TENORM and alpha spectrometry industries: spectra deconvolution

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Introduction

The final treatment of TENORM waste depends on their radiological characterization. These have high concentrations of activity, a priori unknown, so the establishment of the mass, the average time and the appropriate source-detector distance for this determination is not trivial.

Despite analyzing a very small amount of mass, nevertheless maintaining a compromise between the minimum mass to be used and its representativeness and homogeneity; sometimes, to achieve a good spectrum, it is necessary to adjust the measurement parameters. This adjustment is not easy to get since the mass, despite being small, could have high activity; thus, to avoid the overlap between the unknown peaks and the tracer peak, it is necessary to control the measurement time and/or the distance between source-detector. However, despite this control, an adequate spectrum cannot be obtained, being necessary to repeat the analysis decreasing mass and adjusting again the distance and time, with the consumption of time and material that it entails.

To reduce this repetition of samples and the different sequence of measurements, it has been decided to deconvolve the spectra to, despite the overlaps, determine this activity.

Material and methods

The samples, once the radiochemical separation has been carried out and have been electrodeposited in the planchette, have been measured by alpha spectrometry in the PIPS detectors that the LMBA (EHU) has, of 450 mm^2 of area, approximate efficiency of 25% and background of 6 10^{-5} cps.

Work has been done with high-activity polonium, uranium and thorium residues, emphasizing the deconvolution of Po-210 and Po-209 (tracer), U-235 and U-234 and Th-230 and Th-229 (tracer).
Even if alpha emitters emit particles at discrete energies, due to the possible presence in the planchette of impurities from radioseparation, the different paths that emitted alpha particles follow and the use of a thin film that avoids detector recoil contamination, the spectrum does not correspond to a gaussian and it is displaced towards low energies. After comparing different methodologies, it has been decided to deconvolve by adjusting the peaks to a complementary error function, which shifts the curve of the Gaussian distribution towards lower energy emissions.

Results and discussions

First, a Po-209 emission spectrum has been fitted, obtaining a very adequate adjustment of it. Subsequently, the adjustment of this function has been applied to Po-209 and Po-210 spectra, deconvolutionizing both satisfactorily. This adjustment is controlled by the analyst in charge of the spectrometric study.

Conclusions

The approximation of the spectra using the complementary error function provides congruent results, providing an adequate tool for the deconvolution of peaks obtained from TENORM samples.