

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

Illarion Dovhy*¹, Marine Bas¹, Soumaya Khalfallah¹, Nora Vajda², Steffen Happel¹

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

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

Introduction

Rapid and accurate low-level measurement of ⁹⁰Sr, ²¹⁰Pb and ²²⁶Ra activities in environmental, decommissioning and waste samples remain a challenge for analytical laboratories, accordingly there is elevated interest in improving separation materials and methods. The purpose of this work is to characterize a new extraction-chromatographic resin based on 4,4'(5')-di-t-butylcyclohexano-18-crown-6 dissolved in a fluorinated alcohol (TK102 Resin) with respect to its selectivity, extractant bleeding and capacity, and to evaluate its suitability in this context.

Weight distribution ratios (D_w values) of a range of elements on TK102 Resin were determined experimentally using multicomponent solutions of varying HNO₃ and HCl concentrations. The influence of increasing amounts of Ca, Na and K on Sr retention from 3M HNO₃ was also determined.

Based on the obtained D_w values several elution studies were performed with the aim of evaluating the separation performance of the TK102 Resin.

Determination of D_w values

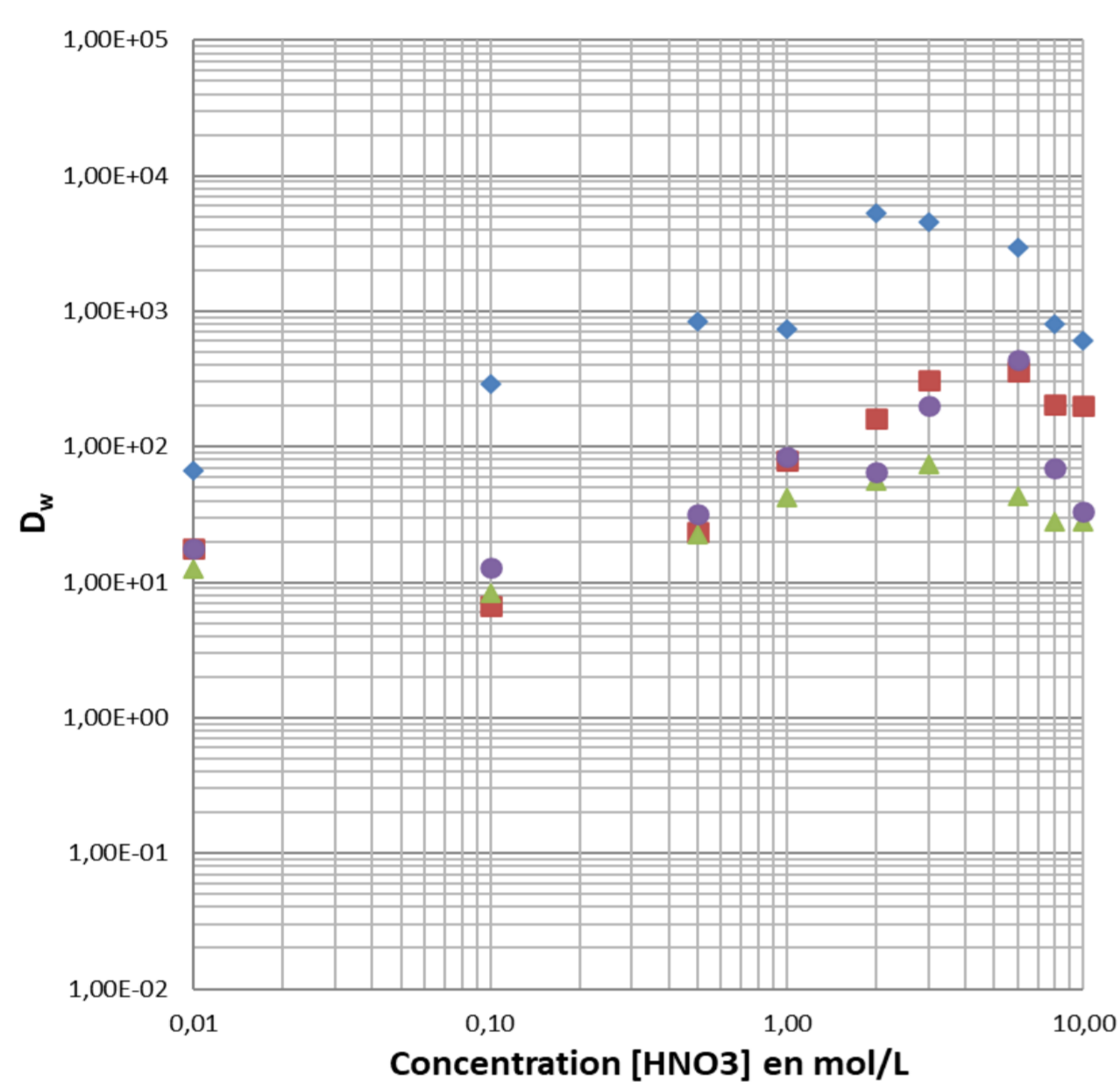


Fig. 1: Distribution coefficients of selected elements on TK102 Resin in HNO₃

