

# Influence of Mobile Phase Composition on the Retention Behavior of Hamilton Anion Resolution and Fast Columns

## Abstract

In this study two new anion exchange columns from Hamilton for high resolution and fast analysis have been tested with several carbonate-bicarbonate buffers. The dependence of the retention times on the composition of the mobile phase is shown. It was found that both columns deliver a good resolution and narrow sample peaks for all commonly used buffer compositions. In addition, the variation of the eluent strength may be applied for additional improvement of the retention times of especially the late eluting anions.

## Introduction

Ion chromatography (IC) is a powerful technique which is very frequently applied for determination of anionic components in water or environmental samples. For the separation of standard inorganic anions a carbonate-bicarbonate mobile phase is very common which is typically used in isocratic mode. Many different compositions of this buffer are reported in literature. In this study two different Hamilton anion exchange columns which are intended for high resolution and fast separation have been tested with the three most frequently used buffer compositions to show the impact of the ionic strength on the obtained results.

## Material & Methods

A Hamilton Anion Resolution column with PEEK housing of 4.6 x 250 mm and 7 µm packing particles and a Hamilton Anion Fast column with PEEK housing of 4.6 x 100 mm and 5 µm particle size have been tested with different carbonate-bicarbonate eluents. The packing material was PRP-X100 resin which consists of cross-linked polystyrene-divinylbenzene carrier particles. The surface is functionalized with trimethylammonium (TMA) anion exchange groups.

The high purity carbonate buffer and anion standards have been supplied by Sigma-Aldrich/Fluka, Buchs, Switzerland. The applied buffer concentrations are shown in Table 1.

	Na-Carbonate	Na-Bicarbonate
Concentration [mM]	1.8	1.7
	2.7	0.3
	3.2	1.0

Tab. 1: Different mobile phase compositions used for anion separation.

All mobile phases contained 0.1 mM Na-thiocyanate as an equilibration agent which allows a faster equilibration after buffer change.

The separation was conducted at 25 °C on a Dionex DX500 ion chromatograph (Dionex/Thermo Fisher Scientific, Sunnyvale, USA). The system was equipped with a GP50

gradient pump, a LC20 column enclosure and a CD20 conductivity detector which was connected to an ASRS 300 4 mm-suppressor in auto-suppression recycle mode. Sample injection was realized by an AS3500 auto sampler. The injection volume was 25 µL and the flow rate was 2 mL/min. The concentration of the anion standards are shown in Table 2. Data processing was done with Clarity software V. 2.4 from Data Apex (Prague, Czech Republic)

Anion Standard	Concentration [ppm]
Fluoride	8.33
Acetate	100
Chloride	10
Nitrite	50
Bromide	60
Nitrate	70
Phosphate	70
Sulfate	80

Tab. 2: Concentrations of anion standards, arranged in order of increasing retention time.

## Results and Discussion

In Figure 1 the separation characteristic of the Hamilton Anion Resolution column is shown for three different carbonate-bicarbonate compositions which are very frequently used for anion analysis. The high capacity PRP-X100 anion exchange resin and the length of 250 mm ensure a high separation efficiency and a wide dynamic range of the injected anion concentrations.

While comparing the data for different eluent compositions in Figure 1 it gets obvious that an increased Na-carbonate concentration leads to decreased retention times of preferably the late eluting anions such as, e.g. phosphate or sulfate due to the higher concentration of counter ions in the buffer. Consequently, an increase of the buffer strength can be applied for tailoring of the retention times, e.g. if faster analysis is required.

