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Extraction Chromatographic Separation with ICP-MS Detection for the Determination of Selenium-79 in Solutions

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Radioactive waste produced by nuclear facilities usually contains significant amount of long-lived alpha- and beta emitters (e.g. ^{99}Tc , ^{93}Mo , ^{93}Zr , ^{41}Ca , ^{126}Sb , ^{107}Pd and ^{79}Se). Characterization of radioactive waste is usually carried out only by gamma-spectrometry because of its easy application for determination of full activity level of the waste. It is the main required parameter of the waste for its categorization (low-, intermediate or high level radioactivity). Using gamma-spectrometry determination of long-lived alpha and beta emitters is not possible; however it would be important and useful for management of nuclear waste sites and for characterization, classification and final disposal of the waste. At the same time the international surveys shows that the radioactive wastes contain usually low level waste (1-10 Bq/g) in 40% therefore their analysis could be highly important.

In this work selenium-79 (^{79}Se) was chosen as a key component of low-level radioactive wastes. Due to several technical challenges of the determination of this nuclide introduction and use of novel chemical and instrumental analytical methods are needed. ^{79}Se is a beta emitter radionuclide originated from ^{235}U fission. It is one of the long-lived radionuclides ($t_{1/2} \approx 105$ years) of interest in nuclear waste disposal. It has potential migration ability from the repository to the environment therefore it would have significant effect in the environmental pollution. Only few papers deal with the measurement of this radionuclide in low and intermediate level wastes despite of its significant presence. Measurement of ^{79}Se using classical radiometric techniques is difficult because of its low activity.

In this work ICP-MS technique was used for determination of ^{79}Se due to its high sensitivity. This technique requires only small amount of the sample (mg) compared to radio-analytical methods which need sometimes kg-s from the samples.

The aim of this work was to develop a radiochemical method for sample preparation before ICP-MS measurement. A new extraction chromatographic separation resin with selectivity for Se is under development.

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