TRISKEM INFOS

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Contents



**Triskem moves to its new headquarter!**

Our wish is to meet your needs with innovative solutions!

We are proud to inform you that we moved to our new premises in November 2015. This is thanks to our independence, and to eight successful years of implementing our production of high quality products, consolidating our strong relationship with our customers and developing our R&D.

Our new building has been designed to optimize our energy consumptions. It includes our Production, our R&D Laboratories, our Customer Service together with our Administration and Finance Department.

This new environment and your confidence in our products reinforce our will to design and develop together innovative solutions to fulfill your ever evolving needs.

We wish to share with you a wonderful year 2016, full of health, joy and success!

*Your TrisKem team*

# ZR Resin

The ZR Resin is based on the hydroxamate functionality frequently used for the separation of zirconium, especially from Y target materials for later use in radiopharmaceutical applications.

Dirks et al.[1] characterized the resin with respect to its selectivity for selected elements in $HNO_3$, HCl and oxalic acid, results are summarized in Figures 1 – 3.

The ZR Resin shows high selectivity for Zr, Ti and Nb over a wide range of HCl concentrations (0.01M – 10M), Fe(III) is strongly retained at low and elevated HCl concentrations, retention is weaker from 1 – 6M HCl. As expected the resin shows very little selectivity for Sc and Y, a separation of e.g. Zr from Y and Ti from Sc seems thus feasible.

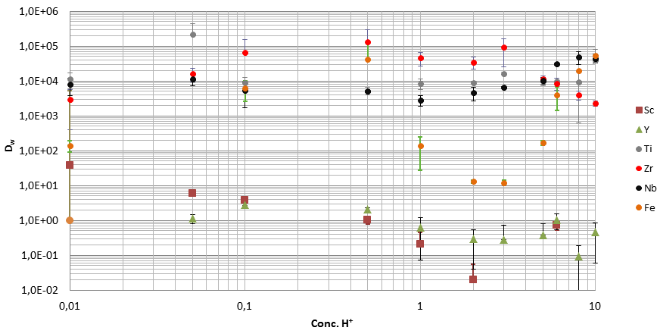


***Figure 1 :*** *$D_W$ values, ZR Resin, HCl, various elements*

The resin shows rather similar selectivity in $HNO_3$, Zr, Ti and Nb are well retained up to 5M $HNO_3$, Fe(III) is well retained up to 1M $HNO_3$. At higher $HNO_3$ concentrations the nitric acid starts attacking the extractant, as indicated by a colour change of the resin from white to brown; accordingly the resin shows no significant selectivity towards the tested cations under these conditions. As in HCl, Y and Sc show no significant retention on the ZR Resin in $HNO_3$.

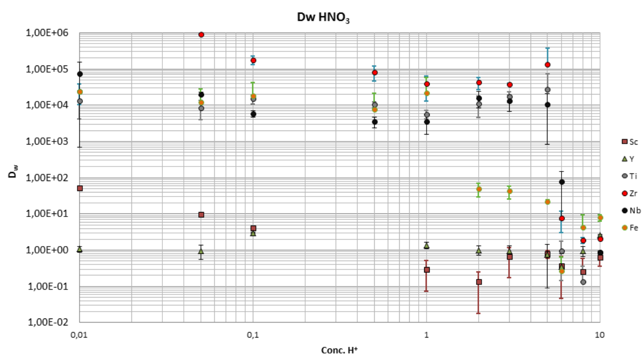


***Figure 2 :*** *$D_W$ values, ZR Resin, $HNO_3$, various elements*



TRISKEM INFOS
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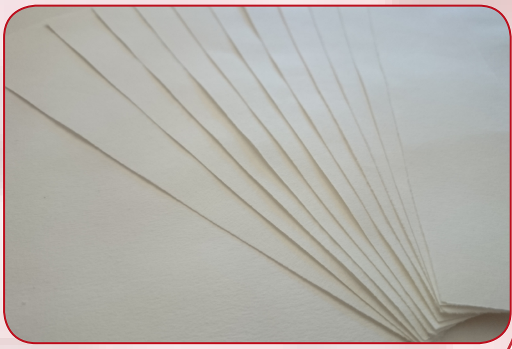
## Product improvements:

New two-way valves for use with cartridges/vacuum box systems, and new 25 mL funnels for 2 mL columns (made of one piece thus eliminating the need for an adapter) available soon.

