

On the way to a standard method for Technetium-99 determination in radioactive waste

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In the context of radioactive waste management, a detailed radionuclide inventory has to be compiled. In France, the National Radioactive Waste Management Agency (ANDRA) specifies radiochemical criteria for 143 radionuclides stored in the repository site devoted to the Low and Intermediate Level short-lived Waste¹. Among this long list¹, Tc-99 has to be declared as soon as its activity concentration is over 0.01 Bq/g and its maximum acceptance limit has been fixed to 44000 Bq/g. Tc-99 can be produced by thermal neutron fission of U-235 obtained according to a relatively high thermal fission yield of 6 %. It can also be generated from neutron activation of Mo. With a half-life of 214000 years, Tc-99 is a major contributor to the radioactivity of nuclear waste at long term. Furthermore, due to its high mobility in the environment as pertechnetate anion, it is crucial to characterize Tc-99. As a beta emitter, Tc-99 has to be isolated from the interfering radionuclides through a radiochemical procedure prior to any measurement. Tc-99 is widely measured by liquid scintillation counting but it can also be quantified with a greater sensitivity by ICP-MS owing to its high half-life. Many literature works² deal with the radiochemical characterization of Tc-99 in environmental samples. There is a guide standard³ for the determination of Tc-99 in soil and a standard project⁴ is currently being finalized for water samples. However, no radiochemical standard or common method has been published for the measurement of Tc-99 in radioactive waste. Since the decommissioning and dismantling of nuclear sites are in growth, it is of prime interest to set up a standard for the accurate quantification of Tc-99 in radwaste.

In the framework of CETAMA commission⁵, a working group dedicated to Tc-99 has been created in 2015. Nine French laboratories have participated to the establishment of a radiochemical procedure suitable for all the various matrices encountered in radwaste samples (sludges, muds, metals or concretes). The aim of this work is to detail the different steps which led to the publication of a common radiochemical procedure to characterize Tc-99 in radwaste (see Figure 1).

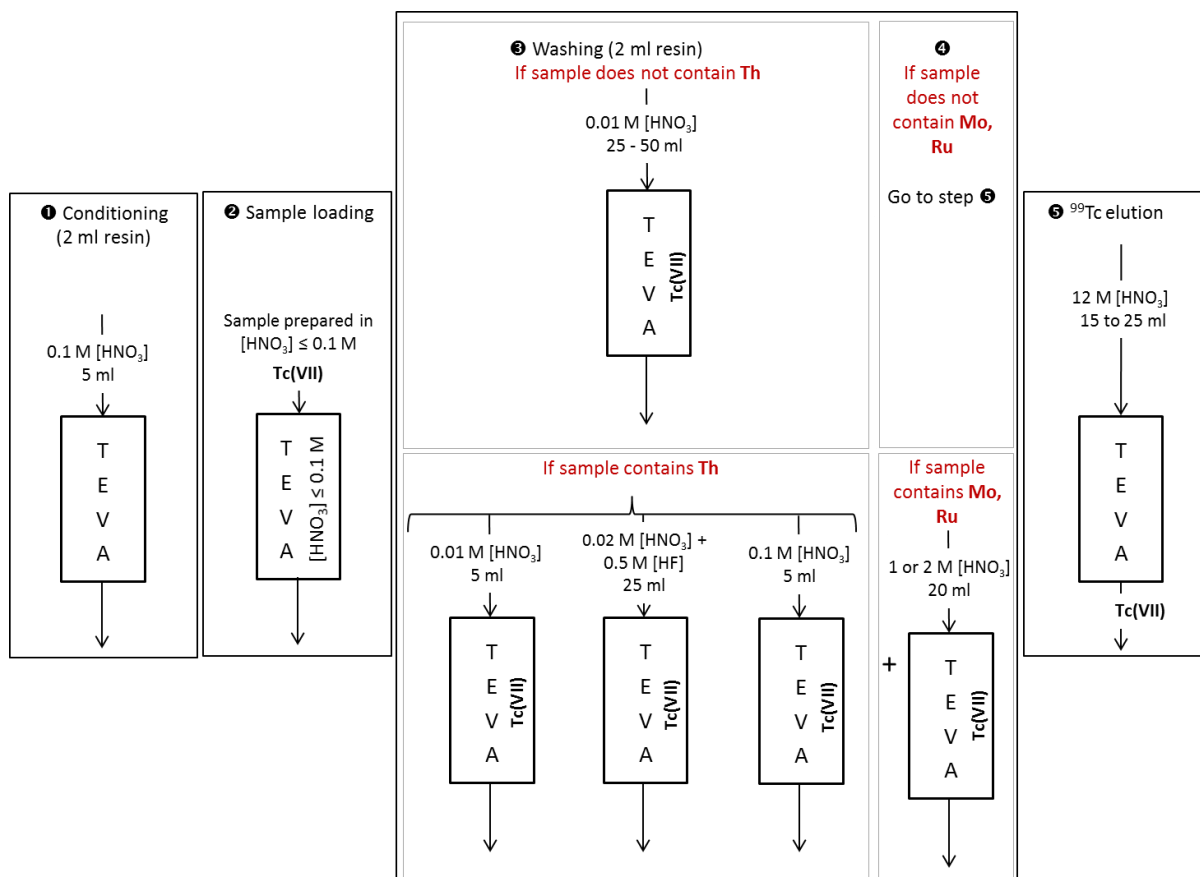


Figure 1: Flow chart of the radiochemical method to measure Tc-99 in radioactive waste

References

¹ANDRA, ACO.SP.ASRE.99.0002D ANDRA specifications (2014).

²Shi et al. Anal. Chim. Acta (2012) 709:1- 20.

³ASTM, Guide standard guide for the determination of Tc-99 in Soil, ASTM C1387-14, ASTM International, West Conshohocken, PA (2014).

⁴Standard ISO 22125-1 and 22125-2, Water quality - Technetium-99 - Test method using liquid scintillation counting or ICP-MS, in press.

⁵CETAMA site, <https://cetama.partenaires.cea.fr/>