Characterization of new crown-ether containing TK102 Resin for the separation of Sr, Pb and Ba/Ra

Illarion Dovhy*[1], Marine Bas[1], Soumaya Khalfallah[1], Nora Vajda[2], Steffen Happel[1]

[1]Triskem International, 3 rue des champs Geons, ZAC de l'Eperon, 35170 Bruz, France

[2]RADANAL Ltd., Konkoly-Thege Miklós út 29-33, 1121 Budapest, Hungary

TRISKEM
Expertise in Separation Chemistry

Determination of D_w values

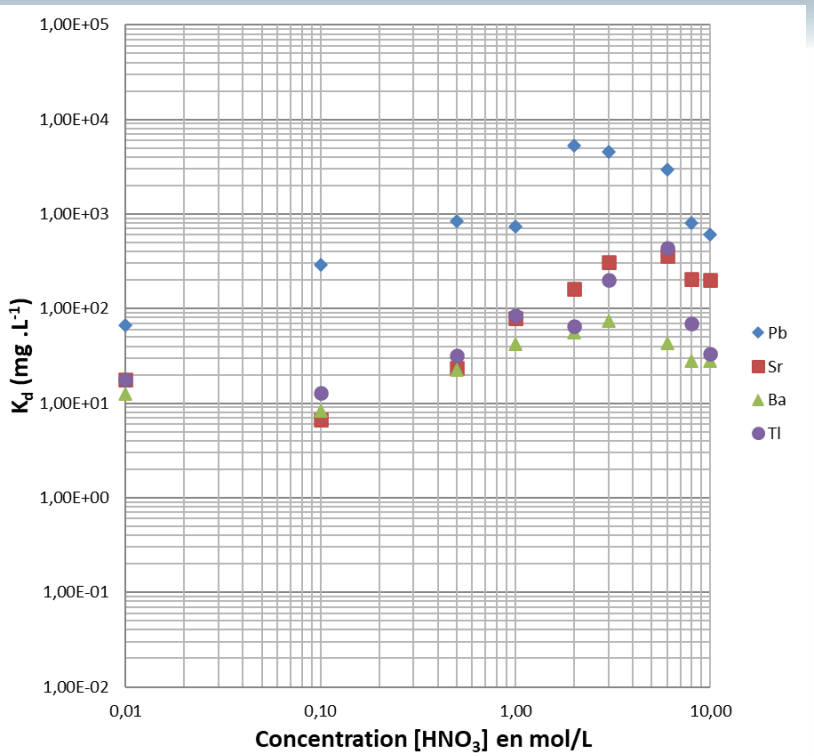


Fig. 1: Distribution coefficients of selected elements on TK102 Resin in HNO_3

► Sr, Ba, Pb and Tl show high D_w in HNO_3

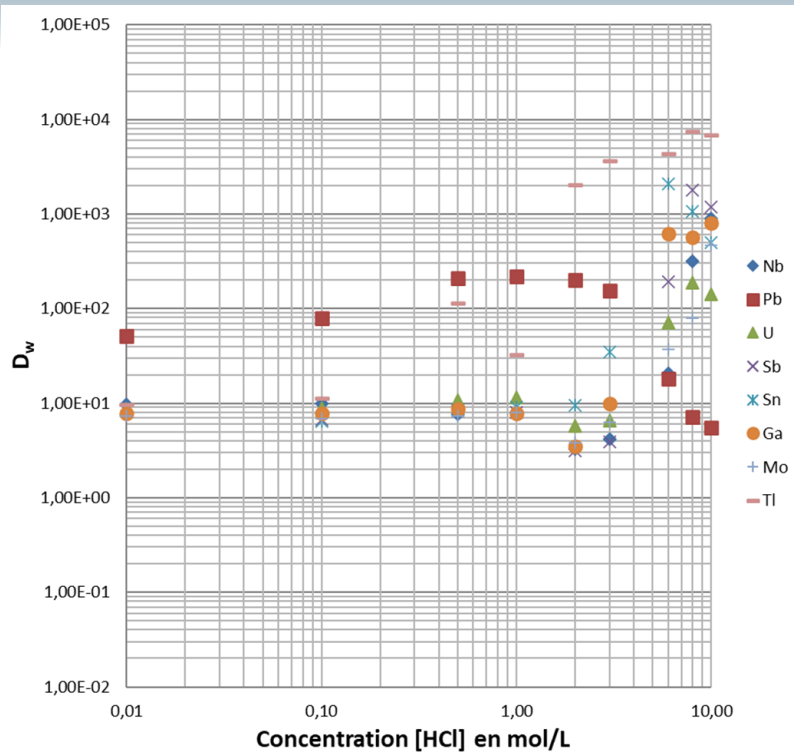


Fig. 2: Distribution coefficients of selected elements on TK102 Resin in HCl

► Pb, Tl, Sn, Sb, Ga show hight D_w in HCl

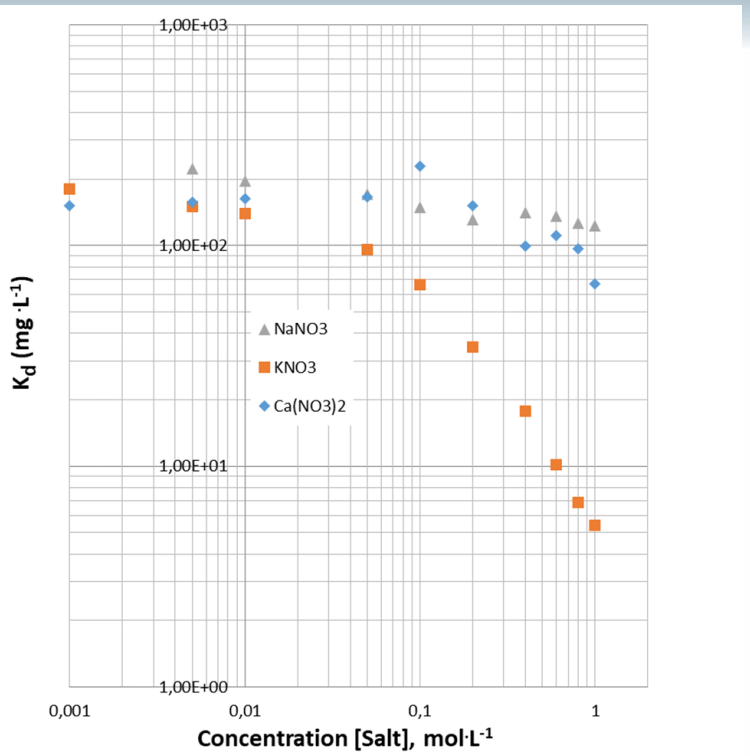


Fig. 3: Distribution coefficients of Sr on TK102 Resin in 3 M HNO_3 in the presence of different salts

► D_w Sr decreases by 30% with $NaNO_3$ up to 1 M,

► no effect of KNO_3 and $Ca(NO_3)_2$ up to 0,05 M.

Determination of capacity (column experiment)

