CHARACTERIZATION OF NUCLEAR WASTE BY ACCELERATOR MASS SPECTROMETRY

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Nuclear energy continues being commonly used nowadays in spite of the general tendency to substitute it by cleaner ways of energy production. In any case, one of the disadvantages of this method of energy production is the necessity of environmental control of the radioactivity especially close to the vicinity of nuclear facilities. Another important drawback is the large amount of residues that it produces. These are originated either in the normal activity of the nuclear power plants and/or on the decommissioning of these plants.

A big part of these residues will need to be stored in special facilities especially designed for this purpose. In order to optimise this process, it is very important to characterize them very well so that only the ones that strictly need this storage treatment are sent to these special stores. This would reduce strongly the amount of material that must be treated as radioactive and, consequently, the loading rhythm of the stores and their economic and social impact.

The long-lived radionuclides fulfil two important characteristics: they remain for a very long time in the nuclear residues and, in many cases, they are very difficult to detect by radiometric methods, as these do not have always enough sensitivity. In spite of this, the knowledge of their activities is essential for their appropriate evaluation. In these cases, a maximum level is fixed although the real level of the radionuclide in the residue will be much lower. The lack of sensitivity is clearly also an inconvenient for environmental samples.

To overpass this drawback, it has been shown that the use of high sensitivity radiometric methods and mass spectrometry methods can reduce strongly the detection limits for several long-lived radionuclides and can be used as an alternative for a series of nuclides whose emissions are difficult to evaluate by traditional counting techniques. Few years ago, the AMS group at CNA carried out a project dedicated to start developing the methodology of the application of Accelerator Mass Spectrometry (AMS) to the characterization low and intermediate level nuclear residues. In this project, we proposed to optimise the originally developed methodology for environmental samples and to extend the application of the technique to new radionuclides of interest for their management that have not been studied before. These studies will be mostly focused on residues generated in the decommissioning of nuclear power plants for its implications in the ongoing activities carried out in Spain, as it is performed in collaboration with ENRESA, the company in charge of nuclear residues in Spain.

Some of the radionuclides present in this kind of residues are ^{129}I, ^{14}C, ^{36}Cl, ^{41}Ca, ^{239}Pu, ^{240}Pu, ^{236}U and ^{237}Np. Our project tries to evaluate the limits of AMS for the determination of these radionuclides in nuclear residues. For this, our efforts are put both on the optimization of the AMS measurement and the radiochemistry. Another important point is that low and intermediate nuclear residues can include a variety of materials that can be liquid or solid, coming from the daily processes carried out in normal operation or from decommissioning. Examples can include paper smears, resins, sludge, concrete, etc.

For many of the previously enumerated radionuclides, the expected levels will be high enough to be measured by AMS in similar conditions as environmental samples. More emphasis has to be put on the radiochemistry, as the isotopic ratios can be, in some cases, high. Sample preparation will then need to

include carrier addition or isotopic dilution to reduce these ratios. Apart from this, radiochemical methods will need to be adapted to every kind of matrix.

The AMS facility at CNA is based on a 1 MV Tandetron and was installed in 2005. Its relatively low maximum terminal voltage makes it difficult to reach very low levels for some of the long-lived radionuclides that are traditionally detected by AMS, for example ^{36}Cl and ^{41}Ca. For them, we expect to evaluate the detection limits that the combination of radiochemical processes and machine set up can offer to reduce the detection limits that other techniques can offer.

In this talk we will present some of the results obtained up to now as well as the strategies and the experiments that are being currently performed in order to fulfil the described objectives.