TRISKEM INFOS
N°24
09/2024

SUMMARY

Edito :

Energy transition and sustainable development is a concern for everybody. Since the beginning of our activities we have been very attentive in restricting hazardous reagents in our production as well as in the applications of our products. Avoiding wastage of resources and limiting waste generation has always been essential to us. Since 2018 Triskem has signed the United Nations Global Compact, which is a non-binding United Nations pact to get businesses and firms worldwide to adopt sustainable and socially responsible policies. Working with around 80 countries all over the world, inclusion is an important value of our company. We are fortunate to have a multicultural and multilingual team, which is committed to serve you at our best.

In 2023 Triskem International has determined its carbon footprint. We aim to reduce our CO_2 emission and advance with regards to the sustainable development goals. We focus on enhancing energy autonomy, environmental protection and the health and safety of our employees.
Ensuring the availability of raw materials and high quality products is part of our risk management system.

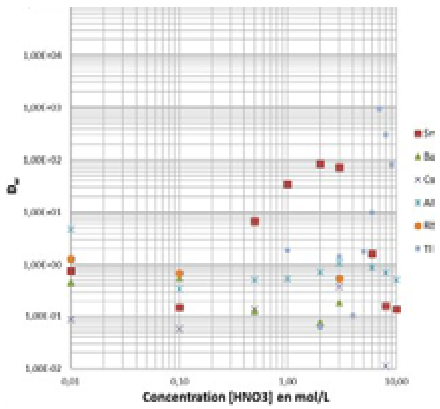
I would like to thank you for your interest in our products and I hope to seeing you at one of the upcoming conferences at our booth.

Michaela Langer
Président of Triskem International

TK222 Resin

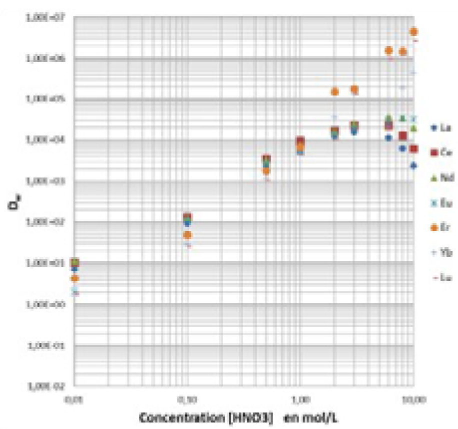
The TK222 Resin is based on a mixture of a branched diglocylamide and a phosphine oxide. It also contains a small amount of a long-chained alcohol. Further, the organic phase is impregnated onto an inert support containing aromatic groups for increased stability against radiolysis.

The following graphs show the selectivity of the TK222 Resin for a wide range of elements in HNO_3 and HCl. All D_W values shown in these graphs were obtained through ICP-MS measurements.



D_W values of selected elements on TK222 in HNO_3

Out of the shown elements only Sr at medium high HNO_3 concentration (2 – 3M) and Tl at elevated concentrations (~8M) are retained.



D_W values of selected elements on TK222 in HNO_3

Lanthanides are generally very well retained at elevated HNO_3 concentrations (≥0.5M), this is particularly true for heavy lanthanides. This point is particularly interesting with respect to the separation of lanthanides from Ac. D_W values are generally low at low HNO_3 concentrations.

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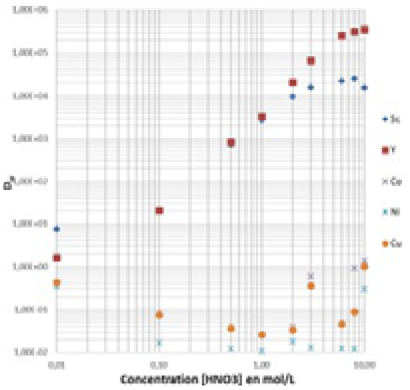
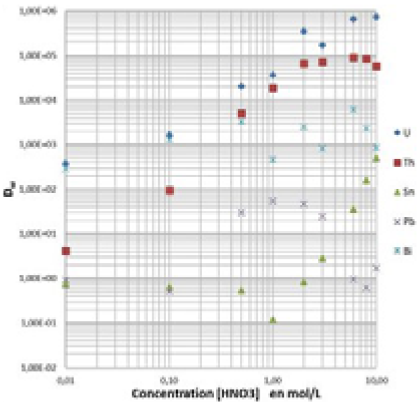


