TrisKem International

New Developments in TrisKem

Aude Bombard

16/09/2022

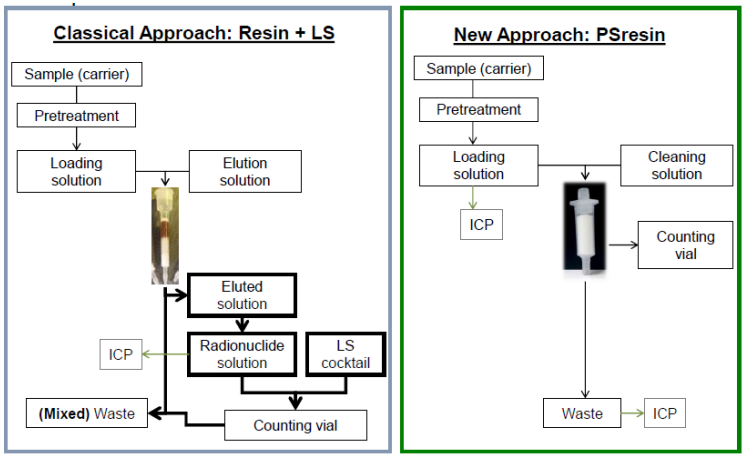
TRISKEM
Expertise in Separation Chemistry

Overview

- New Resins
  - TK-TcScint
  - TK202
  - TK221
- Updates (Methods/applications)
- Under development
  - Extractive membranes/other extractive supports
  - TK300
  - TK102
  - TK222
  - TK225
  - « Industrial » resins
- Other projects

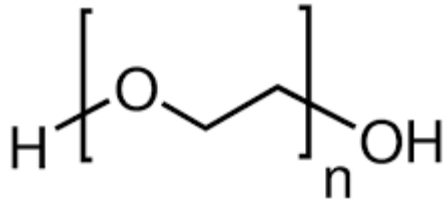
TK-TcScint

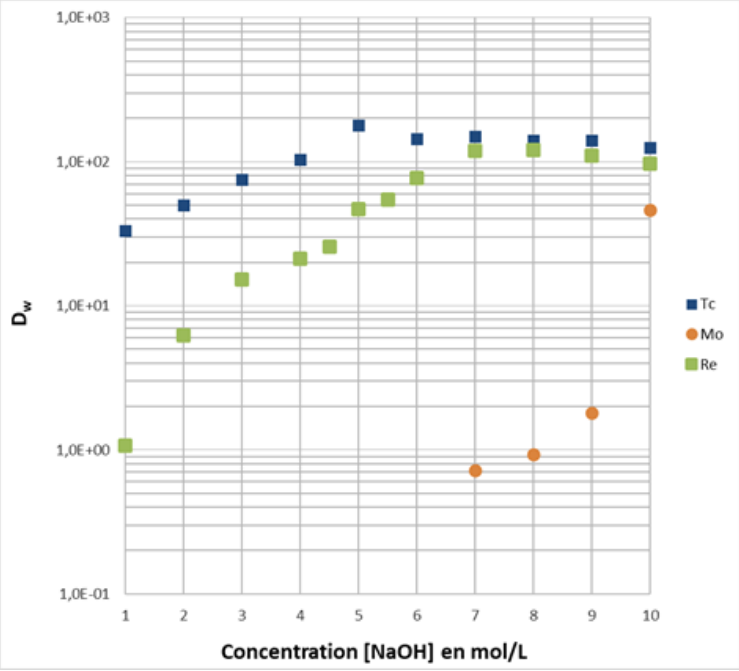
- Plastic scintillating beads impregnated with selective extractant
- Developped by university of Barcelona
  - García, Tarancón, Bagán
- « TK-ElScint » product line
- 1st product: « TK-TcScint »
  - Aliquat336 (similar selectivity to TEVA)
  - Environment/decommissioning => Tc-99 by LSC
  - Othe interest: SR, TK101, CL, AC,…
  - Potential application for RadPharm QC? E.g. Sr-90 via Sr Resin equivalent
- Direct mesurement of the cartrige by LSC after loading and rinsing
  - NO elution/evaporation/aliquoting => easy automatisation
- Chemical yield via Re/ICP-MS in eluates.



