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Radiochemical analysis for radiological characterization of decommissioning waste - determination of 126Sn and 93Mo

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With increased number of nuclear facilities to be decommissioned, radiological characterization of various radioactive waste generated during decommissioning and operation of nuclear facilities is needed for estimation of the total inventory of radioactivity and its variation with time. Among them, determination of hard-to-measure radionuclides is the main challenge. 93Mo is a long-lived (4000 years) radionuclide and decay by electron capture, it is mainly produced by neutron activation of stable molybdenum (92Mo) presented in the construction materials and fuel elements. 126Sn is a long-lived (2.35x105 years) fission radionuclide with beta decay and emission of low energy and low intensity gamma rays. Both 93Mo and 126Sn are high mobile radionuclides in the environment, and therefore important for waste repository. Although some methods for determination of 93Mo in waste samples were reported, but not effective to accurately determine them in radioactive samples from nuclear facilities. The method for determination of 126Sn in radioactive waste is not available. In this work, we report methods for determination 93Mo and 126Sn in radioactive materials, such as spent ion exchange resin, metals and concrete. The key strategy is highly remove the main radionuclides in the radioactive samples such as 60Co and 137Cs by multi-steps chemical separation using chromatographic techniques, and purification from the radionuclides with similar chemical properties, such as 125Sb, 51Cr, 99Tc, 93Nb for 93Mo determination. An ICP-MS measurement technique was developed to measure 126Sn after chemical separation, the interference from 126Xe and 126Te was eliminated and suppressed by using sequential mass separator and dynamic reaction cell technique using NH3 as reaction gas. The developed methods have been successfully applied for the analysis of samples from the decommissioning of nuclear power plants.

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