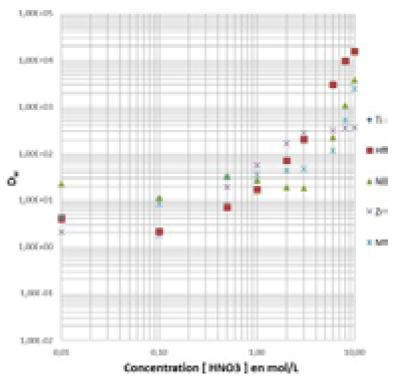
D_W values of selected elements on TK222 in HNO_3

Y and Sc are very well retained at elevated HNO_3 concentrations, while Co, Ni and Cu are not retained.



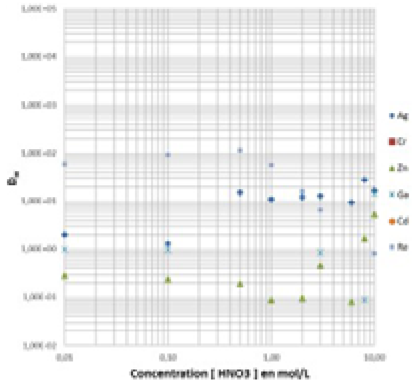
D_W values of selected elements on TK222 in HNO_3

U and Th are very well retained from elevated HNO_3 concentrations. Bi, too is well retained, to a lesser extent than U and Th though. Sn shows some retention at elevated HNO_3. Pb is generally only rather weakly retained with a maximum between 0.5 and 3M HNO_3.



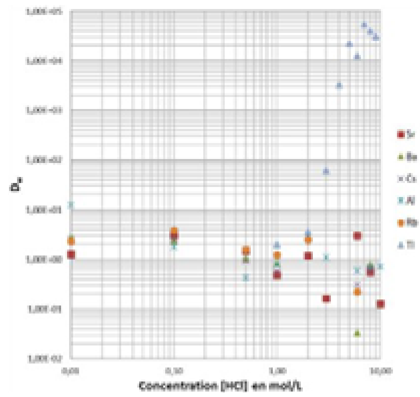
D_W values of selected elements on TK222 in HNO_3

Elements of higher valency such as Hf, Zr, Nb and Mo are well retained from HNO_3 of high concentration.



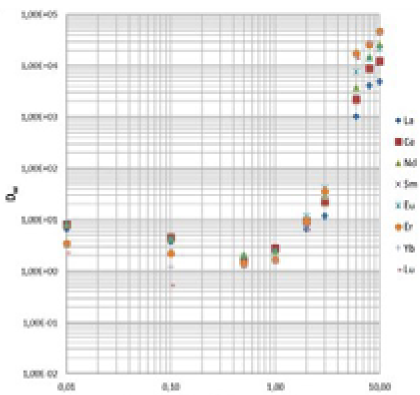
D_W values of selected elements on TK222 in HNO_3

None of the shown elements show significant retention on TK222 from HNO_3.



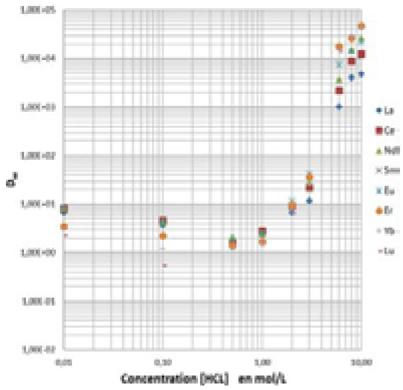
D_W values of selected elements on TK222 in HCl

Out of the shown elements only Tl is well retained at high HCl concentrations.