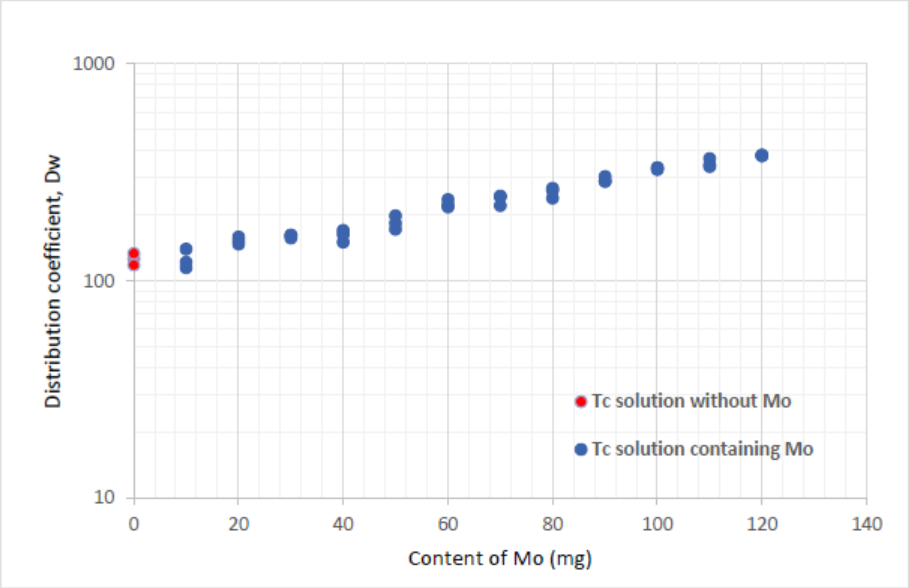
TK202 Resin

- Polyethylene Glycol (PEG) grafted on inert support
- Aqueous biphasic system (ABS)
- Retention of chaotropic anions e.g; TcO_4^- in the presence of Kosmotropic anions (SO_4^{2-}, CO_3^{2-}, OH^-, MoO_4^{2-},…)
- For samples rich in Mo: Tc yield > 90% for 6 – 8g Mo per g TK202





Dw values for Tc, Re and Mo on TK202 Resin, at varying NaOH concentrations. Tc data taken from Cieszykowska et al.

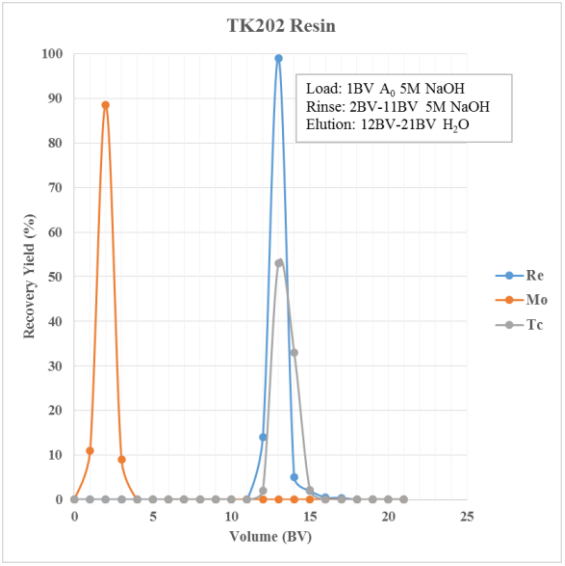


Dw values for Tc in 5M NaOH using 40 mg TK202 Resin, increasing amounts of Mo. Data taken from Cieszykowska et al.

