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Dear customers,

Time is flying and it is now a year's time that we have moved into our new building. We are very pleased with the new situation and having production, quality control and R&D in the same place increases our efficiency considerably. It helps us to provide you faster with new applications, products and services. This past year we have developed new resins for the separation of Tin, Zirconium/Titan/Germanium and Protactinium. Please find the technical information on the latter (TK400 Resin) here enclosed. We are currently working on new separation technologies for the separation of Selenium, Molybdenum and Radium and will present the results on these resins during next year's conferences.

We are also happy to announce that the regional public investment bank (BPI Bretagne) supports our efforts to develop a technique for the separation of non carrier added Lutetium-177. This project allows our research team to grow and to include new competences to its portfolio

Please do not hesitate to contact us if any of these developments are of your interest. My colleagues and myself are at your disposal.

Michaela Langer, CEO

TK400 Resin

The TK400 Resin is an extraction chromatographic resin that is comprised of octanol impregnated onto an inert support. Knight et al.¹ showed that long-chained alcohols, especially octanol, show very interesting selectivity towards Pa at high HCl concentrations, allowing for facile Pa/Np separation using column chromatography. Jerome et al.² characterized the TK400 Resin with respect to its selectivity for a number of elements including Pa, Np, U and Th (Fig. 1).

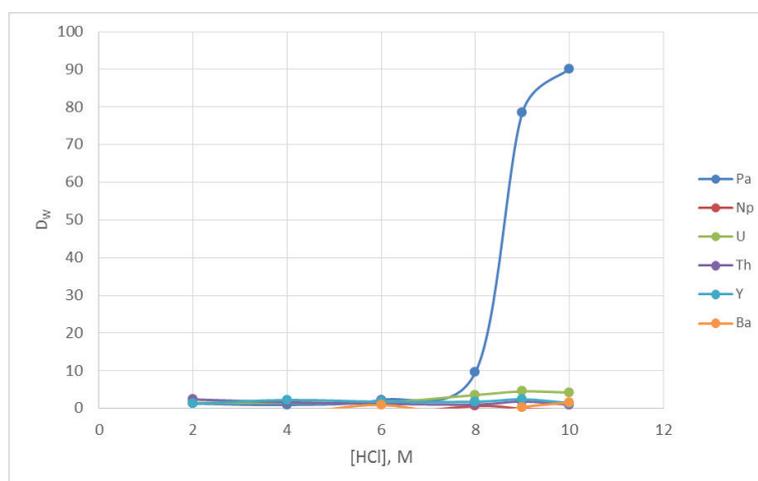


Figure 1: D_w values of selected elements on TK400 Resin in HCl at varying concentration, data provided by Jerome et al.²

They found that Pa retention sharply increases at high (≥ 9 M) HCl concentrations whereas other elements tested are not retained. At HCl concentrations < 8 M HCl on the other hand D_w values of Pa were found to be low allowing for its elution in a small volume. Ostapenko et al.³ found a similar trend for Pa retention with k' values being high for Pa at high HCl concentrations (9 M). These results correspond overall well to the selectivity observed by Knight et al. when performing Np/Pa separation (Fig. 2).

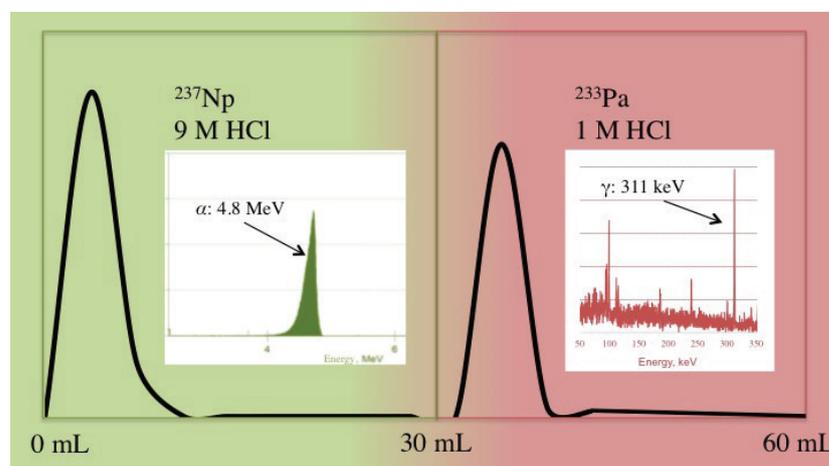


Figure 2: Elution study, Np/Pa separation on octanol resin (taken from Knight et al.¹)



● News

LU-177

We're proud to announce that we've been, as part of the French future investment program, awarded the support of BPI Brittany (Regional Public Investment Bank) for a new project on the separation of heavy lanthanides. Aim of the project is the development of new resins and methods for the separation of no carrier added (n.c.a.) Lu-177 from irradiated Yb targets.