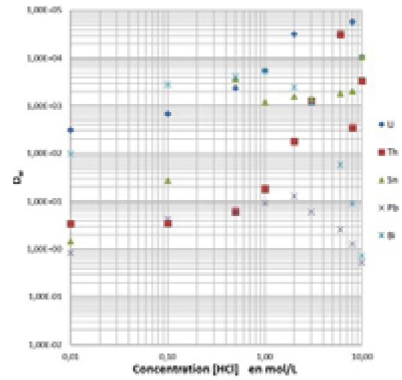
D_W values of selected elements on TK222 in HCl

Lanthanides are strongly retained at high HCl concentrations (≥ 6M) for example. As for HNO_3 this is an important information with respect to the separation of lanthanides from Ac.



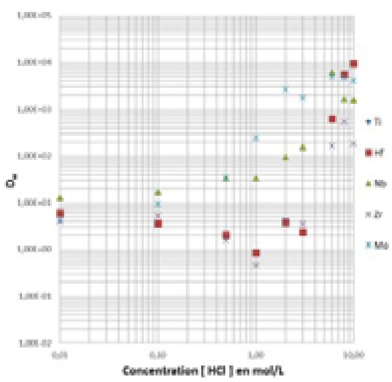
D_W values of selected elements on TK222 in HCl

Like the Lanthanides Y and Sc are very well retained at high HCl concentrations. Co, Ni and Cu are not or only weakly retained.



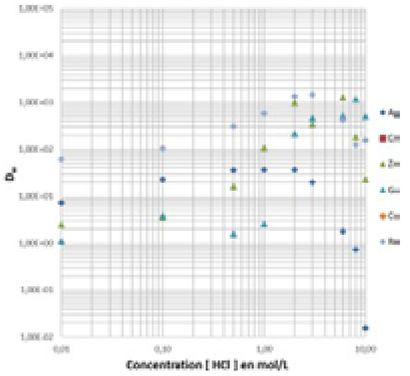
D_W values of selected elements on TK222 in HCl

U, Th and Sn show strong increase of D_W values with increasing HCl concentrations. Pb is only very weakly retained from HCl. Bi is well retained between 0.1M and 2M HCl, its retention then sharply drops with increasing HCl concentration. 10M HCl may e.g. be used to elute Bi from the TK222.



D_W values of selected elements on TK222 in HCl

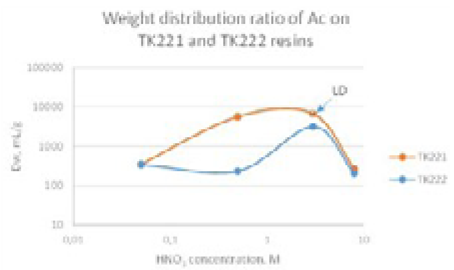
Like for HNO_3, elements of higher valency like Mo, Nb, Zr and Hf are well retained at high acid concentrations.



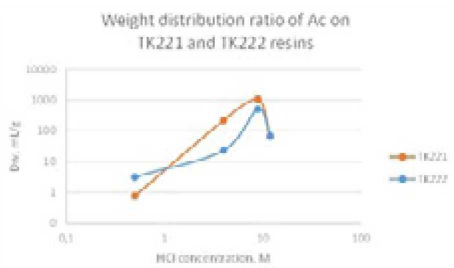
D_W values of selected elements on TK221 and TK222 in HCl

At elevated HCl concentrations Zn and Ga are quite well retained, while the other elements shown are not retained.

The following graphs show the behavior of Ac on TK221 and TK222 (data courtesy of Nora Vajda, RadAnal, all obtained via LSC).