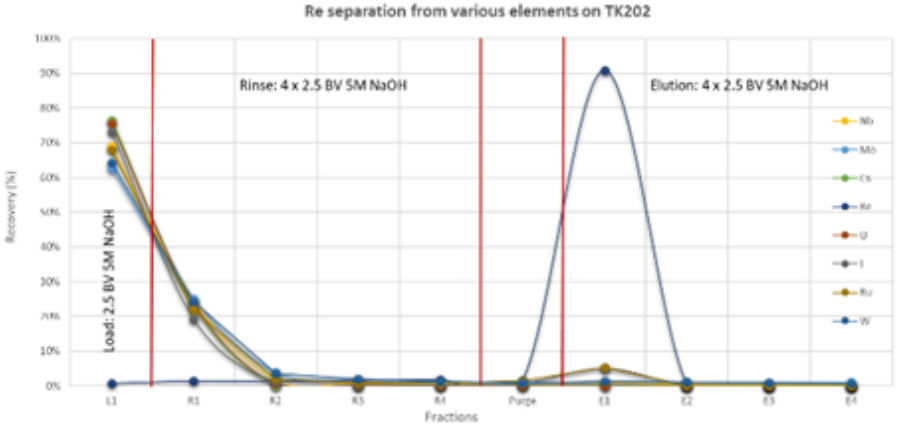
TK202 Resin

- Retention of Tc from concentrated NaOH medium (5 - 7M)
  - Alkaline Fusion e.g. decommissioning samples
  - Dissolution of Mo target
  - Clean separation from other tested elements

  => CAREFUL regarding other chaotropic anions (e.g. I^-)
- Re can be used as internal standard
- Elution in a small volume of water
  - Eluat remains alkaline
  - Load on CEX to neutralise medium + get rid of Na^+ THEN
  - Load on aluminum oxide to get rid of Mo traces + elution in 0.9% NaCl mediums



Re/Tc separation from Mo on TK202 Resin

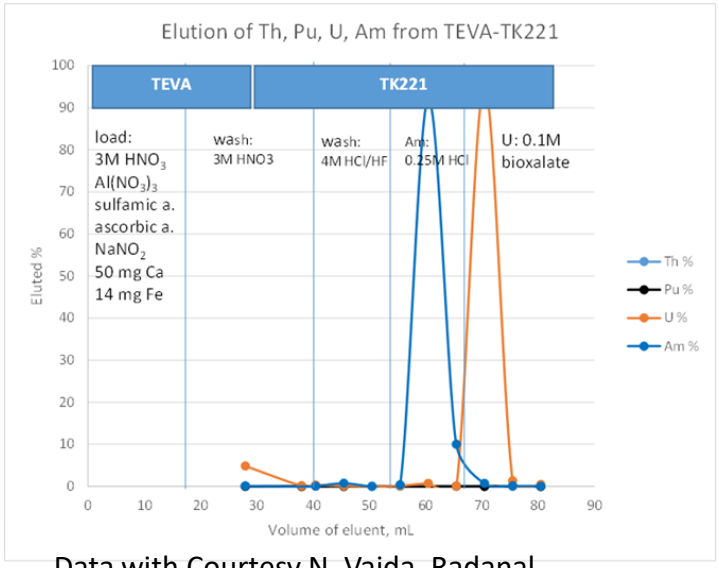


Re separation from selected elements on 2 mL TK202 Resin cartridge, load and rinse at 1 BV/min, elution at 0.25 BV/min.