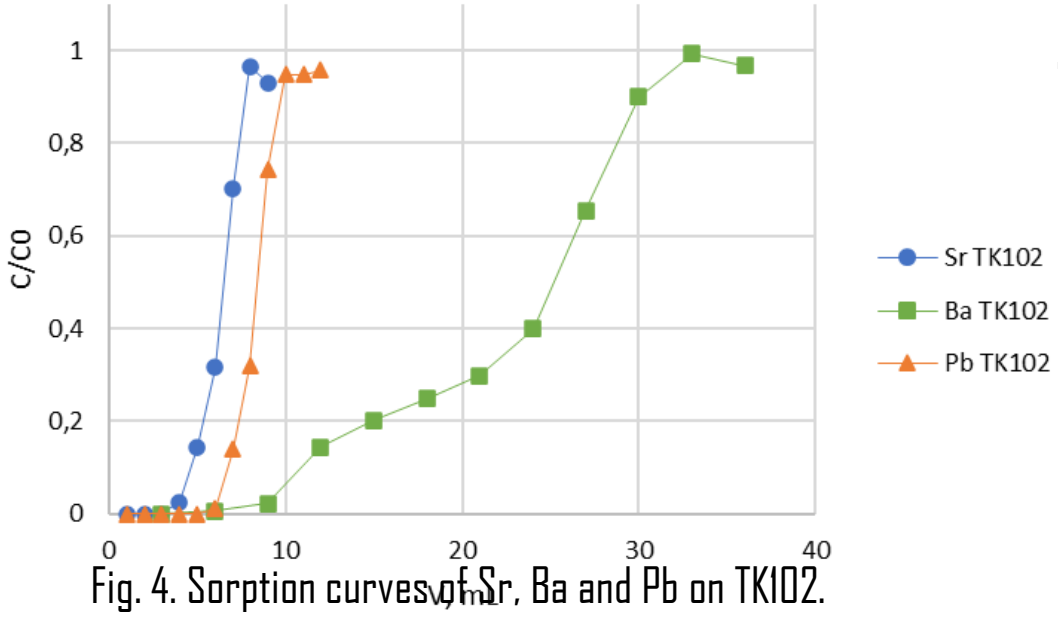


Fig. 4. Sorption curves of Sr, Ba and Pb on TK102.

Table 1 TK102 capacities for Sr, Ba, Pb in 3 M HNO_3 from results of different experiments.

Element	Capacity in column experiment, mg/g	DEC, mg/g	TDEC, mg/g	Langmuir maximum capacity, mg/g	Maximum theoretical capacity, mg/g
Sr	41.6	27.2	40.9	39.7	45.5
Ba	12.8	6.7	19.9	*	70.8
Pb	94.1	74.3	97.2	98.0	106.9

* – cannot be determined under the conditions studied due to limitations in the solubility of $Ba(NO_3)_2$ in HNO_3.

Determination of capacity (Langmier isotherm)