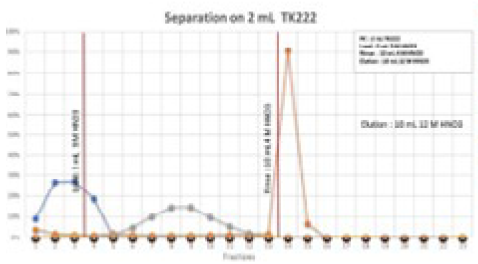
D_W values of Ac on TK221 and TK222 in HNO_3 (data courtesy of N. Vajda, Radanal)



D_W values of Ac on TK221 and TK222 in HNO_3 (data courtesy of N. Vajda, Radanal)

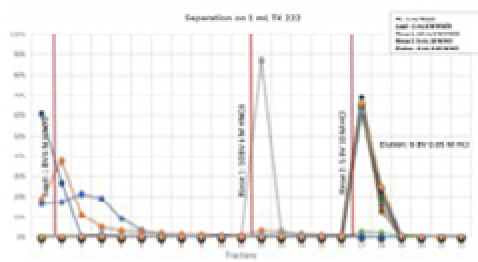
These graphs compare D_W values for Ac on TK221 and TK222 from HNO_3 and HCl. As can be seen TK221 retains Ac significantly stronger than the TK222 Resin. The latter is, on the other hand, easier to elute. Both show rather low D_W values at very high HCl concentrations (> 10M), this should, with respect to the resin's selectivity for lanthanides, allow for the separation of Ac from the lanthanides. Elution in HNO_3 will require significantly higher HNO_3 concentrations (≥ 12M HNO_3) to elute Ac.

The elution studies below were performed with stable elements and ICP-MS measurements.



Elution study, 2 mL TK222 cartridge, 1 BV fractions, various elements.

Ba (the same should be true for Ra) and Pb are removed at elevated HNO_3 concentrations (2 – 4M HNO_3), for Sr elution even higher HNO_3 concentrations are required (here 12M HNO_3). Under these conditions lanthanides, U and Th remain retained on TK222 Resin, while Ac is expected to elute which should result in a suitable separation of Ac from these elements.



Elution study, 2 mL TK222 cartridge, 1 BV fractions, various elements.

When loading the TK222 Resin from 6M HNO_3, followed by a rinse with the same acid, Pb, Ba and Sr are removed. Bi may then be removed using 10M HCl. As can be seen, under the usual Ac elution conditions (0.05M HCl) lanthanides would co-elute, accordingly they need to be removed as described before via the Ac elution from TK222 (or TK221) in very high HNO_3.

Application :

- Ac purification
- Lu-177 purification

TK225 Resin

The TK225 Resin is based on a mixture of a diglocylamide and an ionic liquid. The organic phase is impregnated onto an inert support containing aromatic groups for increased stability against radiolysis.

The main application of the TK225 Resin is the removal of radiolanthanides from acidic solutions, particularly from solutions of elevated HNO_3 concentration, for decontamination purposes.

Graphs 1 – 6 show the selectivity of the TK225 Resin for a wide range of elements in HNO_3 (fig. 1 – 3) and HCl (fig. 4 – 6). All D_W shown in these graphs were obtained through ICP-MS measurements.

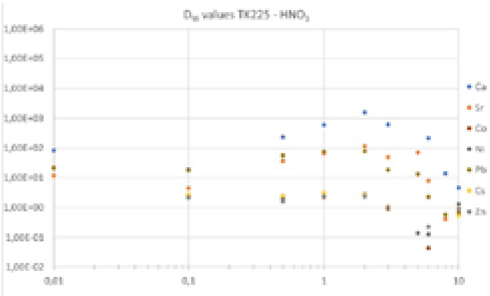


Figure 1: D_W values of selected elements on TK225 in HNO_3

Out of the tested elements only Ca is quite strongly retained at elevated HNO_3 concentrations. Sr and Pb, too are retained under these conditions to a lesser extent though.

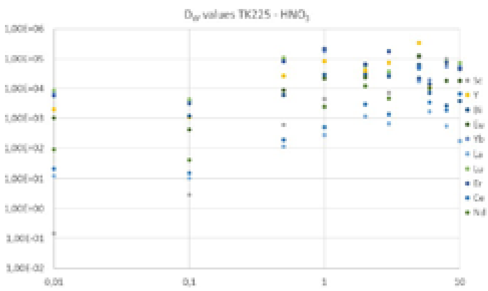


Figure 2: D_w values of selected elements on TK225 in HNO_3

Lanthanides, especially heavy lanthanides, Y and Sc are very strongly retained from HNO_3 of elevated concentration. Especially for heavy lanthanides the D_W values remain very high, even at low HNO_3 concentrations.