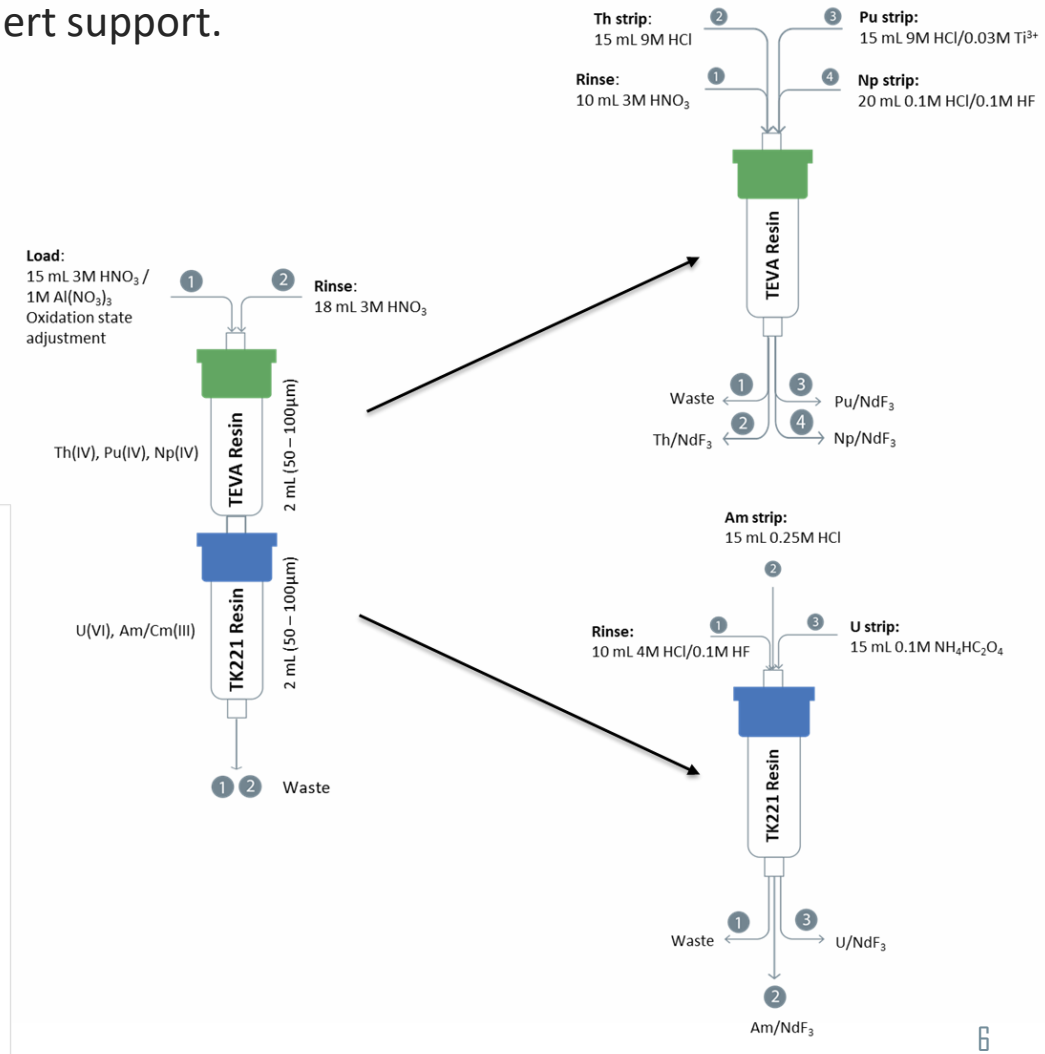
TK221 Resin

Resin based on a mixture of diglycolamide and phosphine oxide + traces long chained alcohol on inert support.

- Main applications in radpharm with separation and concentration of lanthanides (e.g. ca and nca Lu-177)
- Other applications are separation of actinides and actinium

