

# ON THE DIRECT DETERMINATION OF RADIOSTRONTIUM AND Pb-210 FROM WATER SAMPLES

Dirks, C.<sup>a</sup>, Surman, J.<sup>b</sup>, Pates, J.<sup>b</sup>, Happel, S.<sup>a\*</sup>

<sup>a</sup> Triskem International, France

<sup>b</sup> Lancaster Environmental Center, Lancaster University, UK

\*corresponding author: [shappel@triskem.fr](mailto:shappel@triskem.fr)

## Introduction

Crown-ether based extraction chromatographic resins are frequently used for the separation and determination of Pb-210 and radiostrontium in aqueous samples via liquid scintillation (LSC) or gas proportional counting (GPC). These resins only show significant Pb and Sr retention at moderate to high acid concentrations; thus they do not allow for direct loading of the analytes from filtered raw or acidified water samples, making the use of additional pre-concentration steps such as ion exchange or co-precipitation necessary. In order to simplify the radiostrontium and Pb-210 determination two extraction chromatographic resins (TK100 & TK101 Resin) allowing the direct load of the analytes from water samples and their subsequent purification on the same resin have been developed and characterized. Both resins are based on a crown-ether with high selectivity for Sr and Pb, however by including HDEHP (TK100) or a short chained ionic liquid (TK101) into its composition Pb and Sr can be extracted at a much wider range of pH conditions, i.e. pH ≤ 8.

## TK100 Resin

- Original project Sr via DGT (Diffuse Gradients in Thin films)
  - Bio-availability and average concentration of Sr
  - Additional project: rapid method for Sr in aqueous samples
- Aim: Keep Sr Resin selectivity (crown ether), increase uptake pH range
- Replace 1-Octanol by HDEHP
- Characterisation of resin
  - k', capacity, kinetics, interference of other cations
- Elution studies

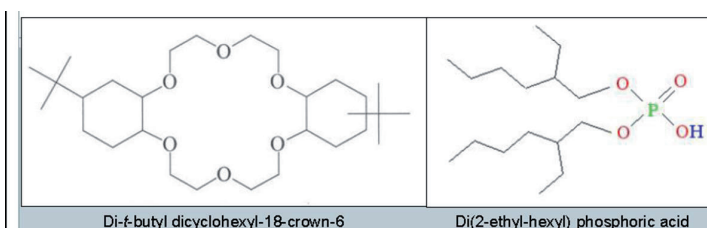


Figure 1: Extractant system TK100 Resin

## Elution study

- Test samples:
  - pH7, 1L, 1 mg Sr, 100 mg Ca, 5 mg K, 0.1 mg Pb, Y, U per sample
- Load in 100 mL aliquots
- 2 mL columns (650 mg resin)
- Vacuum supported separation, 5-10 mL/min
- ICP-MS measurement of effluents
- K and Ca direct breakthrough during load
- Sr breakthrough after 500 – 600 mL
- Y removed with 8M HNO<sub>3</sub>
- Sr elution with 2M HCl
- Pb and U co-eluted with 6M HCl
  - Pb/U separation via oxalates under evaluation

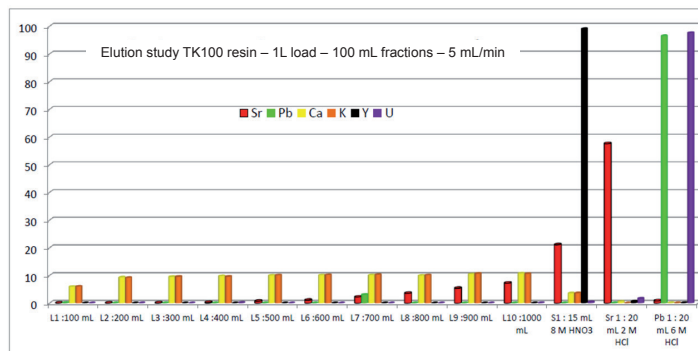


Figure 2: Elution study TK100 resin

## TK101 Resin

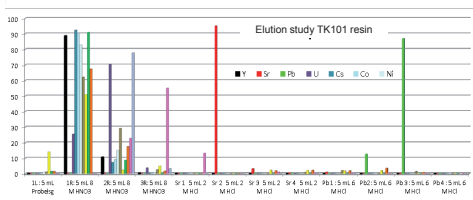


Figure 3: Elution study, selected elements, TK101 resin

- HDEHP replaced by ionic liquids
- Elution studies show improved selectivity for Pb
- Sr breaks through earlier than on TK100 during sample load -> lower loading volumes

## Discs for Pb-210 determination

- Discs allow for faster flow rates
- 47 mm Ø discs based on TK100 resin
- Aim: direct measurement of loaded discs
  - Analogue to Tc-99/TEVA disc method

### ➢ Test on 1L water samples:

- pH 7, 1 mg Sr, 250 mg Ca, 5 mg K, 0.1 mg Pb, Y, U per sample
- Flow rate ~30 ml/min, gravity flow
- Effluents analyzed by ICP-MS
- Pb uptake (ICP-MS) >95%
- Rinsing steps to be optimized

### ➢ Test on 5L water samples:

- pH 7, 1 mg Sr, 500 mg Ca, 25 mg K, 0.5 mg Pb, Y, U per sample
- Load in five 1L aliquots, analysis of effluents by ICP-MS
- Flow rate ~30 ml/min, gravity flow
- Pb uptake during load ≥ 95%

### On-going work

- Optimization of rinsing volumes
- Application to high-salt waters
- Use of TK101 resin instead of TK100
- Application to larger water samples
- Higher flow-rates
- LSC counting of loaded discs

## Conclusions

- Extended uptake pH range for Sr and Pb through introduction of HDEHP or RTILs
- Direct extraction of Pb (and Sr) from non-acidified water possible
- Tests in column/cartridge and disc form
- Use of RTIL increases Pb selectivity but lowers Sr sample load volume
- High Pb uptake from elevated volumes
- Discs for increased flow rates and direct LSC measurement

## Literature

Surman J. et al.: Development of a Rapid Strontium-90 Determination Method for Environmental Waters using a new Sr Selective Resin and Measurement by LSC. Presented at the LSC 2013 conference, 18 – 22.03.13, Barcelona, Spain

Dirks C. et al.: On the development of a method for the rapid determination of Pb-210 in water samples based on a new Sr selective resin. Presented at the NORM 7 conference, 22 – 26.04.2013, Beijing China