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FAST ANALYSIS OF GROSS ALPHA WITH A NEW PLASTIC SCINTILLATION RESIN

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The analysis of radionuclides is complex, with high economic and time costs. This is very evident in decommissioning activities and environmental monitoring, for which the obtention of appropriate information requires doing as many analyses as possible. In such situations, the assessment of the sample content through global or screening parameters may be of help to avoid the use of selection procedures for each radionuclide which are usually long and complex.
One parameter of high interest is the gross alpha. This parameter, conformed by the actinides, radium and polonium content, is measured for example in the characterization of radioactivity in water intended for human consumption. If the value of the gross alpha is under 0.1 Bq L⁻¹ the water is considered drinkable and the specific analysis of several alpha emitters is not needed. Another example is the nuclear dismantling process, which is used to improve waste management as it permits checking if the sample can be treated as conventional or as radioactive waste.
Although there are several approaches to measuring the gross alpha parameter, there is still a need to simplify the determination by the use of faster methods which could also be capable to reduce the uncertainty associated with such determination.
This work presents a new method to determine gross alpha by using plastic scintillation resin (PSresins) packed in a solid-phase extraction cartridge. PSresins were used previously for the measurement of beta-emitting radionuclides such as ⁹⁰Sr and ⁹⁹Tc. In this work, a specific PSresin selective for all actinides, radium and polonium has been developed using P,P′-di[3-(trimethylsilyl)-1-propyl] methylenediphosphonic acid as an extractant. This new PSresin allows the determination of alpha-emitting radionuclides with a detection efficiency above 95%. All alpha emitters studied (²⁴¹Am, ²³⁶Pu, ²³⁰Th, ²³⁸U, ²¹⁰Po and ²²⁶Ra) presented quantitative retention in moderated nitric acid media (pH 2). This optimum working medium was determined though a batch study of 22 different media in HCl, HNO₃ and H₃PO₄ acids for each radionuclide. The analysis procedure proposed consisted just of passing directly through the PSresin cartridge 100 mL of the sample treated previously during 30'at 50ºC with 1% of hydrogen peroxide as a valence adjustment agent. After that, the cartridge is measured in the scintillation detector for 2 hours. Under the correct alpha-beta discrimination parameter (alpha and beta misclassification error around 15%), the gross alpha parameter is determined in less than 4 hours from the sample reception with quantification errors similar to or even lower than the ones obtained with the currently used methods.

Primary authors: GIMÉNEZ GUERRA, Isaac; Dr BAGÁN NAVARRO, Hector (Universitat de Barcelona); Dr TARANCÓN SANZ, Alex (Universitat de Barcelona)

Presenter: GIMÉNEZ GUERRA, Isaac

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