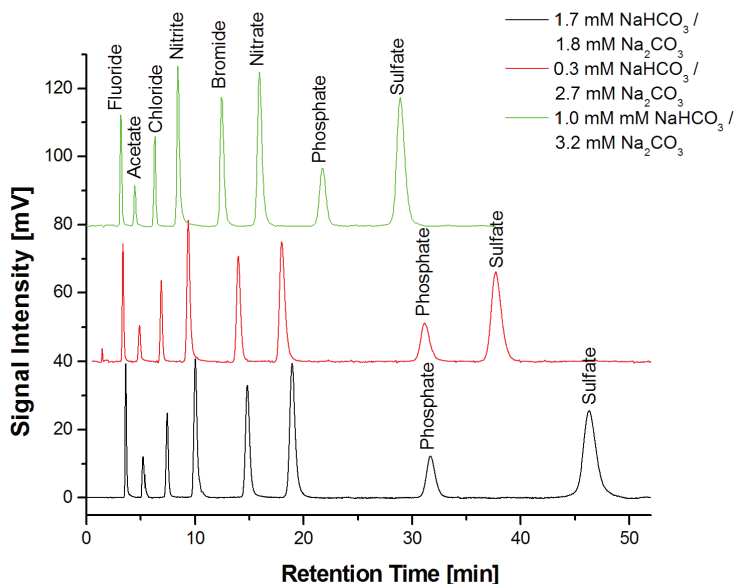


Fig. 1: Separation of anion standards with different buffer concentrations on a Hamilton Anion Resolution column.

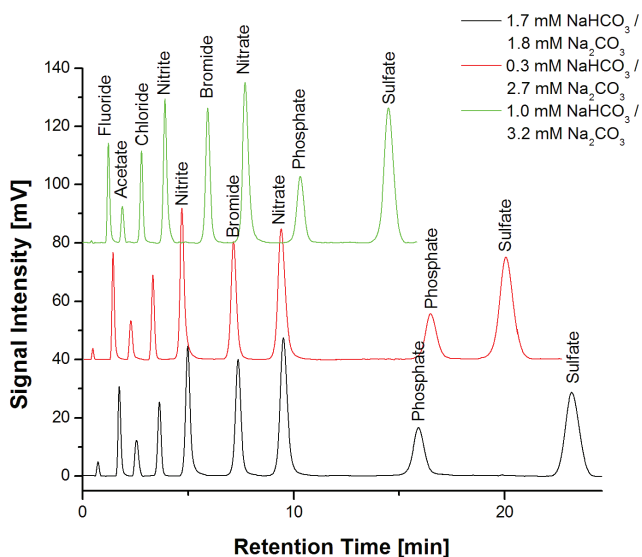


Fig. 2: Separation of anion standards with different buffer concentrations on a Hamilton Anion Fast column.

On the contrary, for samples which contain very high ion concentrations or very high and low concentrated species which elute close to each other it would be beneficial to decrease the buffer concentration for higher separation efficiency and to avoid overlapping of the peaks.

In Figure 2 the same experiment was carried out with the Hamilton Anion Fast column which exhibits a decreased length of 100 mm and a smaller particles size of 5  $\mu\text{m}$  (PRP-X100 resin) to provide an optimum between short analysis time and good separation efficiency. The results in Figure 2 prove that also for the Fast column a certain decrease of the retention times is possible by variation of the buffer concentration. However, since the retention times are already very low only a less pronounced shift was observed. Also for the Fast column a lower buffer concentration should be preferred if high concentrations have to be separated. The Fast column is recommended for medium or lower concentrations of 1 to 500 ppm since it is optimized for fast analysis and the difference in the elution times of the peaks is lower compared with the Anion Resolution column.

## Conclusion

The results obtained with the Anion Resolution and Fast column have shown that both columns can be applied with various compositions of the carbonate-bicarbonate buffer which enables the user to keep his commonly used buffer concentration even if another anion exchange column was applied before. The Resolution column should be chosen for unknown samples since it offers a wide dynamic range regarding the number and concentration of anionic components to be separated. The Fast column should be preferred for standard testing where a short runtime is required and the concentration range and number of different components is already known. In addition, there is still the option to further improve the separation with regard to shorter retention times or higher separation efficiency just by slightly adjustment of the mobile phase composition.

Both Hamilton columns offer a high basic efficiency and a broad dynamic range, making them the perfect solution for standard anion analytics.