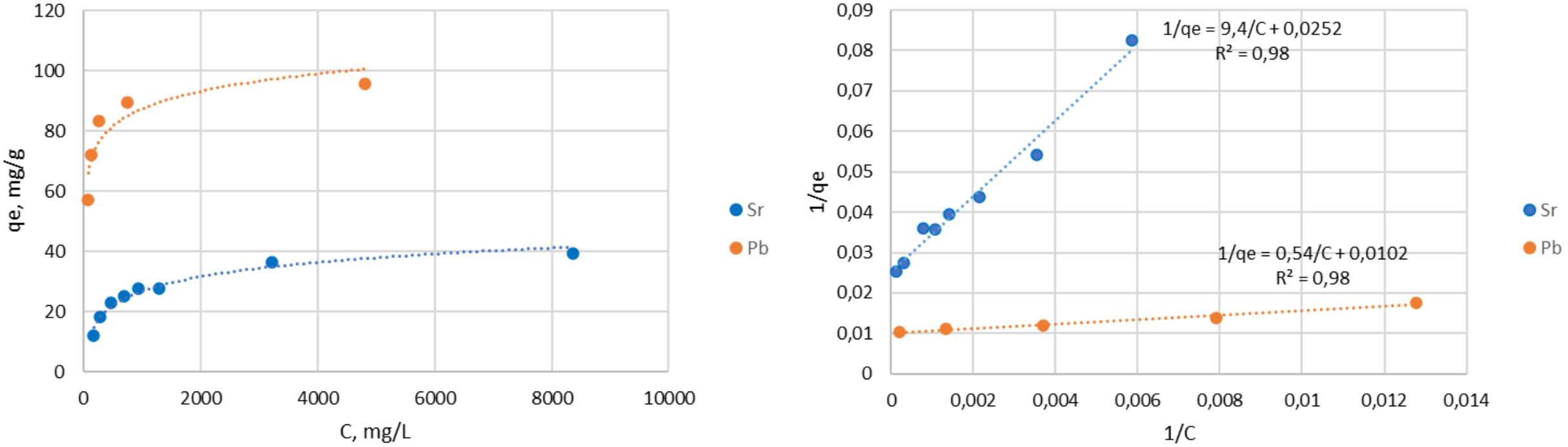
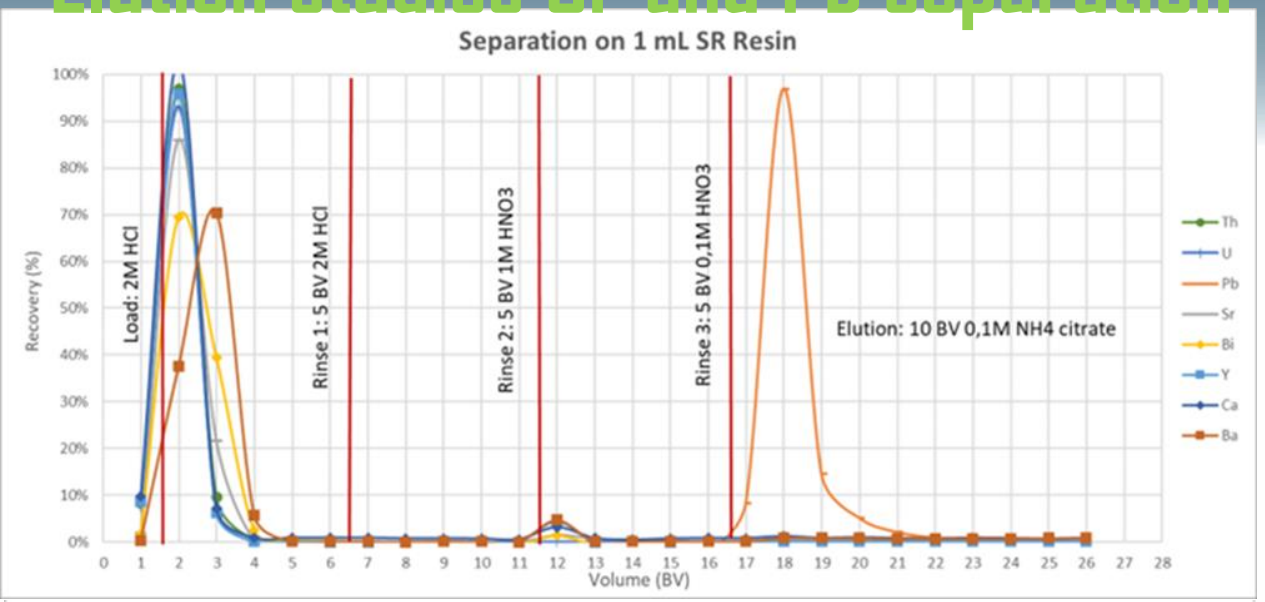