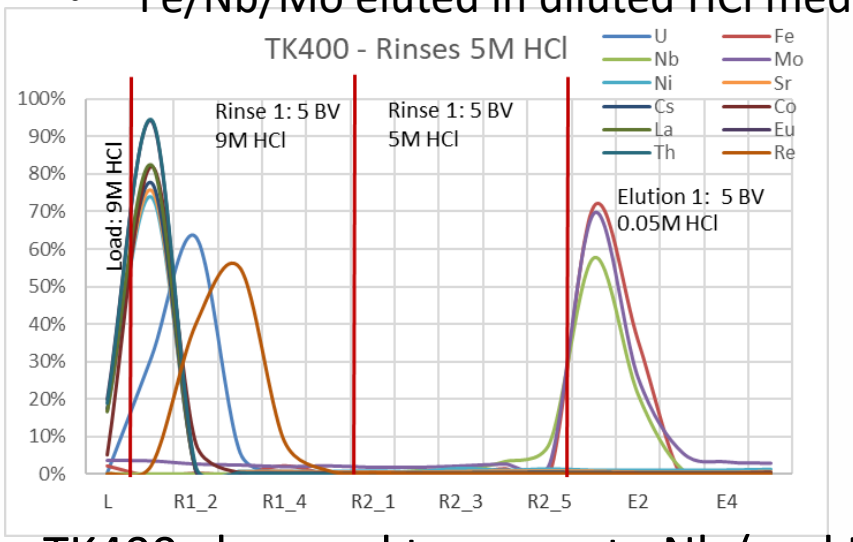


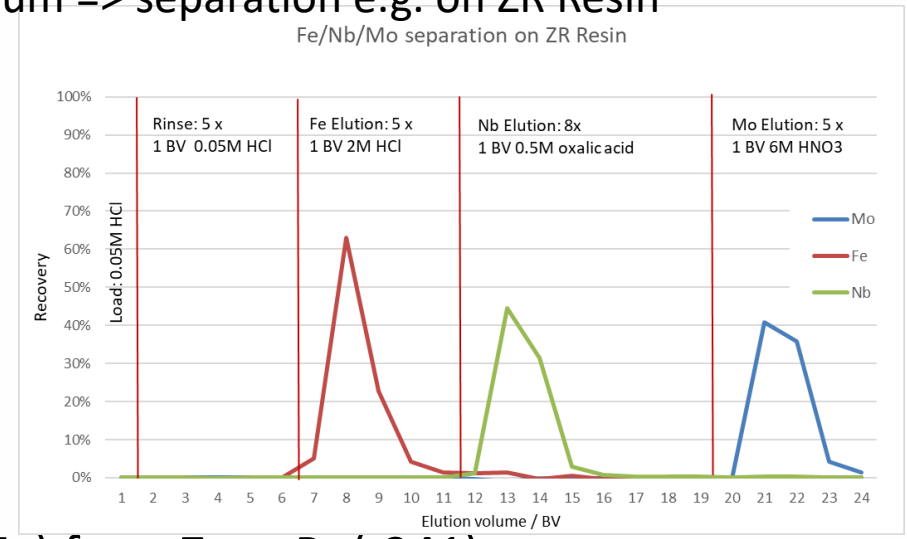
Data with Courtesy N. Vajda, Radanal



TK400 Resin

- Separation of Fe/Nb/Mo in concentrated HCl medium on TK400
  - Most of other element present in solution are eluted during load and rinses (HCl 9M et 5M)
  - Fe/Nb/Mo eluted in diluted HCl medium => separation e.g. on ZR Resin





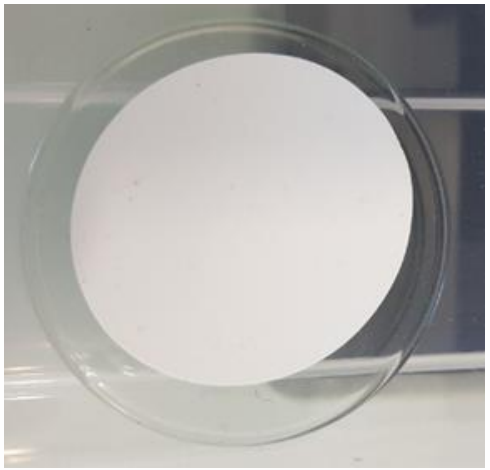
- TK400 also used to separate Nb (and Fe) from Zr or Pu(-241)
  - Zr-93 in decommissioning sample=> method under development (with UTEVA Resin)
  - Separation of Zr-89 from Y targets (with TBP Resin)
- TK400 used to separate Ga-68 from Zn solid targets

  e.g. Tieu et al. 2019 & Svedjehed et al. 2021 (+A8 and TK200)

Coming products – impregnated filtering membranes

- New product line: **impregnated filtering membrane (MF)**
  - Fast flow rates
  - Use with water samples (1 – 5L),

  But also
  - Use as Passive Sampling (DGT)
  - In development (including procedures):
    - **TK100 (Sr, Pb, Zn), TK101 (Pb, Ra)**
    - **CL Resin (radio-iodine)**
    - **TK201 (Tc – Bi/Po)**
    - Calixarenes (Ra, Cs)
    - …



