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GROSS-ALPHA PARAMETER DETERMINATION WITH A METHANDIPHOSPHONIC ACID BASED PLASTIC SCINTILLATION RESIN

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The assessment of the sample radioactivity content through global or screening parameters is of interest since it permits to obtain valuable information about the presence of radionuclides in samples. This strategy has the advantage that avoids the use of laborious selective procedures for each radionuclide which are usually long and complex, leading to the generation of more information in less time and with lesser costs.
One of those parameters is the gross alpha. This parameter 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 can be avoided. In another situation, in a nuclear dismantling process, screening parameters could be used to improve waste management as it permits to check easily if the sample can be treated as a conventional or as radioactive waste. Although there are several approaches to the measurement of 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 to 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. One of the advantages of PSresin regarding other methodologies is that allows separation and measurement using the same material simplifying the analytical procedure. This can even be improved if the sample treatment is simply reduced to a valence state adjustment and the pass of the sample though the PSresin. In this work, a new selective PSresin for all actinides, radium and polonium has been developed using bis-(3-trimethylsilyl-1-propyl)-methanediphosphonic 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, 238Pu, 230Th, 236U, 210Po and 226Ra) presented quantitative retention in moderated nitric acid media (pH 2) and up to 400 mL of sample can be passed though the PSresin without retention being affected. Moreover, applying alpha/beta discrimination adequate separation from the beta emitters retained could be achieved (i.e. misclassification error around 15% at PSA level 135). The analysis procedure proposed consisted just on passing directly though the PSresin cartridge 100 mL of sample treated previously during 30'at 50ºC with 1% of hydrogen peroxide as a valence adjustment agent. Sample were spiked with iron (III) or europium (III), working as tracers, for the posterior confirmation of the total retention of the alpha emitting radionuclides by a colorimetric visual check using thiocyanate or arsenazo (III) complexes respectively for iron (III) and europium (III). After that, the cartridge is directly measured in the scintillation detector for 2 hours with no further treatment. In this conditions the alpha parameter has been determined in several water samples in less than 4 hours from the sample reception with quantification errors lower than the ones obtained with the current used methods.

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