► Sr, Ba, Pb and TI show high D_w in HNO₃

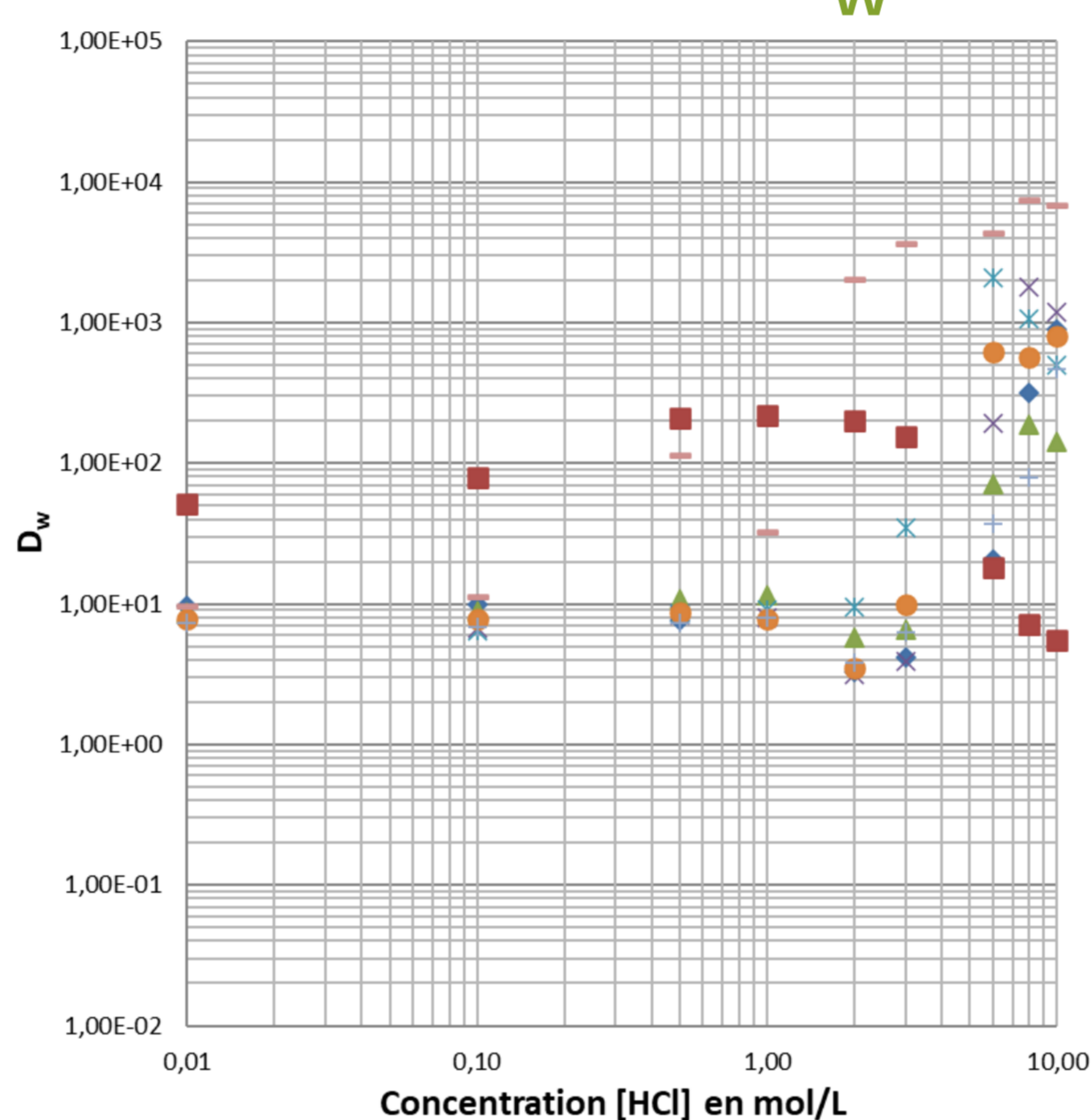


Fig. 2: Distribution coefficients of selected elements on TK102 Resin in HCl

► Pb, TI, Sn, Sb, Ga show high D_w in HCl

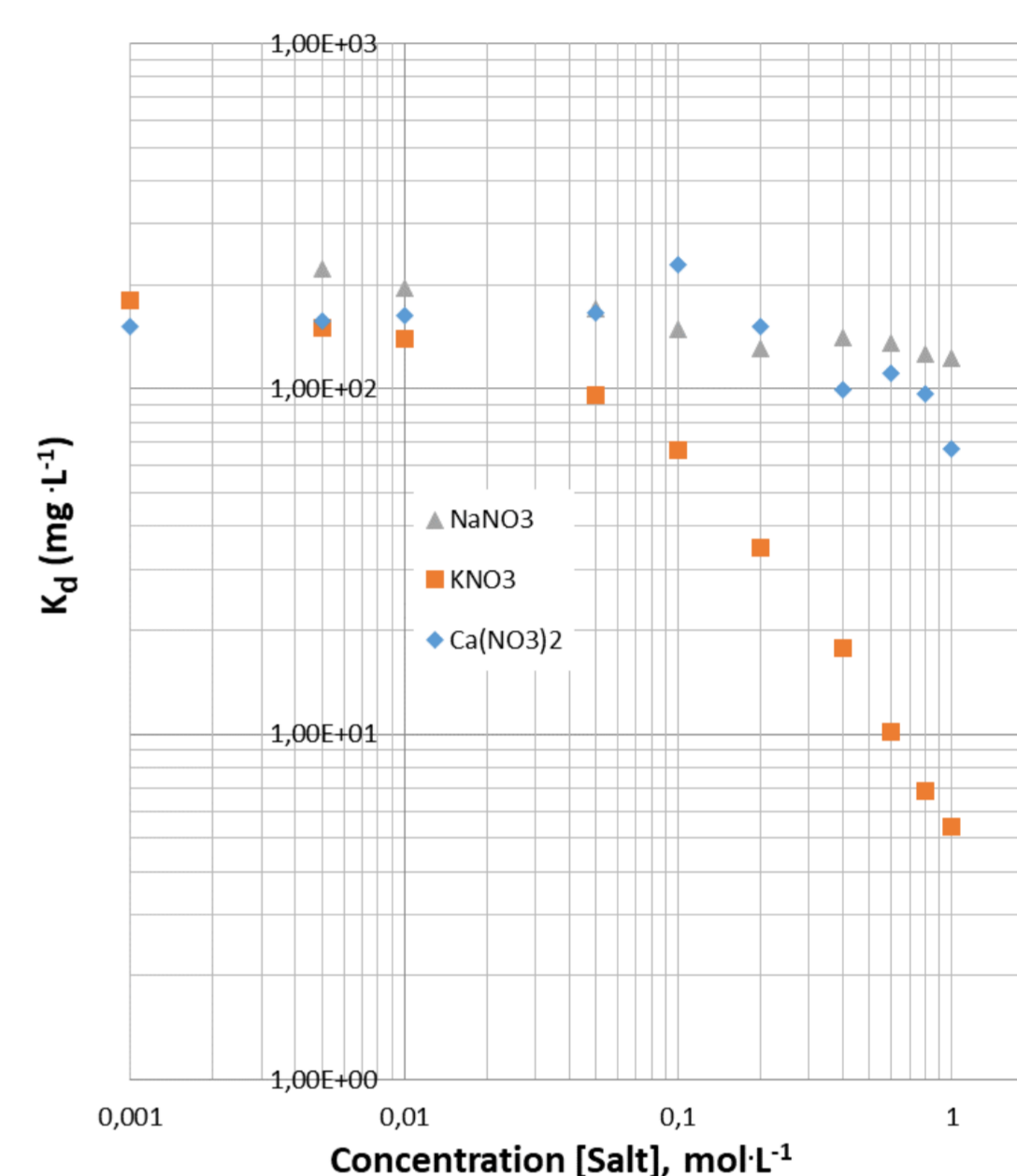


Fig. 3: Distribution coefficients of Sr on TK102 Resin in 3 M HNO₃ in the presence of different salts

► D_w Sr decreases by 30% with NaNO₃ up to 1 M,
► no effect of KNO₃ and Ca(NO₃)₂ up to 0,05 M.