ZR Resin

Three new methods for the separation of Zr from Y, Ti from Sc, and Ge from Ga (all small targets) have been added to our website, they are available for download under: http://www.triskem-international.com/full_methode_TKI.asp. Work on the separation of Ga from Zn targets is currently on-going.

TrisKem at RRMCC

We'll have a booth at the upcoming 62nd RRMCC taking place from 06.02 to 10.02.17 in Hawaii, USA.



Looking forward to seeing you there to discuss new developments including Se separation!

More information about RRMCC at: www.rrmc.co

Figure 3 shows D_w values of an additional set of elements in HCl on the TK400 Resin determined by Dirks et al.⁴. The resin shows high selectivity for Nb at high HCl concentrations over other elements tested such as Ta, Zr, Hf and lanthanides which are not, or only very poorly as in the case of Ta, retained by the resin.

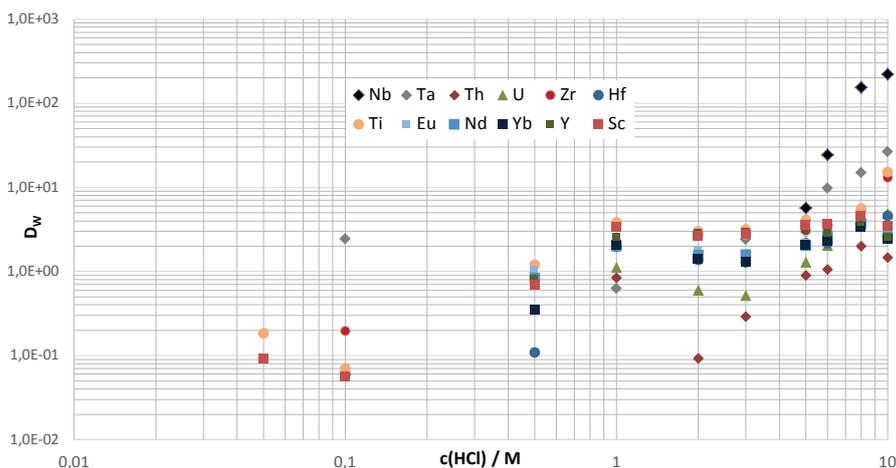


Figure 3: D_w values of selected elements on TK400 Resin in HCl at varying concentration taken from Dirks et al.⁴

With respect to its selectivity the TK400 Resin shows the potential for allowing a number of interesting separations such as Nb/Zr and Pa/U/Th. The results of an elution study on the separation of Nb from a number of elements, including Zr, and the separation method used to obtain these results are shown in Fig. 4 and Fig. 5, respectively. Jerome et al.² employed the TK400 Resin for the separation of Pa from its descendants following the procedure shown in Fig. 6. They found that U, Th, Ac, Ra and Pb were removed from the resin during load and rinse, allowing for obtaining a clean Pa fraction with high chemical yield (~83%).

