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Development of a PSkit for the Fast and Selective Analysis of 99Tc in Decommissioning Samples

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Just in Western Europe, more than 160 nuclear facilities should be closed by 2025. This process requires the management of all the elements with a potential content of radioactivity, in order to determine if there are long live radionuclides present and need to be stored in a deep geological repository, if short live radionuclides are present and need to be temporary stored for its decay or if the levels are low enough to be treated as a conventional waste. The measurement of gamma emitters is already solved, but for alpha and beta emitters, it is necessary to develop fast and selective methods of analysis. Among the beta emitters that should be determined, 99Tc (a fission product of uranium) is a key element due to its long half-life, environmental mobility, and high presence in the radioactive wastes.

The in-situ measurement of these radioactive wastes would allow a fast decision about the classification of the materials, so more measurement of the samples can be performed and therefore a better management can be done. In this sense, the objective of this work is to develop a PSkit for in-situ fast measurement of 99Tc. PSkits are scintillation vials with a foil of plastic scintillator at the bottom. Also, this foil is coated with a selective extractant, in this case Aliquat·336, a known selective extractant for 99Tc. In this way, the sample is added into the vial, stirred and then poured to finally measure the PSkit directly into a scintillation detector.

In this work, first, the synthesis of the foil was optimized in terms of kind of vial, proportion of crosslinker and the porogen. The results obtained shows that the use of a plastic vial, proportions 32:1 and 2:1 (St:DVB in mols) and the use of heptane as porogen produce the best results in terms of detection efficiency and also foil shape and adherence in the vial.

Also, the conditions for the PSkit use were also studied. These included the contact time of the solution in the PSkit, the shaking method and the rinsing conditions, being a gentle stirring and a contact time of the sample in the PSkit of 10 minutes enough to obtain retentions around 80% and detection efficiencies around 50% with low retentions of the common radiometric interferences of 99Tc.

The established procedure was applied to the measurement of simulated samples that reproduces the matrix of real wastes, studying the effect that this matrix had on the retention and detection efficiency. Finally, the quantification errors of the method was determined with the measurement of the simulated samples.

Primary authors: Mr MENDO, Xavier (Universitat de Barcelona); Mr ANTOÑAZAS, Eduardo; BAGÁN, Héctor (Universitat de Barcelona); TARANCÓN SANZ, Alex (Universitat de Barcelona)

Presenter: BAGÁN, Héctor (Universitat de Barcelona)

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