Coming products – impregnated filtering membranes

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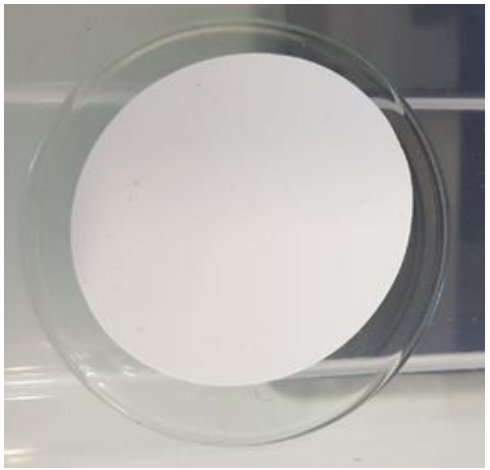
TK100 Membranes – Pb separation

MOP:

- Pre-conditionning : 10mL 10%EtOH
- Load : 100mL solution Pb, Zn and Sr (tapwater @ pH2 ajusted with HNO_3) – flow-rate 10ml/min (600ml/h)
- Rinse 1 : 10mL 0.01M HNO_3
- Rinse 2 : 10mL 2M HCl
- Elution : 10mL 6M HCl

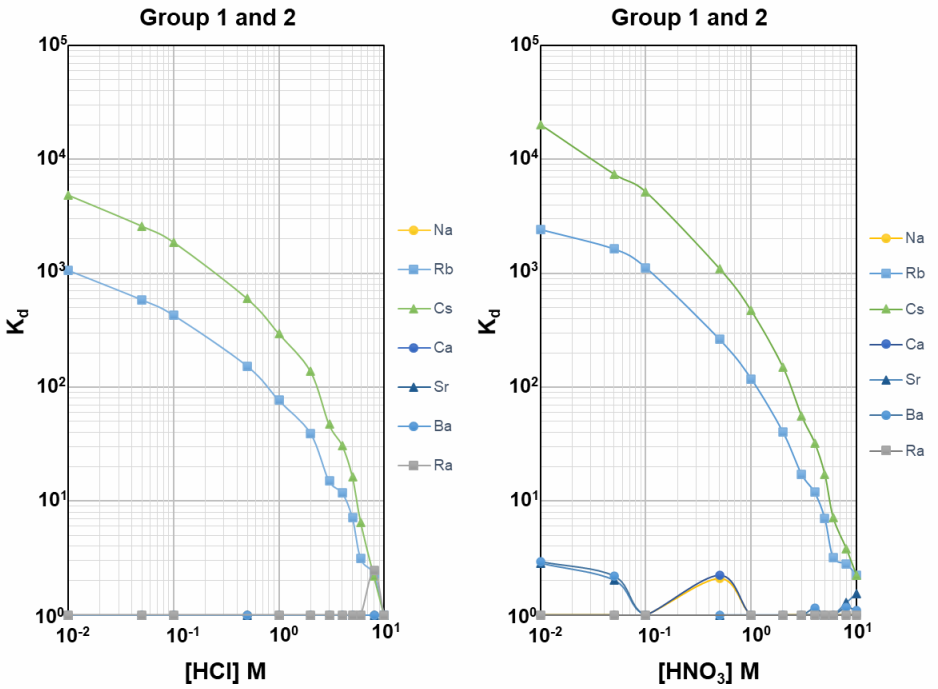


Results:

