PRODUCT SHEET

TK-TcScint

Main Applications

- Separation and LSC measurement of technetium

Packing

Order N°.	Form	Particle size
TCSC-R10-P	10 2mL TK-TcScint Resin cartridges	60 µm

Also available as bulk resin, please contact us for more information.

Physical and chemical properties

Density: 0.59 g/mL TK-TcScint Resin

Conditions of utilization

Recommended T of utilization : 20-25°C

Storage: Dry and dark, T<25°C

TRISKEM INTERNATIONAL
ZAC de l'Eperon – 3, rue des Champs Géons – 35170 Bruz – FRANCE
Tel +33 (0)2.99.05.00.09 – Fax +33 (0)2.23.45.93.19 – www.triskem.com – email : contact@triskem.fr
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TRISKEM
Expertise in Separation Chemistry

PRODUCT SHEET

TK-TcScint

The TK-TcScint Resin is the first of a range of resins based on "Impregnated Plastic Scintillation microspheres" developed by García, Tarancón and Bagán at the University of Barcelona[1-5].
This range of new products will be comprised of plastic scintillation microsphere (PSm), supplied by the group at the University of Barcelona, that are impregnated with selective extractants.
The TK-**Tc**Scint Resin is, as the name indicates, mainly dedicated to the quantification of **Tc**-99. The extractant used in its fabrication is Aliquat336, it further contains small amounts of a long-chained alcohol. Accordingly, its selectivity will generally be very similar to the TEVA Resin.

Figure 1 (a and b) show SEM pictures of the non-impregnated PSm, and the impregnated microspheres (TK-TcScint), respectively.

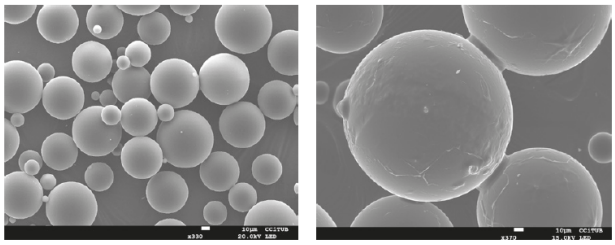

Figure 1 (a and b): left - non-impregnated plastic scintillation microspheres (PSm), right - impregnated PSm (TK-TcScint). Taken from [4]

The TK-TcScint is generally employed as pre-packed 2 mL cartridges for use with vacuum box systems, or automized separation equipments based on pump systems[1, 5].

The PSm support employed in the TK-TcScint Resin is itself acting as scintillating medium, this allows for a direct measurement of the Tc-99 retained on the cartridge, no elution and mixing of the eluate with a liquid scintillation cocktail is necessary.
This has a number of advantages:

- Gain of time which is particularly interesting in emergency situations
- No mixed liquid radioactive waste
- No Tc elution with HNO_3 of elevated concentration and no evaporation / aliquoting of the eluate
- No cutting of columns or cartridges to push the resin into LSC vials

Especially the latter two points are interesting in terms of radiation protection when samples of elevated activity are being analyzed.

Ideally the chemical yield is determined via ICP-MS or ICP-OES using Re as internal standard.

Fig. 2 compares this new approach based on impregnated PSm Resins such as the TK-TcScint with classical methods.

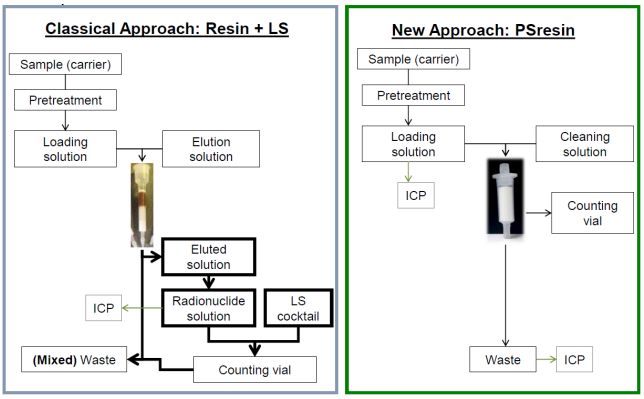

Figure 2 : Overview classical radioanalytical method and PS Resin approach. Taken from [5]

In order to easily handle and avoid contaminating the LSC counter the cartridges should be placed in a standard 20 mL LSC vial for its measurement.

Typical samples analysed include urine and various types of water sample. In case of surface water samples generally a breakthrough volume of > 200 mL can be achieved using 2 mL cartridges, making this technique not only interesting in emergency situations or as screening tool in decommissioning, but also for use in routine biomedical or environmental monitoring. For water samples the chemical yield is generally >98.8%.

The detection efficiency for Tc-99 obtained with the TK-TcScint is very high, in the order of 89.5(0.6)%, while the background of the standard 2 mL cartridges is low with ~1.09 CPM (obtained in Quantulus™ detector in the high-energy and low-coincident bias configuration).
Further the TK-TcScint cartridges show reproducibly low quench with a mean SQP(E) of 787(7).
Figure 3 shows typically obtained Tc-99 spectra, as can be seen spectra obtained for three replicates match very well.

