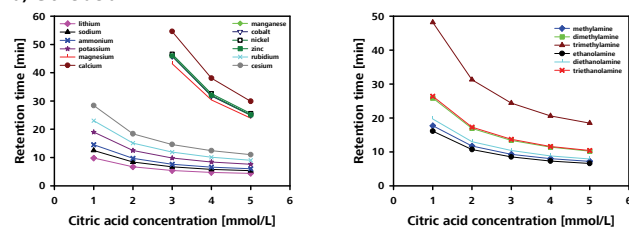
b) Nitric acid and dipicolinic acid (DPA)



c) Nitric acid



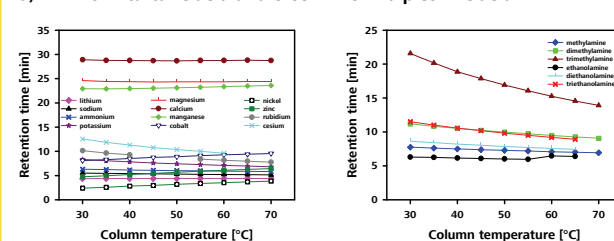
d) Citric acid



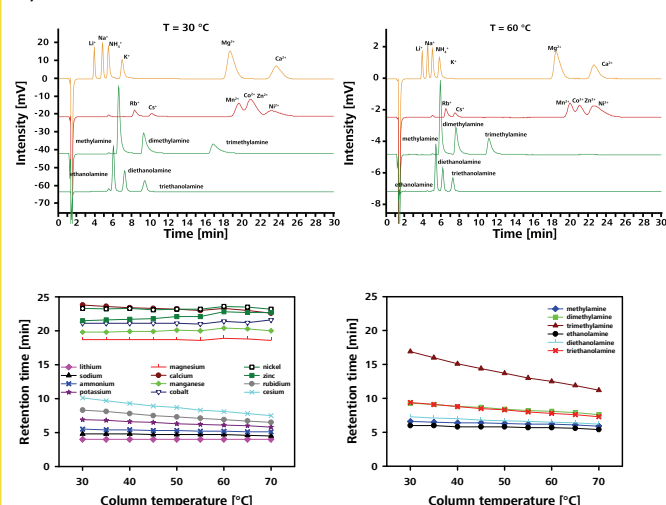
Column temperature

Flow: 1 mL/min, detector temperature: 45 °C

a) 4 mmol/L tartaric acid and 0.05 mmol/L dipicolinic acid



b) 2 mmol/L nitric acid



Overview

Eluent composition*	Lithium	Sodium	Potassium	Rubidium	Cesium	Ammonium	Magnesium	Calcium	Manganese	Cobalt	Nickel	Zinc	Methylamine	Dimethylamine	Trimethylamine	Ethanolamine	Diethanolamine	Triethanolamine
Tartaric acid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
DPA (0.75 mmol/L)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nitric acid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
DPA (0.2 mmol/L)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nitric acid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Citric acid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oxalic acid (not shown)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Temperature	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA	no DPA
DPA (>0.02 mmol/L)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+