

ON-LINE ANALYSIS OF U, Pu AND Am IN URINE BY COUPLING BETWEEN
CHROMATOGRAPHY BASED ON FUNCTIONALISED CALIX[6]ARENES COLUMNS
AND INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY

Céline Bouvier-Capely, IRSN/PRP-Hom/SDI/LRC, 31, avenue de la division Leclerc, 92260
Fontenay-aux-Roses, France, celine.bouvier@irsn.fr

Sarah Baghdadi^{1,2}, , Gérard Cote², François Rebière¹,

¹ IRSN/PRP-Hom/SDI/LRC, 31, avenue de la division Leclerc, 92260 Fontenay-aux-Roses,
France,

² PSL Research University, Chimie ParisTech - CNRS, Institut de Recherche de Chimie Paris, 11
rue Pierre et Marie Curie, 75005 Paris, France.

In the event of a nuclear accident or a terrorist attack, radionuclides may be released into the atmosphere. Alpha emitters such as actinides are a far-reaching issue as they would create severe damages at the cellular level. Current protocols used especially for individual monitoring of nuclear workers are based on actinides analyses in urine by alpha spectrometry after urine mineralisation and actinides separation on chromatographic columns. The detection limits are very low and the methods are accurate and sensitive, but it takes 7 to 15 days to get an acceptable result regarding ICRP recommendations and dose regulations. That is why it cannot be used in case of an emergency with loads of people potentially contaminated and thousands of samples to deal with. Emergency protocols have already been developed with reduced sample volume and shorter counting time for alpha spectrometry. However, detection limits obtained are much higher than the ones for routine protocols.

The Radiochemistry laboratory of the French Institute for Radiation Protection and Nuclear Safety developed calix[6]arenes-based chelating molecules specific of actinides. This project, funded by the IRSN and the Ministry of Defense, aims at developing a fast analysis method (less than 8h) of actinides in urine by coupling a calix[6]arene-based chromatographic column to an ICP-MS.

The use of a trishydroxamic calix[6]arene-based column allows to extract simultaneously 97% of plutonium, 81% of americium and 61% of uranium from mineralised urines. The uranium extraction is matrix dependent and investigations were conducted to improve it as well as to find the right solvent to elute quantitatively all three actinides. A semi-automated coupling between the column and ICP-MS was developed using an integrated sample injection system. It allowed the optimisation of the chromatographic parameters regarding both column dimensions and elution flow-rate. Two calibration methods (external calibration and internal standard) were validated on synthetic samples and real urine samples. The results show that the total analysis time is below 8 hours with the mineralisation step included. The performances of this new protocol will be presented at the conference and detection limits compared to those of alpha spectrometry.