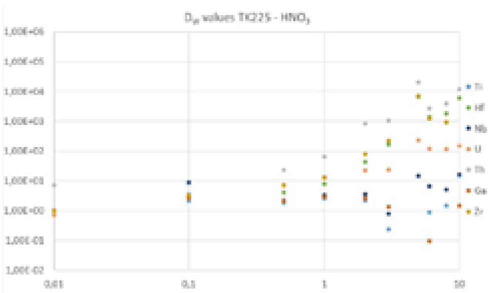


Figure 3: D_W values of selected elements on TK225 in HNO_3

The TK225 Resin generally retains tetravalent elements such as Zr, Hf and Th at elevated HNO_3 concentrations quite strongly.

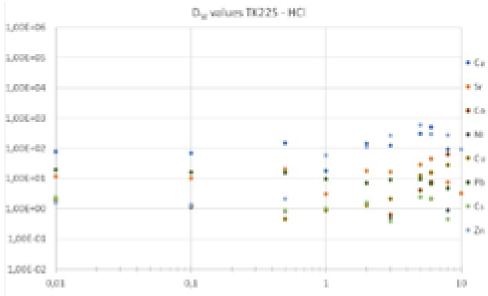


Figure 4: D_W values of selected elements on TK225 in HCl

The TK225 Resin shows elevated retention of Ca and Zn at high HCl concentrations. Other elements shown are not or only very weakly retained.

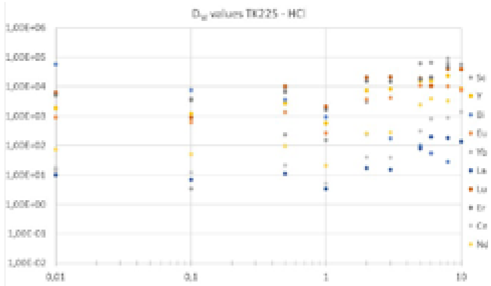


Figure 5: D_w values of selected elements on TK225 in HCl

Especially heavy lanthanides are well retained over a broad HCl concentration range, with highest retention being observed at high HCl concentrations. At high HCl concentrations Y, Sc and lighter lanthanides are well retained, too.

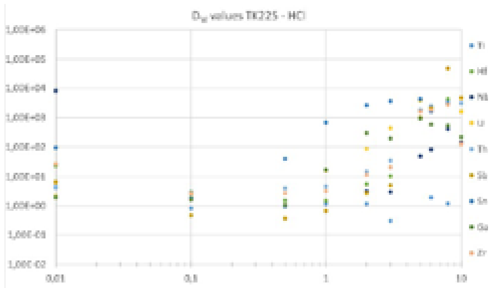


Figure 6: D_W values of selected elements on TK225 in HCl

Higher valent elements such as Sb, Sn, Zr and U are well retained at high HCl concentrations, while showing very little retention at low HCl concentrations.

TK225 Resin is mainly used for the removal of radiolanthanides, especially heavy radiolanthanides such as Lu-177, Yb-175, Tb-161,… from acidic solutions.

Especially the heavy lanthanides are near impossible to elute, accordingly the resin is mainly suitable for the decontamination of acidic effluents and waste solutions.

• News

• Our new **CU Sheets** will be commercially available in September. For more information please see here: *https://www.triskem-international.com/scripts/files/63cc0785685f67.88384488/terachem-poster-20220909.pdf*

• The **TK-SrScint Resin** will be available later this year for more information see the last page of this newsletter

• ***Discs:***
As you might know, we are currently developing a new range of impregnated membrane filters. One of the applications we are working on is the determination and identification of alpha emitters in aqueous samples after filtration through one of these filters, followed by direct measurement of the impregnated filter by alpha spectrometry.

