Simultaneous determination of ^{93}Zr, ^{93}Mo and niobium radionuclides from decommissioning samples, extension of the method for analysis of actinides

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Nuclear reactors must be decommissioned sooner or later after final shutdown, the reactor and its auxiliary devices must be dismantled. During decommissioning, large amounts of radioactive waste with variable chemical composition is produced. The classification and radiochemical characterization of different waste types are crucial regarding their safe long-term storage, radiation protection of the staff and in a broader sense the population and the environment.

In course of the years, a combined radiochemical method to separate long-lived difficult-to-measure (DTM) nuclides has been developed at RADANAL Ltd for the simultaneous determination of the major actinides based on an extraction chromatographic (EC) separation of uranium, plutonium, neptunium, americium and curium on a single DGA resin (containing diglycolamide)[1] followed by measurement of ^{237}Np by ICP-MS and those of other actinides by alpha spectrometry. Later the method was extended for the determination of ^{93}Zr by including a purification step using TEVA resin (containing tetraalkyl amine) and measurement by ICP-MS[2]. Recently we have further improved the separation scheme and extended it for the determination of DTM nuclides ^{93}Mo, ^{93m}Nb and ^{94}Nb. Molybdenum and Nb are separated on the DGA resin, Mo is purified on activated alumina column and Nb on TEVA resin, ^{93}Mo is measured by LSC, ^{93m}Nb by low energy gamma spectrometry (LEGe) and ^{94}Nb by standard gamma spectrometry.

Up to now, certified reference materials which represent activated reactor components were unavailable. Recently, an international intercomparison exercise was organized for radiochemical laboratories in order to determine ^{93}Zr, ^{93}Mo, ^{93m}Nb and ^{94}Nb nuclides from a steel sample originating from decommissioned reactor[3].

Steps of method development, model experiments, sample preparation, as well as the results of the intercomparison test will be presented.

References:

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3. A. Leskinen et al. (2025) Intercomparison exercise of 93Mo and 59Ni analysis in activated steel. Nordic Nuclear Safety Research, Report NKS-495, ISBN: 978-87-7893-593-9