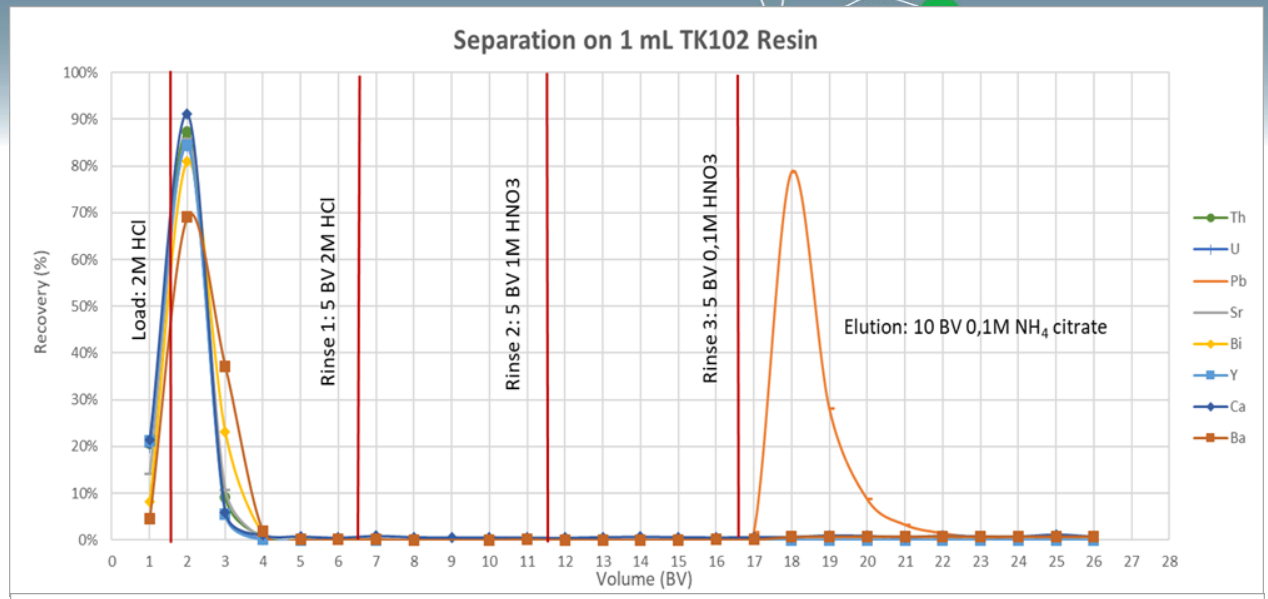