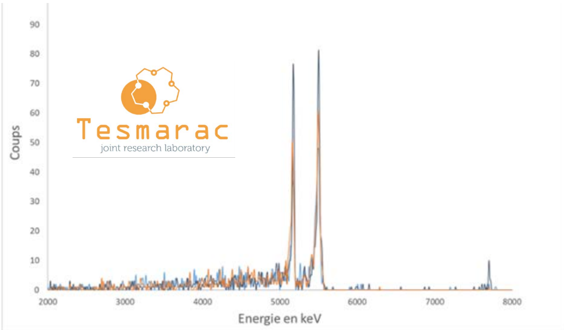


Figure 1: Alpha spectrum, Am-241 & Pu-239, ~50mBq each, data courtesy of C. Bailly and G. Montavon (Subatech, France)

• ***TK200 & TK221 Resins:***
As you might have noticed, TK200 and TK221 are increasingly finding use in actinide separation chemistry. If you would like to know more, the following publications might be of interest for you:

Zhongtang Wang, Zhaoya Huang, Yun Xie, et aL. Method for determination of Pu isotopes in soil and sediment samples by inductively coupled plasma mass spectrometry after simple chemical separation using TK200 resin, Analytica Chimica Acta, 1090, 2019, 151-158,
www.sciencedirect.com/science/article/pii/S000326701931030X

Zhao Huang, Xiaolin Hou, Xue Zhao, Rapid and Simultaneous Determination of 238Pu, 239Pu, 240Pu, and 241Pu in Samples with High-Level Uranium Using ICP-MS/MS and Extraction Chromatography, Anal. Chem. 2023, 95, 34, 12931–12939, *https://doi.org/10.1021/acs.analchem.3c02526*

Papp, I., Vajda, N. & Happel, S., An improved rapid method for the determination of actinides in water. J Radioanal Nucl Chem 331, 3835–3846 (2022).
https://doi.org/10.1007/s10967-022-08389-9

Ling Zhang, Emilia Vassileva, Determination of ultra-trace level 241Am in marine sediment and seawater by combining TK200-TK221 tandem-column extraction chromatography and SF ICP-MS, Talanta, 271, 2024, 125724,
https://doi.org/10.1016/j.talanta.2024.125724

Youyi Ni, Wenting Bu, Ke Xiong, Sheng Hu, Chuting Yang, Liguo Cao. A novel strategy for Pu determination in water samples by automated separation in combination with direct ICP-MS/MS measurement, Talanta, 262, 2023, 124710,
https://doi.org/10.1016/j.talanta.2023.124710

• Agenda

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

• 10th International Conference on Nuclear- and Radiochemistry (NRC10), August 25 – 30, Brighton (UK)
https://www.rsc.org/events/detail/38385/10th-international-conference-on-nuclear-and-radiochemistry-nrc10

• 19th International Workshop on Targetry and Target Chemistry (WTTC 19), August 25 – 30, Heidelberg (Germany)
https://www.dkfz.de/en/Radiopharmazeutika-Praeklinische-Studien/WTTC19_welcome.html

• Prismap Radiolanthanides Workshop, September 03 – 05, Villigen – PSI (Switzerland) *https://indico.psi.ch/event/15961/page/2872-scope*

• RadWorkshop 2024, September 09 – 13, Riso (Denmark)
https://www.conferencemanager.dk/radworkshop2024

• 3rd Global Meeting COST-NOAR, October 01 – 03, Nantes (France)
https://astatine-net.eu/events/cost-third-global-meeting-from-1-to-3-october-2024-in-nantes/

• "Tumor targeting, Imaging, Radiotherapies" Workshop, October 09 – 12, Erquy (France) *https://www.cgo-workshop-vecto.fr/*

• 37th Congress o the European Association of Nuclear Medicine, October 19 – 23, Hamburg (Germany) *https://eanm24.eanm.org/*

• 67th Annual Radiobioassay and Radiochemical Measurements Conference (RRMC), October 21 – 25, Purdue University, West Lafayette, IN (USA) *https://www.rrmc.co/*

• 6th International Conference on Radioecology & Environmental Radioactivity (ICRER), November 24 – 29, Marseille (France) *https://www.icrer2024.org/en/*