Elution studies

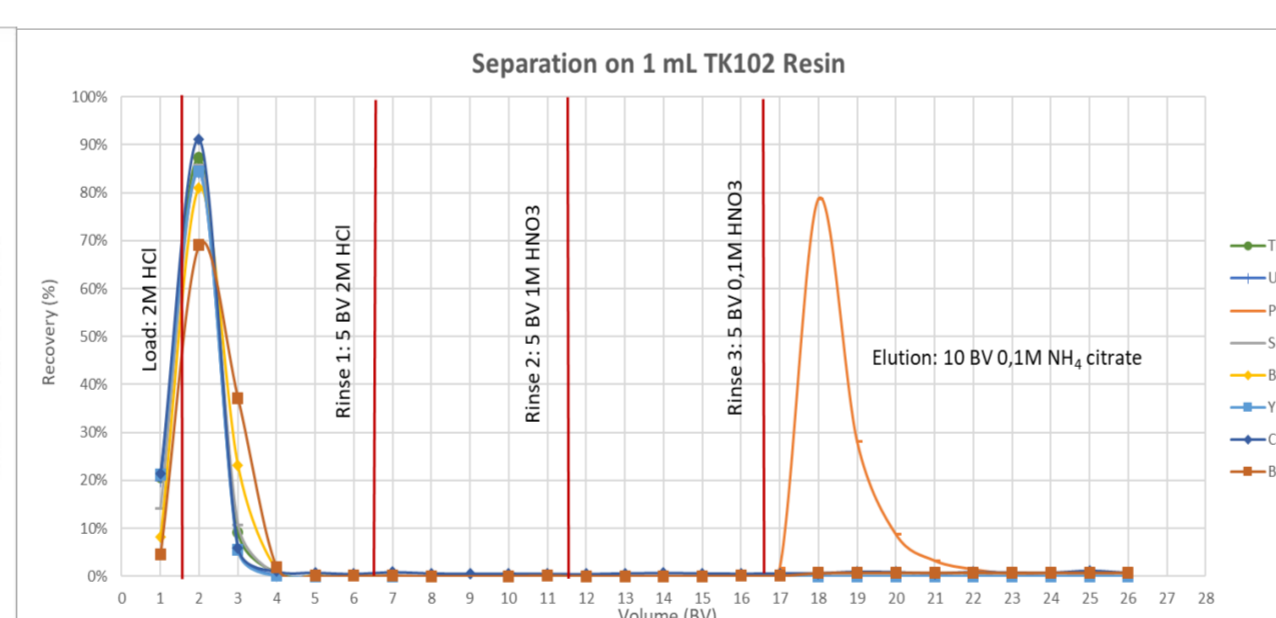
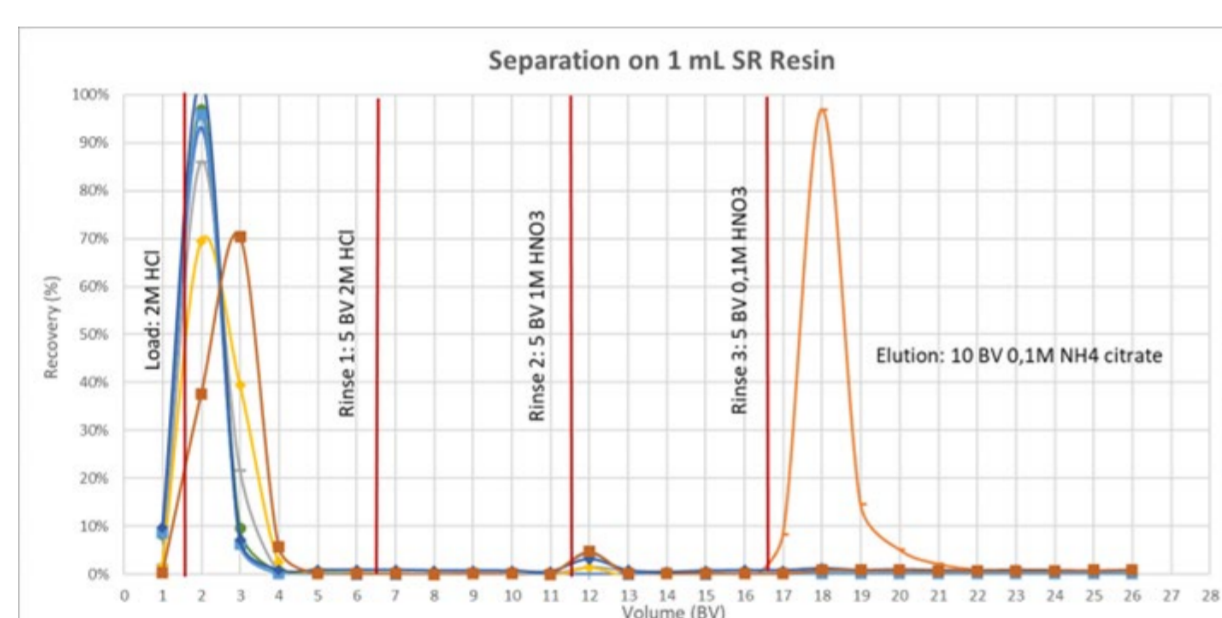


Fig. 4: Comparative elution study, SR Resin vs TK102 Resin, Pb separation conditions, 1 mL columns at gravimetric flow.

