Development of chemical separation of Sn from concrete matrices using TEVA® resin

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Abstract: This paper presents an HCl-free chemical separation procedure for Sn recovery from concretes. Two pretreatment methods of solution samples followed by a proposed solid-phase extraction on TEVA® resin were examined. The obtained results show that Sn can be highly recovered by the developed separation scheme with good reproducibility.

Keywords: ^{126}Sn, solid-phase extraction, TEVA®

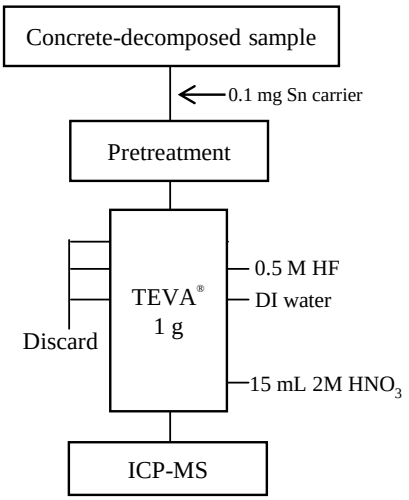

Fig. 1 Schematic separation of Sn

1. Introduction

Long-lived fission product ^{126}Sn (half-life of 2.1x10^5 years) is one of the 38 critical nuclides, which need to be estimated for radioactive classification and disposal of decommissioning waste collected from the Fukushima Daiichi Nuclear Power Plant (1F). The regulated limit of ^{126}Sn content for surface landfill method (trench disposal method) is at 1.3 Bq/g, which can be measured by radiometric methods. The required concentration limit is equivalent to 1.23 ng/g of ^{126}Sn, which can be more simply and rapidly detected by ICP-MS. The separation scheme has been developed as a preparation method for estimating ^{126}Sn in concrete rubble collected from decommissioning of 1F by the modern ICP-MS.

2. Experimental

The condition for purification of Sn was first investigated with recovering standard Sn on TEVA® sorbent. Then, the synthetic concrete dissolved sample was applied to test the effect of matrices. Figure 1 shows the proposed separation scheme. The pretreatment step includes coprecipitation with Fe or evaporation-dissolution to completely remove nitrate (NO_3^-), which hinders the retention of Sn on the sorbent.

3. Results・Conclusion

Recovery of Sn standard sample was 99.7% ± 1.8% (2σ, n=5). Meanwhile, recoveries of Sn from synthetic concrete-decomposed matrices were 102.1% ± 1.9% (2σ, n=5) and 98.5% ± 4.9% (2σ, n=4) respectively for the coprecipitation and evaporation sample pretreatments, showing good recovery and reproducibility of the developed separation method. Decontamination of ^{126}Te was 1.9x10^4, which measures ratio of the initial weight of ^{126}Te carrier against that of ^{126}Te found in the final 2M nitric acid eluting fraction. This indicates that the proposed method can be used for purifying ^{126}Sn from concretes for its ICP-MS determination.

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