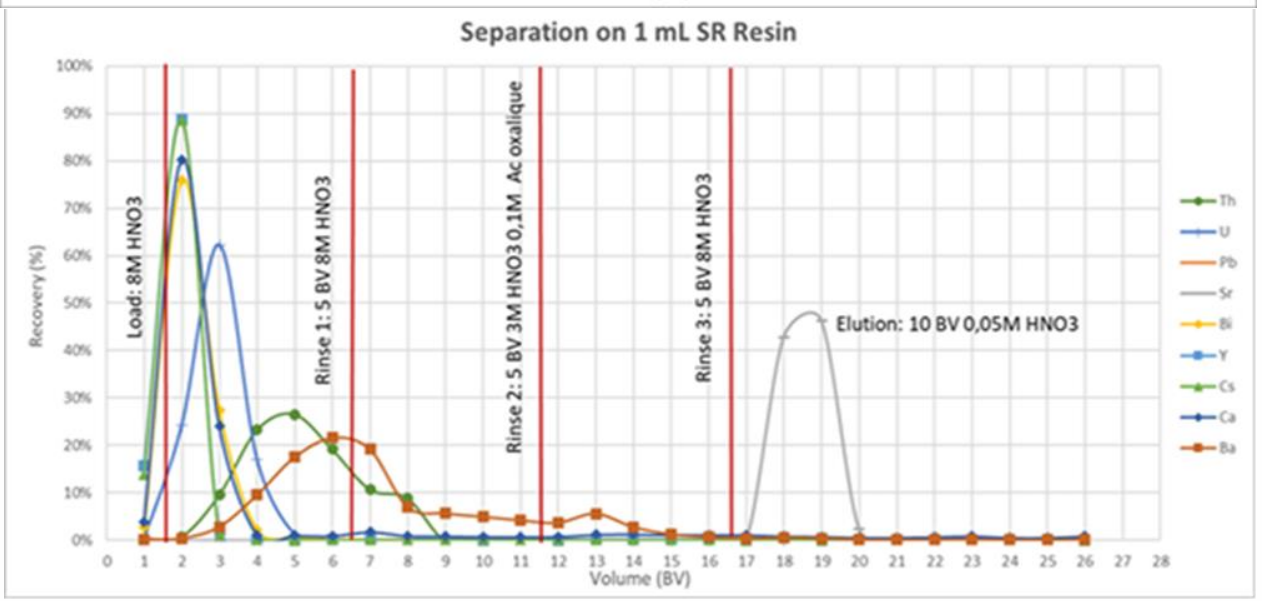
Fig. 5. Sr sorption isotherms with TK102: q_e – C plot (a), linearized in coordinates: $1/q_e$ – 1 / C plot (b),

