SOLID PHASE EXTRACTION COUPLED TO ICP-MS: A ROBUST METHOD FOR THE QUANTIFICATION OF RADIUM-226

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Radium is an alkaline earth metal, with only radioactive isotopes. Among its isotopes, radium-226 is the longest lived and most common. This isotope is in the radioactive decay chain of uranium-238, with a half-life of 1600 years. Its abundance in the environment is therefore important and dependent on uranium presence. This isotope is an alpha and gamma emitter that decays into radon-222 following an alpha emission of 100% intensity. Radium-226 is therefore very radiotoxic due to the emanation of radon-222 and the possible substitution of bone calcium. Its quantification in different matrices of the environment is essential, in particularly in the context of radiation protection studies.

At the institute for radiological protection and nuclear safety (IRSN), the analysis of radium-226 at the lowest levels is necessary as part of the environmental monitoring, to better understand its biogeochemical dynamics or to study its transfer mechanisms. Radium-226 can be quantified by direct gamma spectrometry or by the emanometry method via the measurement of its descendant, radon-222. Although these methods have many advantages, performances they achieve in terms of detection limit and accuracy are not always sufficient.

The proposed alternative is a more efficient method and unique for all liquid and solid environmental matrices. This new method is based on chromatographic separation followed by ICP-MS measurement. Indeed, in recent years, new specific chromatographic resins with promising properties for radium separation have been developed. The use of these resins improves the existing procedures due to more efficient elimination of polyatomic interferences and allows to lower the detection limit. Moreover, this new method proposes a quantification of radium-226 by isotopic dilution. To achieve this and given that radium-226 isotopic tracers are not commercially available, a natural thorium standard containing radium-228 has been previously purified and characterized. The use of a radium isotope allows having robust results. Performances with the proposed radium-226 quantification method are characterized by an optimized turnaround time (< 1 day), excellent chemical yields (> 80%) and a detection limit compatible with regulatory requirements. Furthermore, radium-226 quantified activities are consistent with reference activities in different kind of environmental samples.