Preparation of a 5 mCi prototype ^{44}Ti/^{44}Sc radionuclide generator

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Introduction: For preparation of ^{44}Ti/^{44}Sc radionuclide generators, several radiochemical criteria are relevant, such as effective separation strategies providing high ^{44}Sc yields and low ^{44}Ti breakthrough, high long-term stability, and type of Sc eluates useful for subsequent labelling reactions (i.e. low volume, low pH, high purity etc.) [1,2]. In previous studies, the distribution coefficients of Ti(IV) and Sc(III) have been determined for AG1x8 anion exchange resins and HCl / oxalic acid mixtures [3].
Further studies reported on the strategy of "direct" and "reverse" elution strategies [4] with the conclusion, that "reverse" type washing steps after each elution using the same composition of 0.2 M HCl / 0.1 M oxalic acid mixtures indicate the approach to long-term stability of ^{44}Ti/^{44}Sc generators. In addition, periodical washing using 0.2 M HCl / 0.1 M oxalic acid mixtures allows for focusing the ^{44}Ti distribution on the ion exchange column [5].

Experimental: For the generator, a column (H=150 mm, D=3 mm, V_0=0.55 ml) was made of PEEK and filled with anionit AG-1×8 (200-400 mesh, Br^--form). The column was washed with 20 ml 12 M HCl and 10 ml H_2O. Finally, it was washed with 10 ml 0.1 M $H_2C_2O_4$. The probes with purified ^{44}Ti (5 mCi) [6] were dried and dissolved in 20 ml 0.1 M $H_2C_2O_4$. This solution was brought into the generator and the generator was washed with 0.005 M $H_2C_2O_4$ / 0.07 M HCl mixture in "reverse" direction. Two days later, the generator was eluted for first time using 20 ml of 0.005 M $H_2C_2O_4$ / 0.07 M HCl. Aliquots were selected for each 2 ml. One week later, the activity of ^{44}Ti in these samples were analysed by means of g-spectrometry.

Results and Discussion: The profile of ^{44}Sc elution is shown in Fig. 1. The content of ^{44}Ti is given in Fig. 2.

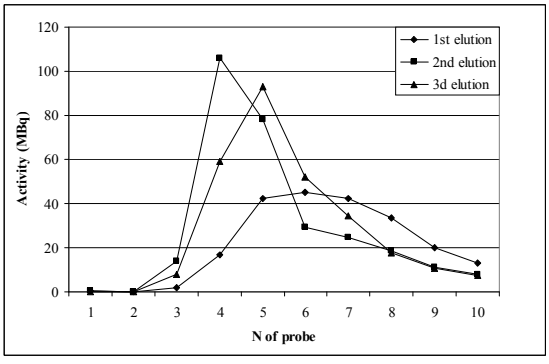

Fig. 1. Elution profile of ^{44}Sc (Curie-meter measurements, relative units) for the first three elutions. Each fraction contains 2 ml.

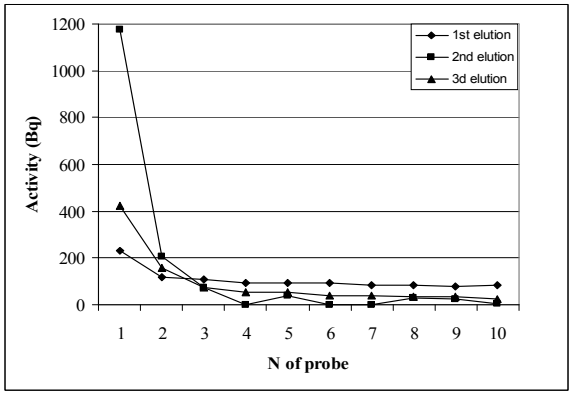

Fig. 2. Breakthrough of ^{44}Ti (γ-spectroscopy) for the first three elutions. Each fraction contains 2 ml.

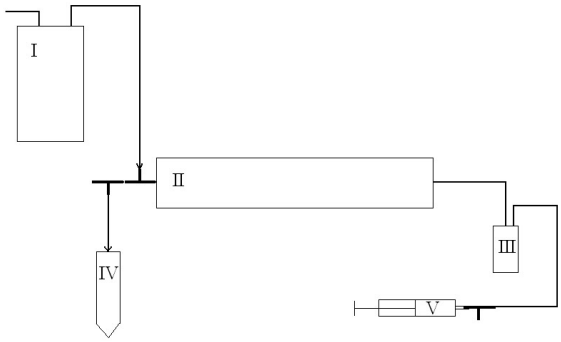

Fig. 3. The scheme of "reverse" Ti/Sc-generator,
I – 500 ml bottle with 0.005 M $H_2C_2O_4$ / 0.07 M HCl mixture
II – generator; III – 20 ml bottle; IV – product vial; V – Syringe

Conclusions: After second elution as we can see from fig. 1 the yield of ^{44}Sc is higher and from fig. 2 the yield of ^{44}Ti is lower. After few elutions the profile becomes better.

References:

[1] F Rösch, Radionuklid-Generatorsysteme für die PET. Der Nuklearmediziner 27 (2004) 226-235
[2] F Rösch, FF (Russ) Knapp. Radionuclide Generators. In: A Vértes, S Nagy, Z Klencsár, F Rösch (eds.), *Handbook of Nuclear Chemistry* – Vol. 4, pp 81-118, 2003, Kluwer Academic Publishers, The Netherlands
[3] D.V. Filosofov, N.S. Loktionova, F. Rösch, Determination of K_d values of ^{44} Ti and ^{44} Sc in HCl/$H_2C_2O_4$ solution of various concentrations, 2007
[4] D.V. Filosofov, N.S. Loktionova, F. Rösch, Preparation and evaluation of pilot ^{44} Ti /^{44} Sc radionuclide generators, 2007
[5] D.V. Filosofov, N.S. Loktionova, F. Rösch, Determination of K_d values of ^{44}Ti and ^{44}Sc in HCl/$H_2C_2O_4$ solution of various concentrations, 2007
[6] D.V. Filosofov, N.S. Loktionova, F. Rösch, Purification of ^{44}Ti, 2007