



Contribution ID: 696

Type: Invited

Rapid Method for the Determination of Actinides and 93Zr in Radioactive Waste, Biological and Environmental Samples

Thursday, 17 May 2018 10:30 (30 minutes)

A novel method based on the retention and sequential elution of all actinides on a single small DGA resin® column has been developed and published recently¹. DGA resin® is an actinide selective extraction chromatographic material which contains N,N,N',N'-tetraoctyldiglycol-amide sorbed onto Amberchrom CG-71 inert support (developed by Horwitz et al.², available from Triskem International). According to the original procedure, nuclear power plant waste samples were wet ashed, actinides were pre-concentrated by co-precipitation, and the chromatographic procedure was optimized by changing the nature, the acidity of the eluents, the oxidation states of the actinides, the concentration of complexing agent, and the temperature. Alpha sources were prepared by micro-coprecipitation. ²⁴¹Am, ^{239,240}Pu, ²³⁸Pu, ²³⁸U, ²³⁵U, ²³⁴U were determined by alpha spectrometry, ²³⁷Np was determined by ICP-MS.

Making advantage of the extremely high distribution ratios (D_w) of all tri- and tetravalent actinides on DGA resin, the pre-concentration step was omitted and sample solutions originating from 100 mL waste concentrates were directly loaded and processed, therefore recoveries were increased, actinides were successfully determined.

Due to the high retention (D_w) of Zr on the resin, the method was extended for determination of ⁹³Zr in radioactive wastes using ICP-MS for detection.

The method was also adopted for the analysis of environmental samples (soil, sediment). The rapid fusion technique using NaOH was applied to 5g of sample according to Maxwell et al.³ Sample solution was loaded without pre-concentration on the resin followed by the optimized sequential elution process.

The method was also adopted for the determination of actinides in 100-200 mL urine samples where not only the pre-concentration but the urine destruction was omitted.

High recoveries and decontamination factors were obtained in each alpha and ICP-MS source. The methods became much simpler and faster, typically the complete analyses of actinides and ⁹³Zr could be performed in one day.

References:

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Session Classification: NAM 4

Track Classification: Nuclear Analytical Methods