► For both resins a clean Pb separation could be obtained

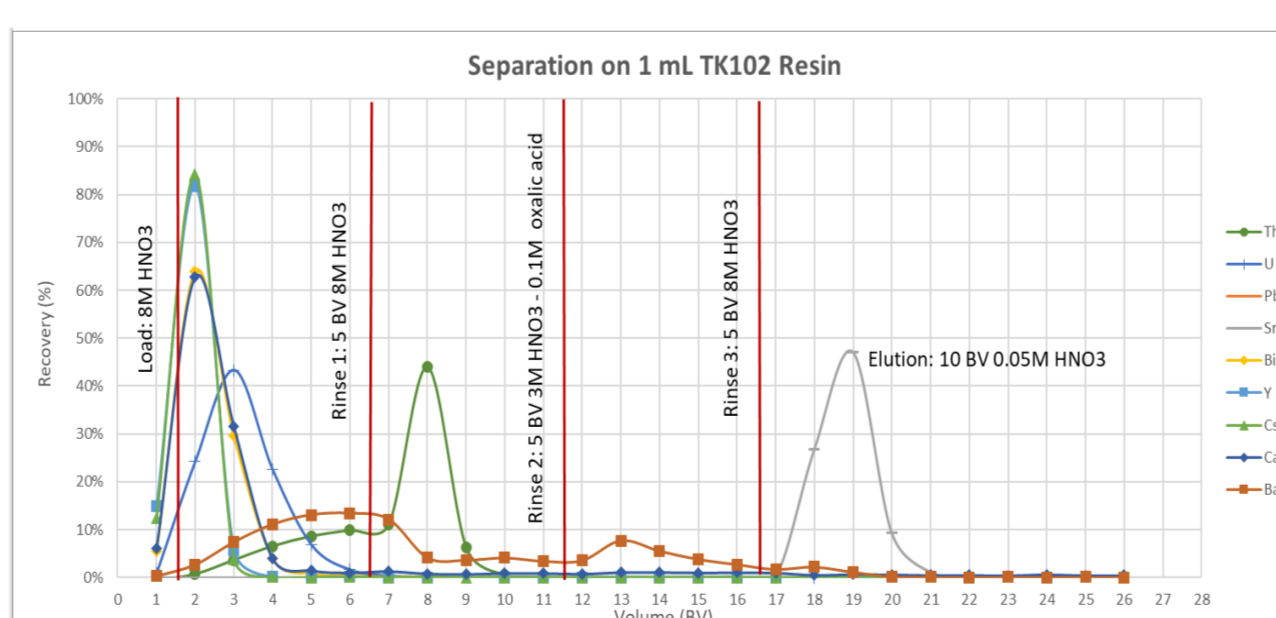
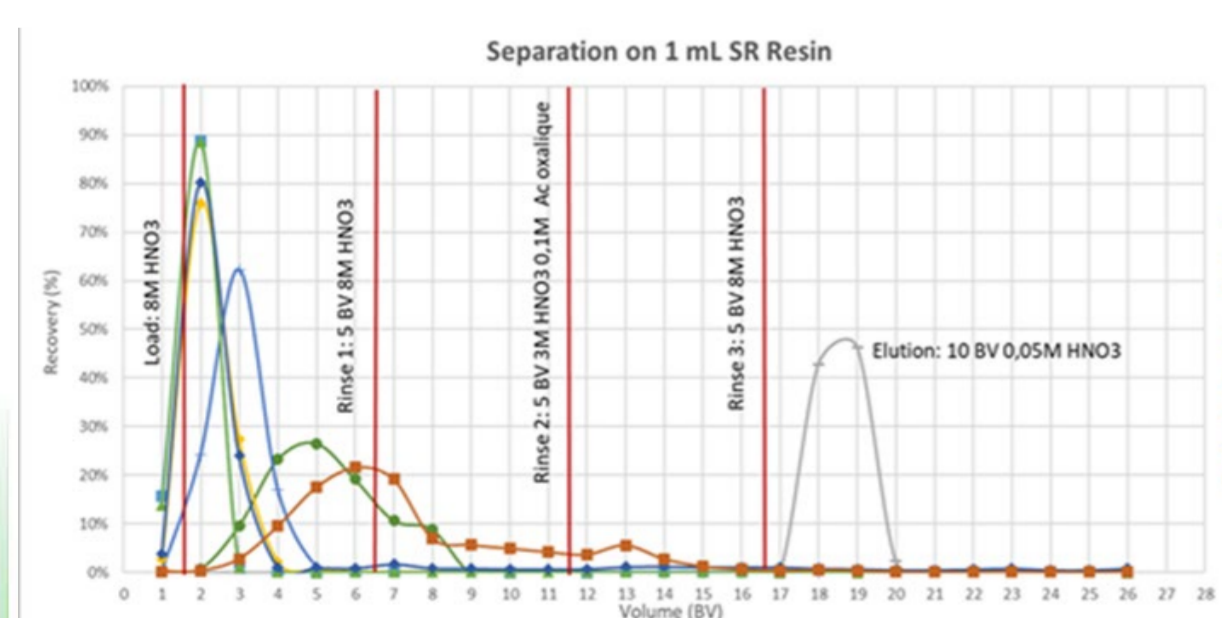


Fig. 5: Comparative elution study, SR Resin vs TK102 Resin, Sr separation conditions, 1 mL columns at gravimetric flow.