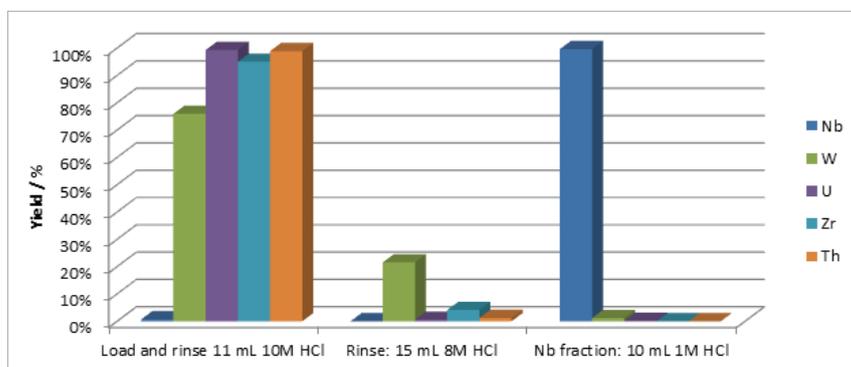


Figure 4: Elution study, Nb separation from selected cations, 2 mL TK400 column

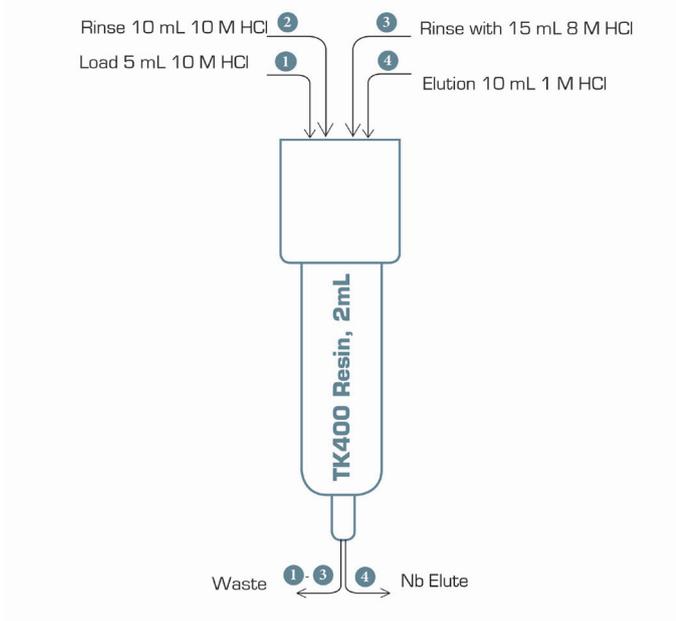


Figure 5: Nb separation on TK400 Resin

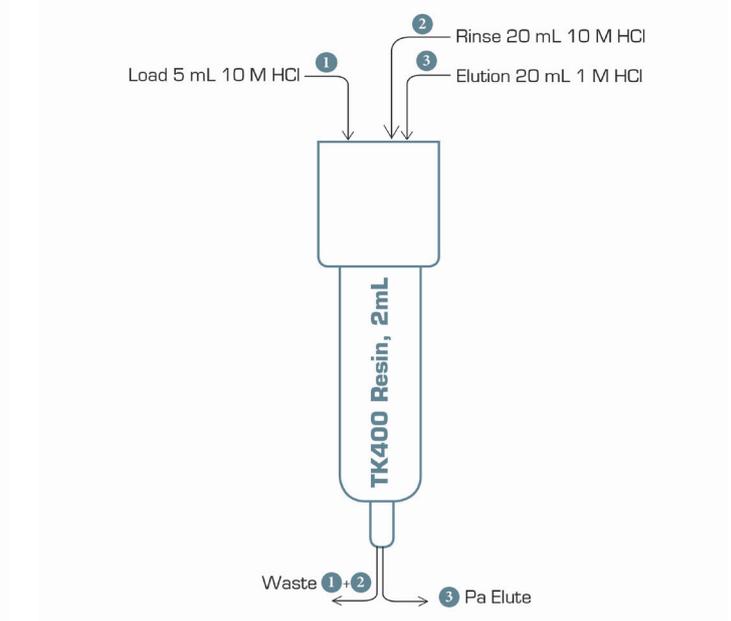


Figure 6: Pa separation from its descendants following Jerome et al.²

● DGA Sheets

Radionuclide separation and radionuclidic purity determination was never easier. Separation of generator isotopes and radionuclide mixtures on DGA impregnated chromatographic paper, which has been developed at the CVUT (Prague), including mixtures like $^{227}\text{Ac}/^{227}\text{Th}$ / ^{223}Ra , $^{90}\text{Sr}/^{90}\text{Y}$, $^{68}\text{Ge}/^{68}\text{Ga}$, $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$, ^{212}Pb and $^{225}\text{Ac}/^{213}\text{Bi}$ is now possible using one separation material, just by changing the composition of the mobile phase (diluted mineral acids like 1M HNO_3 or HCl). The chromatographic paper is impregnated with DGA with variable active compound loading (0.1-10%).

The method is easy to validate and TLC scanners or alternatively, after cutting the paper, common radiometers may be used to determine radionuclidic purity of a generator eluate or a purified radionuclide product.

Proposed standard sheet dimensions are 5 x 20 cm or 20 x 20 cm. Other formats and custom dimensions are however also available upon request.