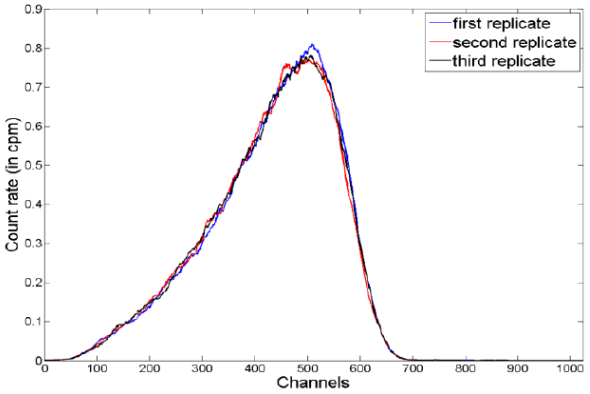

Figure 3: Liquid Scintillation Spectrum of Tc-99 on TK-TcScint. Taken from [5]

The analysis of water samples such as e.g. river and sea water (typically 50 mL) using TK-TcScint cartridges is rather straightforward [1, 5].
After filtration, if necessary, samples are heated to 90°C for 60 min after addition of a few mL of 30% H_2O_2 to assure that Tc is present as pertechnetate. The solutions are then adjusted to 0.1M HCl using conc. HCl. Once the samples reach room temperature, they are ready for separation.
After loading of the sample the cartridge is typically rinsed successively with 0.1M HCl, 0.1M HNO_3/0.1M HF (only necessary in case Th is expected to be present) and finally water.
These rinses allow eliminating possible interferences while Tc (and the internal standard Re) remain on the cartridge. Load and rinse fractions are combined and analysed for Re content to allow calculating the chemical yield of the separation. The TK-TcScint cartridge can then be directly counted on an LSC counter.
The authors found very good match between expected and measured activities, for the spiked water samples as well as for two spiked MAPEP samples[1].

Using 50 mL samples and 180 min counting time allowed the authors obtaining a limit of detection of 0.15 $Bq.L^{-1}$.

As could further be shown by the authors, this method can easily be automized. In their case they developed their own separation unit called OPENVIEW-AMSS, a modular, vacuum box based equipment. They could show that both, manual and automized separations allow for obtaining high chemical yields and detection efficiencies, no significant differences were observed when analysing samples in parallel. However, with respect to hands-on time and radiation protection automatization provides significant advantages.

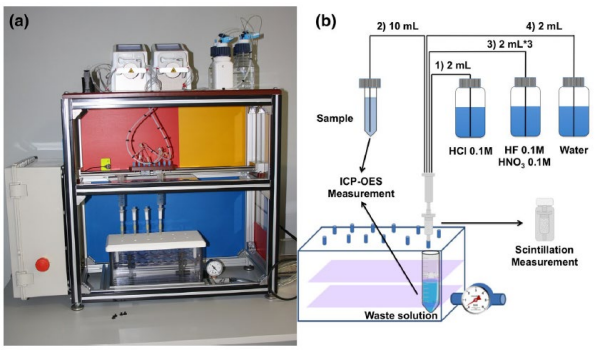

Figure 4: OPENVIEW-AMSS system and scheme of a typical separation of water samples. Taken from [1].

Further to the unit developed by the authors the TK-TcScint cartridges are also compatible with commercially available equipment such as the Hidex Q-Are 100[4].

Besides water samples urine samples were also analysed using TK-TcScint cartridges[5].
With respect to their higher matrix load this kind of samples requires a thorough sample pre-treatment. The described method is based on 100 mL urine samples that are first wet-ashed using conc. HNO_3, followed by an additional ashing step in a muffle furnace at 550°C.
The obtained ash is then dissolved in 3 mL of conc. HNO_3 and diluted to 100mL using deionized water. To assure Tc is present as pertechnetate the solutions are heated, after addition of a few mL hydrogen peroxide, to 90°C for 60min. As described before, Re was used as internal standard.
By analysing spiked urine samples the authors could show that accurate results can be obtained using the impregnated PSm approach. A minimum detectable activity (MDA) of 0.036 $Bq.L^{-1}$ for 100mL samples and 24h counting was reported.

Further to the analysis of Tc-99, PSm Bagán et al.[6] showed that Aliquat 336 impregnated resins may also be used for the analysis of $[^{14}C]SCN^-$ used as radiotracer for study of oil reservoir dynamics.

With respect to the selectivity of the Aliquat extracant, the compound giving TEVA Resin[7] its selectivity, a use of the TK-TcScint cartridges for the screening of other radioelements such as e.g. Pu isotopes or Po-210 seems well possible.

Bibliography

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(2) Barrera et al. ”A new plastic scintillation resin for single-step separation, concentration and measurement of technetium-99” Analytica Chimica Acta 936 (2016) 259-266. https://doi.org/10.1016/j.aca.2016.07.008

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(6) H. Bagán et al. “Determination of oil reservoir radiotracer ($S^{14}CN^-$) in a single step using a plastic scintillator extractive resin”, Analytica Chimica Acta, 736, 2012, 30-35, https://doi.org/10.1016/j.aca.2012.05.045

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