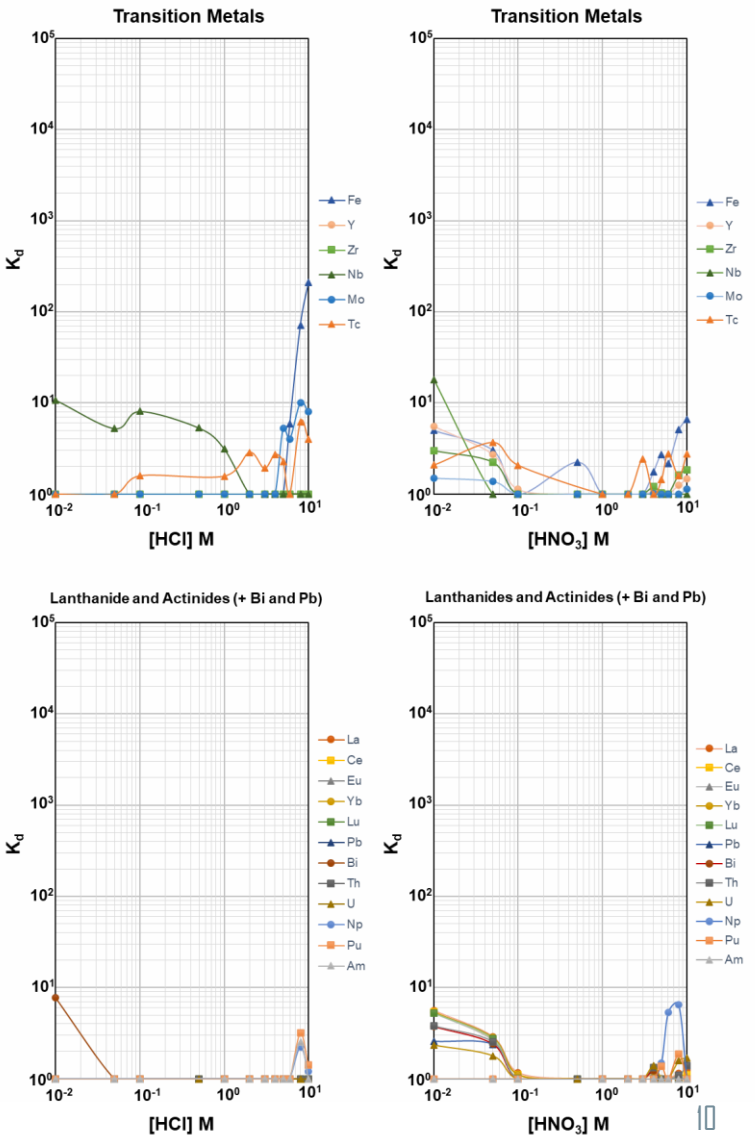
	Load (% retained on membrane)	R1 (% retained on membrane)	R2 (% retained on membrane)	Elution (% in eluat)
Pb	99,6%	99,6%	96,1%	***35%***
Zn	8,2%	2,6%	1,9%	0%
Sr	53,8%	49,1%	5,6%	***13,6%***

Coming products - TK300 Resin

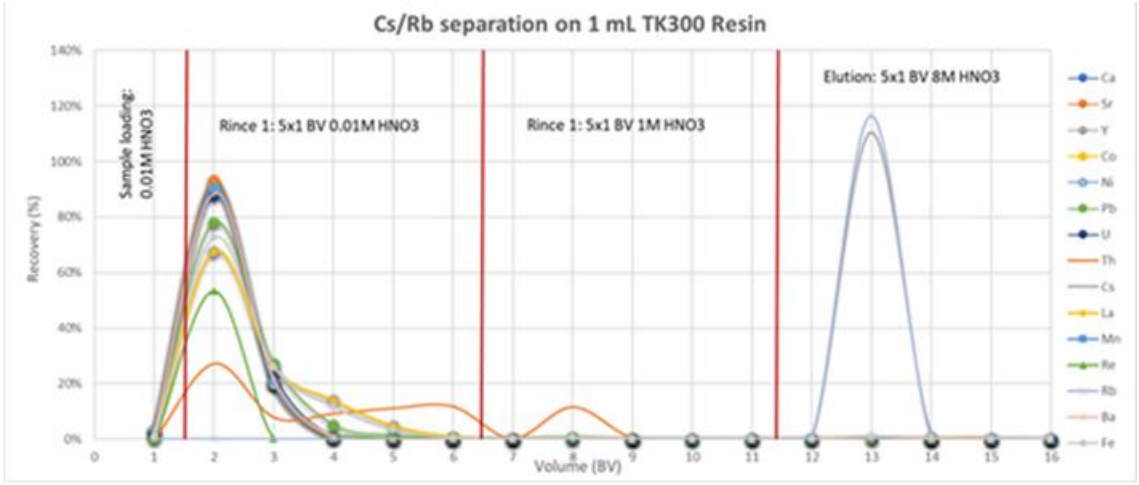
- Resin based on a Macrocycle
- Separation of Cs and/or Rb (i.e. from Ba/Sr)
- Selectivity for Cs and Rb compared to other tested elements (Fe,Y,Nb,Mo,Tc,Na,Ra,Sr,Ca, Ba,Lns,Acs) in HNO_3 and HCl