*For further information please contact* ***contact@triskem.fr***

## New product :

DGA-SHEETS – a new simple tool for quality control and separation of generator isotopes and radionuclide mixtures on DGA impregnated chromatographic paper. The DGA sheets have been developed at the CVUT in Prague and may be applied to mixtures such as $^{227}Ac/^{227}Th/^{223}Ra$, $^{90}Sr/^{90}Y$, $^{68}Ge/^{68}Ga$, $^{99}Mo/^{99}mTc$, $^{212}Pb$ and $^{225}Ac/^{213}Bi$. For more information please don't hesitate to contact us (*mailretd@triskem.fr*) or to have a look at the product sheet (*http://www.triskem.com/iso_album/technical_sheet_dga_paper.pdf*). You'll also find more information in our next TKI.



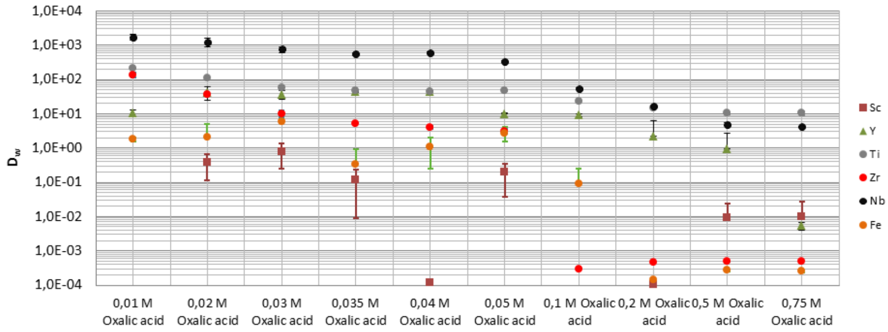



***Figure 3 :** $D_W$ values, ZR Resin, oxalic acid, various elements*

Oxalates are very strong complexing agents for Zr, accordingly they are very frequently used for the elution of Zr.

It could be shown that oxalic acid concentrations above 0.05M lower the $D_W$ value of Zr on the ZR Resin strongly; they are thus suitable eluting agents for Zr. It was further observed that Nb shows high $D_W$ values even at 0.05M oxalic acid, indicating that Zr and Nb may be separated by adjusting the oxalic acid concentration accordingly.

Based on obtained $D_W$ values several elution studies were performed[1] with main focus on the use of the resin in the context of radionuclide production for radiopharmaceutical use. Fig. 4 and 5 show the results of these elution studies.

As indicated by the $D_W$ values the ZR Resin can be loaded over a wide HCl concentration range. The rinsing conditions were kept close to the conditions suggested by Holland et al.[2]: after the load the resin is first rinsed with four times 2.5 mL of the same acid used during the load (here 2M or 6M HCl), followed by an additional rinse with four times 2.5 mL water. Zr is finally eluted using 0.1M oxalic acid.

Under the given conditions a very clean separation of Zr from Y and Sc was obtained, both are breaking through during the loading of the ZR Resin, last traces are removed during the first rinsing steps. Zr can be recovered near quantitatively in 1.5 mL 0.1M oxalic acid even in presence of up to 300 mg stable Y (using a 100 mg ZR Resin column); however no complete Zr/Nb separation could be achieved under these conditions. Ti is only partially eluted under these conditions; in order to remove it quantitatively it will be necessary to apply more suitable elution conditions.

Fig. 3 indicates that a Zr/Nb separation should be possible using 0.05M oxalic acid as eluting agent for Zr, this could be confirmed through elution studies as shown in Fig. 6. In order to quantitatively elute Nb higher oxalic acid concentrations will need to be employed (> 0.2M oxalic acid).


Fig 4 to 6 further show that Fe(III) will to a certain extend follow Zr this might lead to interferences with labeling reactions; accordingly it might be preferable to remove it from the Zr fraction. One possibility is loading the resin under reducing conditions using suitable reducing agents such as ascorbic acid or hydroxylamine hydrochloride, as can be seen in figure 7.

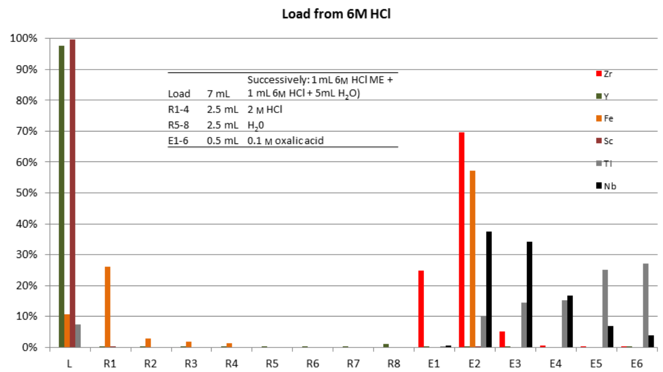



***Figure 4 :*** *Elution study ZR Resin, 100 mg, load from 6M HCl, multielement solution (ME), fractions analysed by ICP-MS*