$$\frac{1}{q_e} = \frac{1}{K_L \cdot q_m \cdot C_e} + \frac{1}{q_m}$$

Elution studies Sr and Pb separation







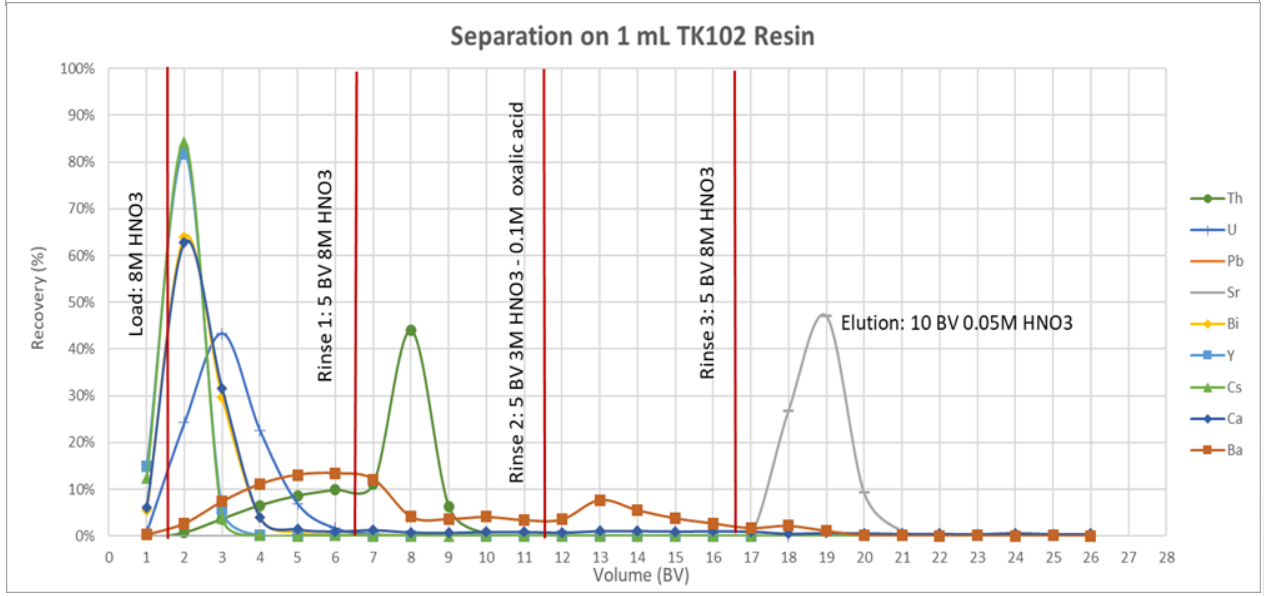
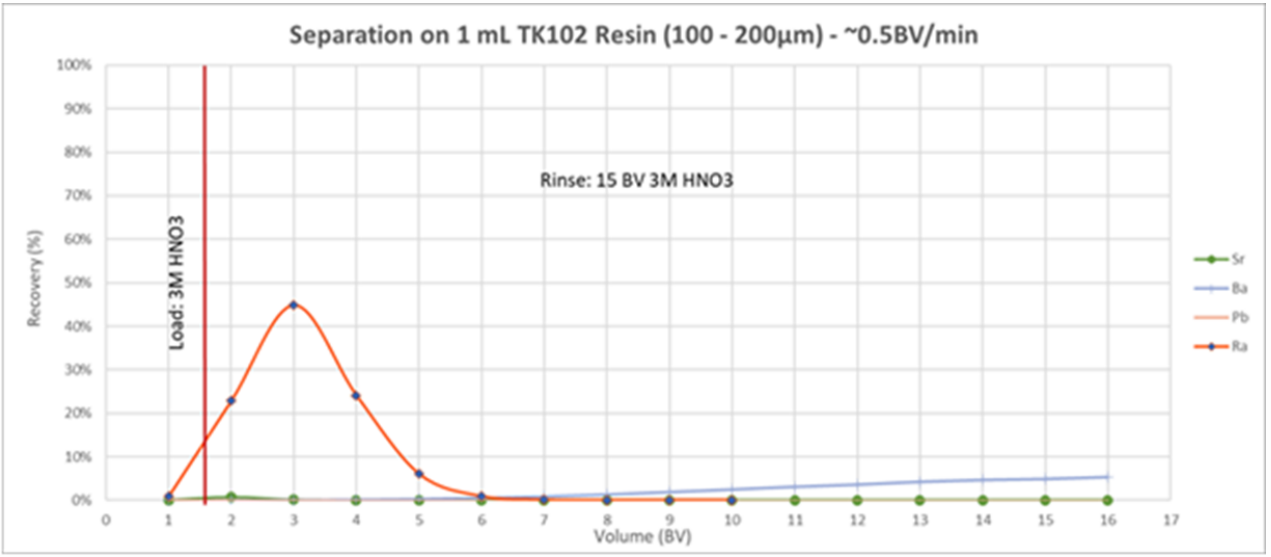


