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A comparative study to determine 63Ni in Low and Intermediate Level Nuclear Wastes

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The LASE (Operator Support Analyses Laboratory) develops and implements radiochemical methods devoted to the characterization of Long-Lived Radionuclides in Low and Intermediate Level Nuclear Wastes. 63Ni is generally one of the radionuclides which impose the classification of the radioactive wastes. This radionuclide is produced by neutron activation of stable nickel which is a major component of construction materials used in nuclear industry. As a pure beta emitter, 63Ni must be isolated from the matrices and the interfering radionuclides through chemical separations prior to any measurement [1]. Due to its half-life (98.7 years), the French National Radioactive Waste Management Agency (ANDRA) requests its monitoring in waste packages from an activity threshold of 1 Bq/g [2]. Consequently, a rapid and selective radiochemical procedure is needed to measure 63Ni in nuclear wastes.

The reference radiochemical method which has been used for a long time in the laboratory is standardized [3]. It is based on the extraction of a Ni-dimethylglyoxime (Ni-DMG2) complex with chloroform followed by a back-extraction with diluted HCl. The aim of this work is to determine an alternative protocol that eliminates chloroform which is restricted through REACH regulation. An alternative method can be the precipitation of Ni-DMG2 complex followed by its dissolution in HNO3 [3]. Another procedure consist in implementing extraction chromatography where Ni precipitates on Ni® resin impregnated with DMG and is then eluted in HNO3 [4,5].

The presentation will first focus on the optimization of the radiochemical procedures by performing speciation calculations with Chess® software. The second part of the work will be addressed to the application of the three separation methods to various types of radioactive wastes (polymers, ion exchange resins, effluents and steels). For all procedures, 63Ni is analyzed by liquid scintillation counting (LSC) whereas the separation yield is determined from stable Ni measured by ICP-AES. The results will be compared in terms of accuracy, separation yields, analysis time and waste production.

References:
[1] X. Hou et al., Anal. Chim. Acta 608 (2008) 105-139.
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[5] P.E. Warwick et al., Anal. Chim. Acta 567 (2006) 277-285.

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