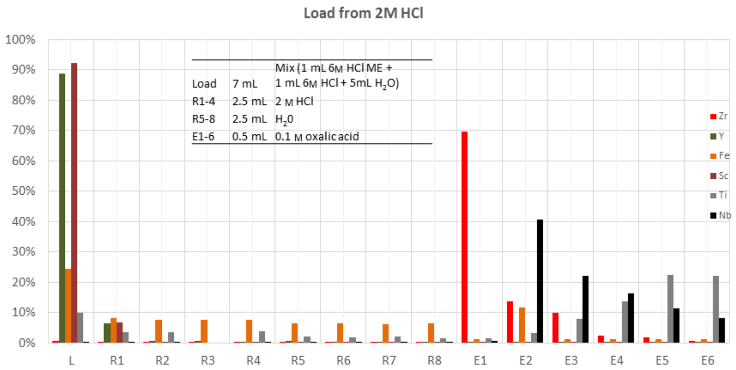



***Figure 5 :*** *Elution study ZR Resin, 100 mg, load from 2M HCl, multielement solution (ME), fractions analysed by ICP-MS*

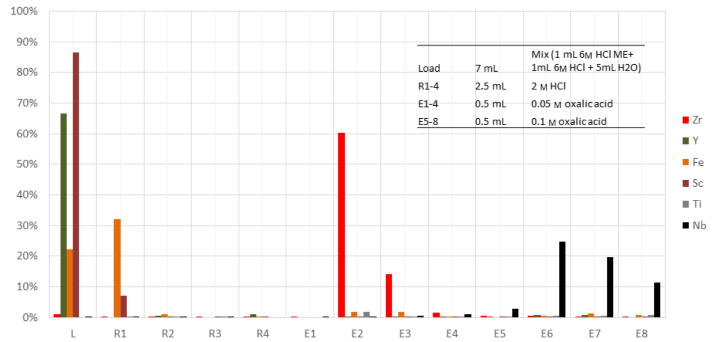



***Figure 6 :*** *Elution study ZR Resin, 100 mg, load from 2M HCl, Zr elution with 0.05M oxalic acid, multielement solution (ME), fractions analysed by ICP-MS*

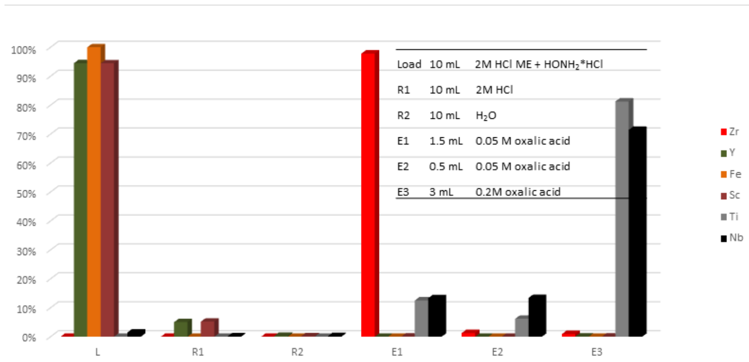



***Figure 7 :*** *Elution study ZR Resin, 100 mg, load from 2M HCl under reducing conditions ($HONH_2$*HCl), multielement solution (ME), fractions analysed by ICP-MS*

Fig 8 schematically shows the suggested Zr purification method.

Other than for Zr the ZR Resin also shows very interesting selectivity for Ti, especially with respect to Sc. Fig. 9 shows an example of a Ti/Sc separation performed on the ZR Resin: while Sc is not retained from 10 M HCl Ti is fixed very well. 0.1M citric acid may be used to elute Ti from the resin; however a volume of at least 3 mL will be needed. Beside citric acid, hydrogen peroxide or oxalic acid of elevated concentration may be employed.

As Ti is retained over a very wide range of HCl concentrations, including dilute HCl, its potential for use as support for a Ti/Sc generator was evaluated. A 100 mg ZR Resin column was loaded with a small volume of a solution containing Ti and Sc. The column was then rinsed five times with 1 mL 0.01M HCl, followed by 10 rinses with 5 mL 0.01M HCl. As shown in Figure 10 Sc is easily removed in a small volume of dilute hydrochloric acid whereas Ti remains retained, the general selectivity of a generator is thus given, however, further testing will be necessary in order to further evaluate Ti breakthrough and purity of the obtained Sc.

