

Activity concentration and atomic ratio of man-made actinides determined by a quadrupole mass spectrometry

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Current practice primarily constrains routine control of the radiological situation to radioisotopes identifiable by gamma spectrometry. Given the potential for the selective release of radioactive contamination, particularly alpha emitters, the existing monitoring strategy may be inadequate for detecting nuclear events. Novel solutions are required to address these challenges. A key recommendation for nationwide and international nuclear safety monitoring networks is to incorporate regular measurements of pure beta and alpha emitters within all environmental contexts. In light of the above concerns, a rapid method was developed and implemented for determining ^{236}U , ^{237}Np and $^{239, 240}\text{Pu}$ by the Agilent 8900#100 ICP MS/MS (Agilent Technologies) in conjunction with the Apex IR desolvating nebuliser (Elemental Scientific). Prior to the measurement process, a sequential radiochemical procedure was employed, encompassing ashing at 600 °C, microwave mineralisation and separation on TEVA or UTEVA resins (Triskem International). Radioisotopic standards of ^{239}Pu , ^{242}Pu , $^{239}\text{Pu}/^{242}\text{Pu}$, $^{233}\text{U}/^{236}\text{U}$ and $^{236}\text{U}/^{238}\text{U}$ (NIST, EC-JRC) were utilised for method calibration, whereas reference materials of IAEA-385 and IAEA-447 (IAEA) were employed for quality assurance purposes. The measurements were conducted in energy discrimination or mass shift modes, using He or O₂ gas in the collision-reaction cell, respectively, to eliminate polyatomic and isobaric interferences. The outcomes of this approach included not only activity concentrations of ^{236}U , ^{237}Np , ^{239}Pu and ^{240}Pu , but also atomic ratios of $^{236}\text{U}/^{238}\text{U}$, $^{236}\text{U}/^{239}\text{Pu}$, $^{237}\text{Np}/^{239}\text{Pu}$ and $^{240}\text{Pu}/^{239}\text{Pu}$. The LOD level was calculated to be equivalent to a few femtograms of the radionuclides examined.