► For both resins a clean Sr separation could be obtained

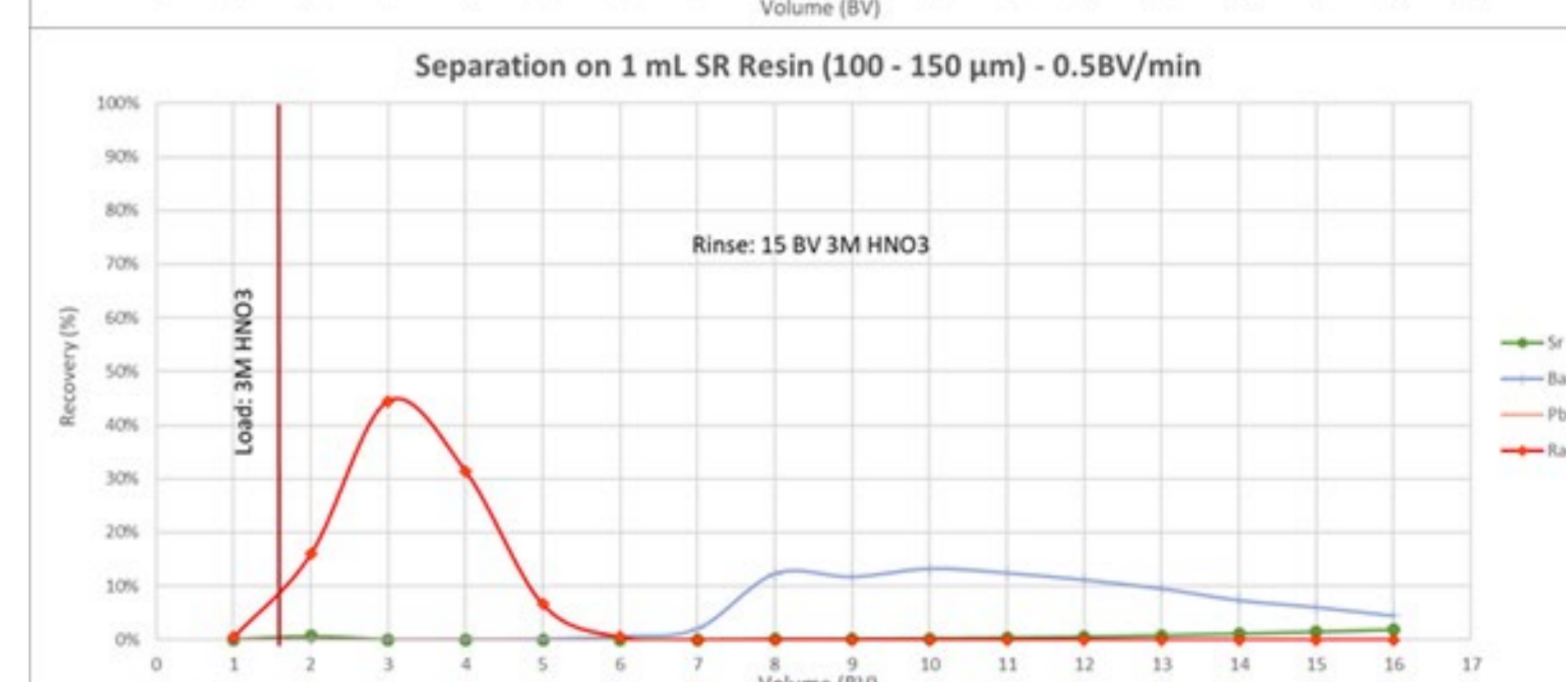
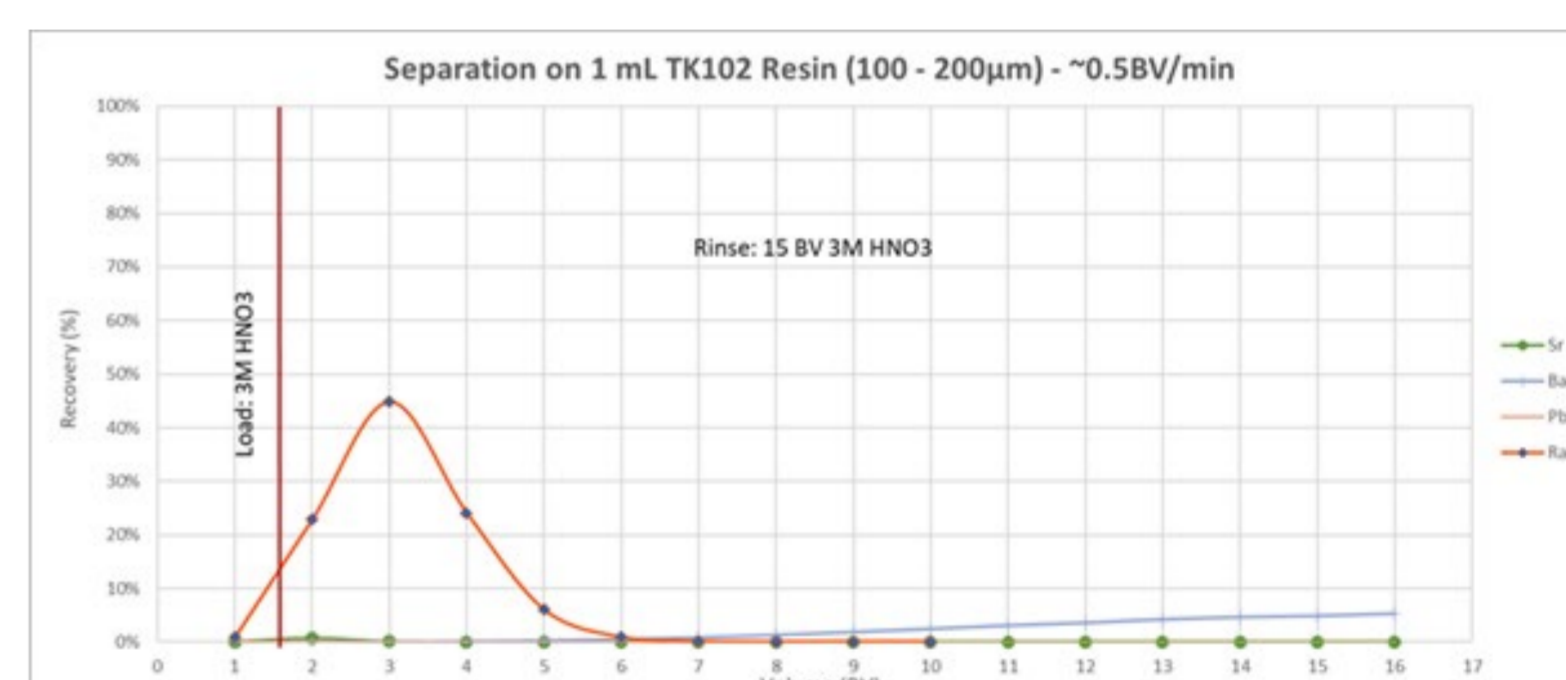


Fig. 6: Ra separation on 1 mL TK102 Resin (above) and Sr Resin (below). Load and rinse: 3M HNO₃

► 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 ⁹⁰Sr, ²¹⁰Pb and other radionuclides such as ²²⁶Ra in environmental, decommissioning and waste samples. It has up to near 50% higher Sr distribution coefficients than SR Resin in HNO₃, and high dynamic capacity for Sr (>40 mg·g⁻¹) and Pb (>90 mg·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.