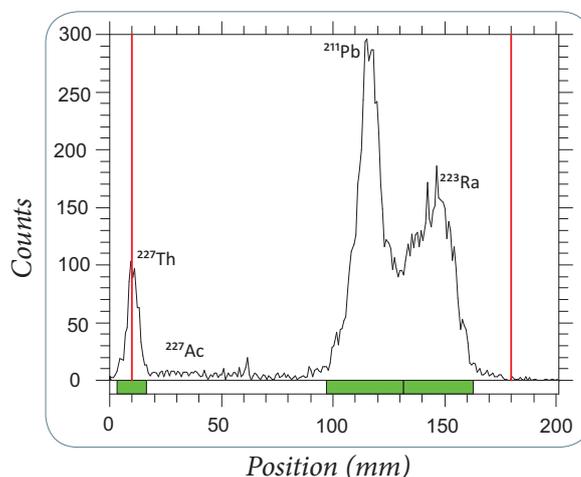


Figure 7: Radiochromatogram measured immediately after separation.



Agenda

TrisKem will be participating to the following upcoming conferences and is very much looking forward to meeting and discussing with you there!

Radiobioassay & Radiochemical Measurements conference (RRMC),
6 – 10.02.17, Hawaii (USA)
<https://www.rrmc.co>

European Winter Conference on Plasma Spectrochemistry (EWCPS),
19 – 24.02.17, St. Anthon (Austria)
<http://www.ewcps2017.at/>

Advances in Liquid Scintillation Spectrometry (LSC) 2017,
1 – 5.05.17, Copenhagen (Denmark),
<http://lsc2017.nutech.dtu.dk>

PROCORAD,
21 – 23.06.17, Aachen (Germany),
<http://www.procorad.org/>

International Symposium on Radiopharmaceutical Sciences (ISRS) 17,
14 – 19.05.17, Dresden (Germany),
<http://isrs2017.org/>

You'll find an update on our participations to conferences on our website :
www.triskem.com

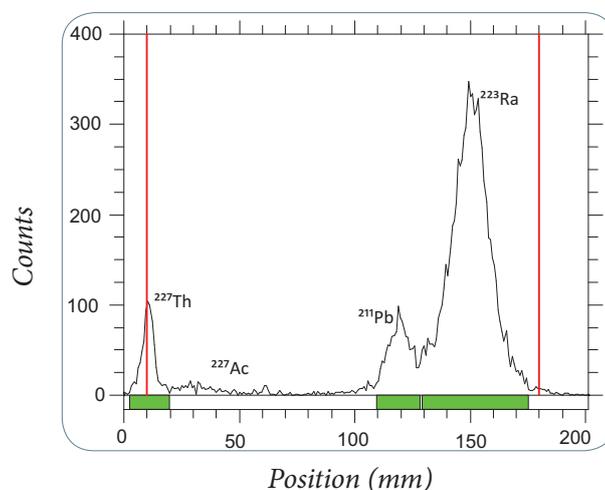


Figure 8: Radiochromatogram measured one hour after separation.



Figure 9: Scheme of a paper chromatographic separation of a mixture of ^{227}Ac and its daughter nuclides. ^{227}Th remains on start, ^{227}Ac has a retention factor R_f of ca 0.2, ^{211}Pb of ca 0.7 and ^{223}Ra of ca 0.9



All data provided by J. Kozempel and M. Vlk, CVUT (Prague)

The DGA Sheets are currently also being tested for the rapid evaluation of complex radionuclide mixtures (e.g. solubilized decommissioning samples) through 1D and 2D paper chromatography combined with autoradiography

Literature :

- (1) A.K. Knight et al.: "A chromatographic separation of neptunium and protactinium using 1-octanol impregnated onto a solid phase support", J Radioanal Nucl Chem (2016) 307:59–67
- (2) S. Jerome et al.: "Isolation and purification of Protactinium-231", submitted to the ICRM 2017 conference, 15 – 19.05. 2017, Buenos Aires,
- (3) V. Ostapenko et al.: "Sorption of protactinium(V) on extraction chromatographic resins from nitric and hydrochloric solutions", J Radioanal Nucl Chem, (2016), DOI 10.1007/s10967-016-4996-x
- (4) C. Dirks et al.: "New developments – TrisKem", presented at the RANC 2016 conference, 10-16.04.16 - Budapest, Hungary