## Agenda

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

RANC 2016, 1st International Conference on Radioanalytical and Nuclear Chemistry, 10/04/16-15/04/16, Budapest (HU),
**http://www.jrnc-ranc.com/**

Lomonosov, 12/04/16 – 14/04/16, Moscow (RU),
**http://radiochemistry-msu.ru**

COGER, 05/04/16-07/04/16, Glasgow (UK),
**http://www.coger.org.uk/**

Atalante 2016, Nuclear Chemistry for Sustainable Fuel Cycles, 05/06/16-10/06/16, Montpellier (FR),
**http://www.atalante2016.org/**

SNMMI, 11/06/16-15/06/16, San Diego (US),
**http://www.snmmi.org/am/**

Jornadas de Calidad, 15/06/16-17/06/16, Barcelone (ES )

Procorad, 15/06/16-17/06/16, Dijon (FR),
**http://www.procorad.org/**

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

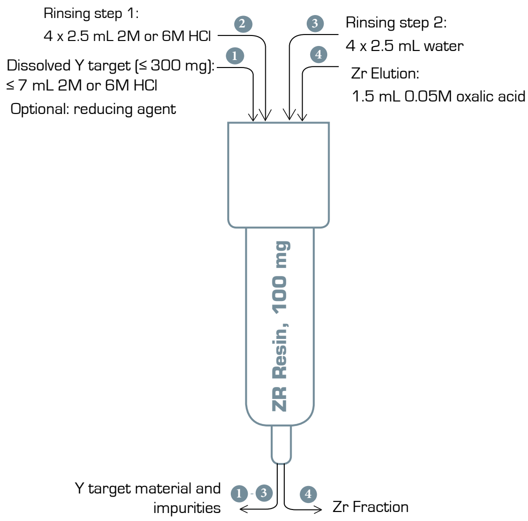



**Figure 8 :** *Suggested method for the separation of Zr from Y targets (≤ 300 mg) using the ZR Resin*

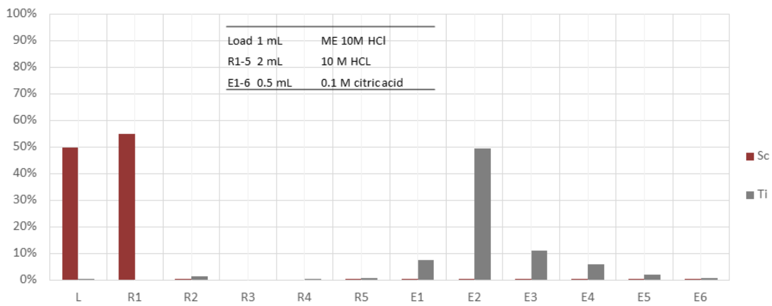



**Figure 9 :** *Elution study ZR Resin, 100 mg, load from 10M HCl, Ti and Sc, fractions analysed by ICP-MS*

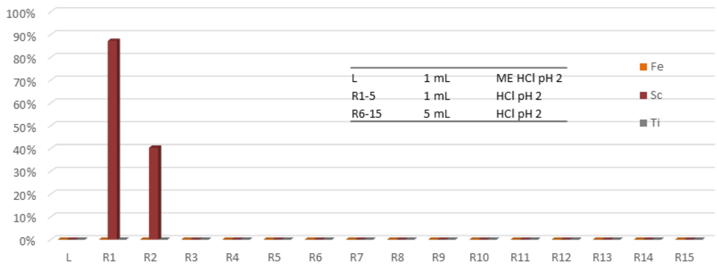



**Figure 10 :** *Elution study ZR Resin, 100 mg, load from 0.01M HCl, Ti and Sc, repeated elutions, fractions analysed by ICP-MS*

In addition to the separation of Zr/Y and Ti/Sc the resin also allows the separation of Ge from macro amounts of Ga, work on this separation is currently on-going.

## Literature :

(1) Dirks and al.: "On the development and characterisation of an hydroxamate based extraction chromatographic resin". Presented at the 61st RRMC, October 25th - 30th, 2015, Iowa City, IA, USA:
***http://www.triskem-international.com/iso_album/poster_zr_resin_radiopharmacy.pdf***
(2) Jason P. Holland, D.Phil, Yiauchung Sheh, Jason S. Lewis, Ph.D: "Standardized methods for the production of high specific-activity zirconium-89", Nucl Med Biol., 36(7), 2009, 729–739; doi:10.1016/j.nucmedbio.2009.05.007:
***http://www.nucmedbio.com/article/S0969-8051(09)00151-6/abstract***

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