You'll find an update on our participations to conferences on our website : https://www.triskem-international.com/ma/ events

COMING SOON : TK-SrScint

Plastic Scintillation microspheres (PSm) impregnated with a selective extractant Developed by Tarancón & Bagán at Universitat de Barcelona

- Based on **SR Resin** crownether and fluorinated alcohol used in TK102 Resin
- Selectivity similar to **SR** and **TK102 Resin**

Available as ready-to-use 2mL cartridges:

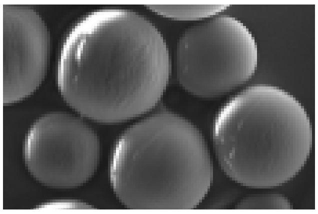
- Compatible with vacuum boxes
- Facile automatization

Direct measurement of cartridges :

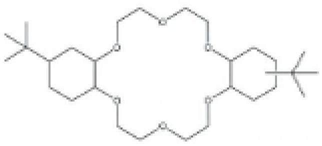
- No elution/addition of LSC Cocktails
- Detection efficiency:
  - t=0 > 85%[*]
  - t=28 days > 185%[*]
- Tested on milk[+] and riverwater samples[*]
- Sr yield ≥ 85%, deviation: < ±10%

Advantages:

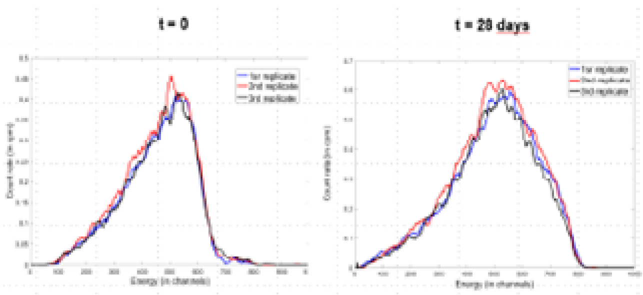
- Less hands-on time
- Faster turn around time
- Less radioactively contaminated waste
- No mixed wastes



TK-SrScint Resin



4,4'(5')-di-t-butylcyclohexano-18-crown-6



Sr-90 spectra on TK-SrScint at t=0 (after Sr-90/Y-90 separation) and after 28 days (Y-90 ingrown), measured on a 300SL (Hidex)

Application :

- Sr-90 determination in environmental and decommissioning samples

Literature

- Baudat, E., Gautier, C., Bagán, H. et al. Optimization of a new radiochemical method based on extraction chromatographic resins and plastic scintillation for measurement of 90Sr in nuclear waste. J Radioanal Nucl Chem. *https://doi.org/10.1007/ s10967-024-09396-8. 2024*

- *I. Giménez, J. Rotger, E. Apellániz, H. Bagán, J. Tent, A. Rigol, A. Tarancón. A new method based on selective fluorescent polymers (PSresin) for the analysis of 90Sr in presence of 210Pb in environmental samples. Applied Radiation and Isotopes, Volume 199, 110879. *https://doi.org/10.1016/j.apradiso.2023.110879. 2023.*

- [+]Marina Sáez-Muñoz, M.; Bagán, H.; Tarancón, A.; García, J.F.; Ortiz, J.; Carlos, S.; Martorell, S. Rapid methods for radiostrontium determination in aerosol filters and vegetation in emergency situations using PS resin . Journal of Radioanalytical and Nuclear Chemistry, 322:1397-1408. *https://doi.org/10.1007/s10967-019-06779-0. 2019.*

- Marina Sáez-Muñoz, M.; Bagán, H.; Tarancón, A.; García, J.F.; Ortiz, J.; Martorell, S. Rapid method for radiostrontium determination in milk in emergency situations using PS resin. Journal of Radioanalytical and Nuclear Chemistry. 315, 543–555. 2018

- H. Bagán, A. Tarancón, G. Rauret, J.F. García. Radiostrontium separation and measurement in a single step using plastic scintillators plus selective extractants. Application to aqueous sample analysis. Analytica Chimica Acta, 686, 1-2, 50-56. 2011.

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