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Development of ^{151}Sm analytical method for the purpose of nuclear waste characterization

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In France, nuclear wastes are managed by the French National Radioactive Waste Management Agency (ANDRA). Several repository sites have been built in order to accommodate nuclear waste packages. One is dedicated to the Low and Intermediate Level short-lived Waste. Criteria for 143 radionuclides have been defined by ANDRA which guarantee the safety of the facility. From this long list, ^{151}Sm has to be declared as soon as its activity is over 0.1 Bq/g. The declaration threshold for this radionuclide is very low and the maximum acceptance level in waste packages has been fixed to 4.5 10⁵ Bq/g. ^{151}Sm is a fission product with a radioactive period of 90 year. As a pure beta emitter, it must be isolated from the matrices and the interfering radionuclides through chemical separations prior to any measurement. Consequently, a selective radiochemical procedure is needed to measure ^{151}Sm in nuclear wastes.

The LASE (Operator Support Analyses Laboratory) and Nuclab-Prod have shared their radio-analytical skills to develop an analytical method to measure ^{151}Sm in radioactive waste. The analytical process includes 5 steps. First, digestion is performed for organic material, aqueous suspension or solid sample in nitric acid media. Neodymium as carrier and stable samarium as yield tracer are added. In order to reduce the salt concentration, a hydroxide precipitate is completed. Lanthanides are isolated from the other elements still present, by extraction chromatography using the Re-Spec[®] column from Eichrom. A high performance liquid chromatography is implemented in order to separate samarium from the other rare earth element such as europium, neptunium, promethium... Alpha-Hydroxybutyric acid as ligand agent is introduced in the mobile phase. Injected volume, eluent composition, fraction collection procedure have been optimized in order to assure recovery of Sm over 90%, no cross-contamination and effectiveness of the separation. This step has been completely automatized. The solution containing samarium is conditioned for liquid scintillation counting

The presentation will first focus on the optimization of the radiochemical procedures and the way the various elements are discarded. The choice will be argued. The second part of the work will be addressed to the application of the method to nuclear waste, results will be discussed.

Reference

[1] ANDRA, NT ASCO.SP.ASRE.99.002 « Spécifications d'acceptations des colis de déchets radioactifs au centre de l'Aube (INB N°149) –spécifications générales –Spécification d'évaluation et de déclaration des caractéristiques radioactives»

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