Fig. 6: Comparative elution study, SR Resin vs TK102 Resin, Sr separation conditions,1 mL columns at gravimetrical flow.

► For both resins a clean Sr separation could be obtained

Elution studies Ba and Ra separation



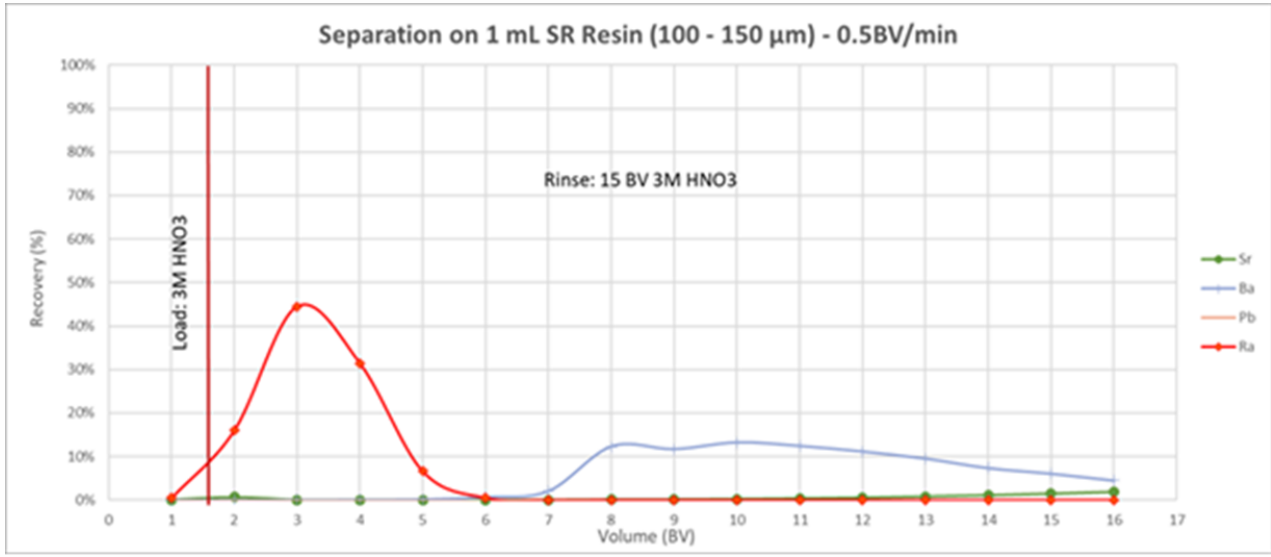


Fig. 7: Ra separation on 1 mL TK102 Resin (above) and Sr Resin (below).
Load and rinse: 3M HNO_3

► TK102 Resin shows higher Ba retention compared to SR Resin. Ra is rapidly eluted from both resin.

Conclusions

The new TK102 Resin shows promise for use in the radioanalytical determination of ^{90}Sr, ^{210}Pb and other radionuclides such as ^{226}Ra in environmental, decommissioning and waste samples.

- It has up to near 50% higher Sr distribution coefficients than SR Resin in HNO_3, and high dynamic capacity for Sr (>40 $mg \cdot g^{-1}$) and Pb (>90 $mg \cdot g^{-1}$).

- It further allows improved Ba removal from Ra compared to SR Resin.

- Due to the higher hydrophobicity of the diluent employed in the TK102 Resin it shows significantly (more than 10 times) less bleeding of organic material (measured as NPOC) than the SR Resin.