Preparation and evaluation of pilot ^{44}Ti / ^{44}Sc radionuclide generators

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Introduction:

In previous reports, best conditions for efficient separations and for the design of ^{44}Ti/^{44}Sc radionuclide generators have been determined in terms of distribution coefficients depending on the composition of HCl / $H_2C_2O_4$ mixtures. Using AG-1x8 resins, optimum K_d values for the HCl / oxalic acid mixtures of 0.2 M HCl and 0.1 M $H_2C_2O_4$, have been obtained [1].

Consequently, the performance of model generators needs to be investigated. This report is on the construction and evaluation of low-activity generators using two different modes of elution.

Experimental:

Two columns made of PEEK (diameter 3 mm, length 40 mm) have been prepared in the institute´s workshop. Both columns were filled with AG-1x8, 200-400 mesh, in Br^--form.
The columns were washed with 5 ml 12 M HCl and 5 ml H_2O two times. Finally, they were washed with 5 ml 0.1 M $H_2C_2O_4$.

A sample of ^{44}Ti was evaporated to dryness and taken up with 420 µl of 0.1 M $H_2C_2O_4$. The solution obtained was divided into two parts (and used for generators Nr. 2 and Nr. 3). To each probe 2 ml 0.1 M $H_2C_2O_4$ were added. The two ^{44}Ti fractions of 300 kBq activity each probes were transferred to the generators Nr. 2 and Nr. 3.

Generator 2 was eluted using 10 ml of 0.1 M $H_2C_2O_4$ / 0.1 M HCl solutions, while generator Nr. 3 was eluted with 0.1 M $H_2C_2O_4$ / 0.2 M HCl solutions in a standard procedure.

Elution of both generators was carried out 3 times a week.

Results and Discussion:

Figure 1 illustrates the yield of ^{44}Sc obtained for the increasing number of elutions for both generator types. While the generator No. 2 design guarantees a constant level of ^{44}Sc elution, the elution of ^{44}Sc in the case of Nr. 3 is decreasing with about the 10th elution. This corresponds to an increasing breakthrough of ^{44}Ti in generator Nr. 2 as shown in Fig. 2. The elution strategy of pilot generator Nr. 2 results in an increasing breakthrough of ^{44}Ti, which results in a 50% desorption of ^{44}Ti after about 30 elutions, and an almost complete release of ^{44}Ti after 50 elutions.

In contrast, the breakthrough of ^{44}Ti in the case of the type elution (Nr. 3) scheme is negligible for the first 10 elutions, and is increasing only slightly in the following 40 elutions. The maximum breakthrough of ^{44}Ti is about 0.2 %.

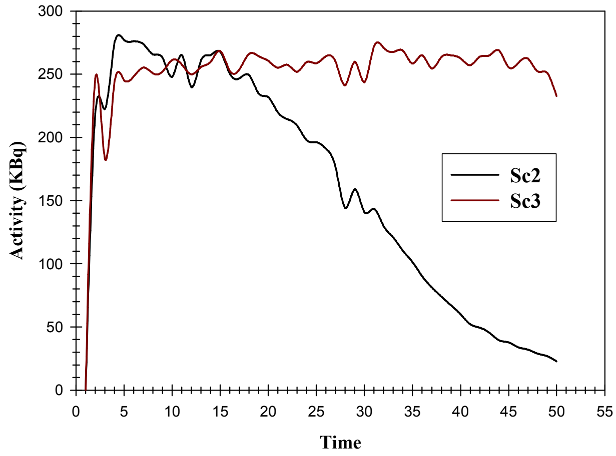

Fig.1.
Yield of ^{44}Sc (γ-spectroscopy) for increasing number of elutions for Sc2 and Sc3 elution modi

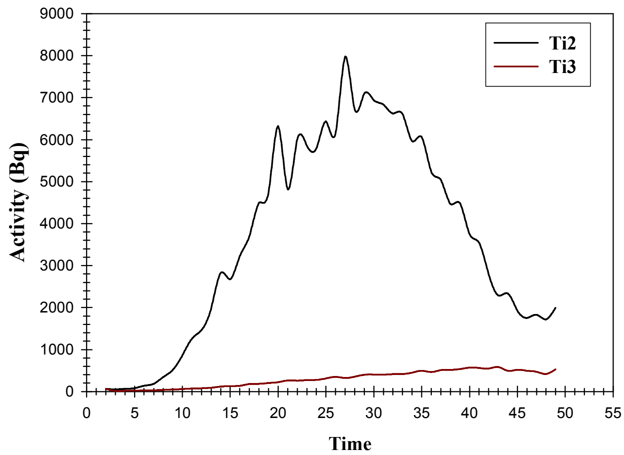

Fig. 2.
Breakthrough of ^{44}Ti (γ-spectroscopy) for increasing number of elutions for Ti2 and Ti3 elution modi

Conclusions: In terms of long-term stability of ^{44}Ti/^{44}Sc generators, adequate generator elutions are necessary.

In optimum constellations, the elution yield of ^{44}Sc is always high and constant with 85-90%.

References:
[1] 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