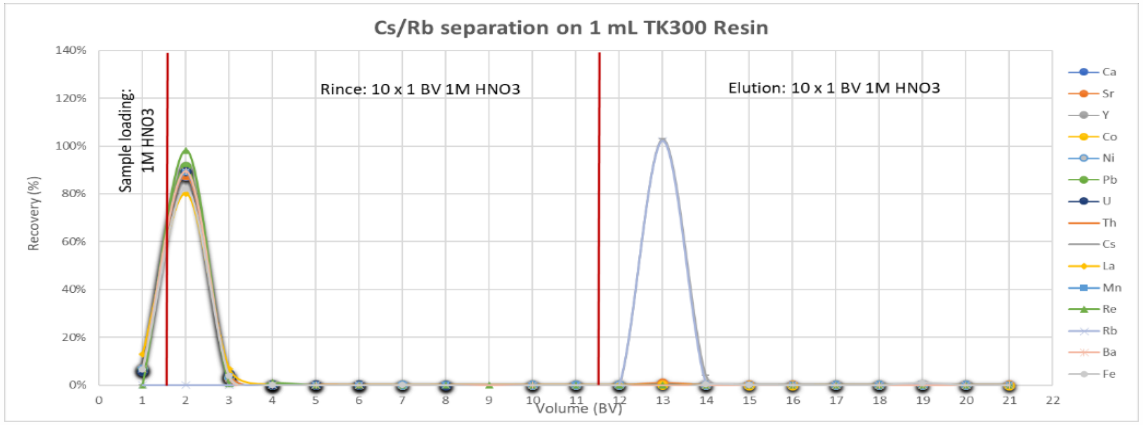
Data provided by B. Russel (NPL)



Coming Products - TK300 Resin



Elution study, Cs and Rb separation from selected elements on TK300 resin, loading from dilute acid.



Elution study, Cs and Rb separation from selected elements on TK300 resin, loading from 1M HNO3

- Separation of Cs and Rb
- Retention on a large pH window (up to 1M HNO_3)
- Possible separation Cs/Rb (@ 2M – 2,5M)
- Elution >3M HNO_3
  - Alternative => push resin in LSC vial (=>TEVA)
  - Filtering membrane
- Limitations:
  - Capacity in Cs
  - Interference of K
  - For environmental samples

➢ Use for decommissionning samples

Under development – TK102 Resin

- Modified version of SR Resin
  - Same crown-ether
  - Solvent, inert support and ratios => different
- Distribution coefficient Kd ~50% higher (Pb, Sr, Ba)
- Higher capacity (Pb and Sr) => I. Dohvyi Poster during ERA14
- Separating Methods under development
  - Including Sr-82 production combined with TK100

Under development

- TK222
  - TEH-DGA version of TK221 resin
  - Use for Ac and Sc separation?
- TK225
  - Resin based on TO-DGA and ionic liquid
  - Selectivity similar to DGA,N Resin
  - Presence of ionic liquid => increase of teh selectivity towards trivalent éléments (difficult to remove from elute from resin)

Production of « industrial » extraction chromatographic resins 'Industrielles'

- Requests from hydrometallurgy area
  - Possible applications in decontamination and valorisation of effuents or decontament (e.g. acid)
- Different resins
- Bigger particle size support and higher amount of resins requested
  - ~400 – 600µm
  - Challenge: supply of extractant and inert support
    - Extractants: sufficient quality, low costs, high quantities
- Increase of production capacity for these resins

Other Projects

- Tesmarac LabCom
- Ac separation (including Ra recycling)
  - TK221/2, TK200
- Radium
  - New resins and macrocycles
- SE Resin
- Improvement to radiolysis stability
- Rapid Tests
  - Test sticks => Univ Southampton
  - SBSE (extraction par sorption sur barreau magnétique)
- On-site Preconcentration
- DGT (Diffusive Gradients in Thin Films) => 'bio-availability'
- DTM (Difficult To Measure) separation
  - Decommissionning
  - Zr-93, Fe, Mo, Nb,…
- Microfluidics
- Nuclear Medecine

Thank you for your attention!

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