Method for Determination of Neptunium in Large-Sized Urine Samples Using Manganese Dioxide Coprecipitation and $^{242}$Pu as Yield Tracer

A novel method for bioassay of large volumes of human urine samples using manganese dioxide coprecipitation for preconcentration was developed for rapid determination of $^{237}$Np. $^{242}$Pu was utilized as a nonisotopic tracer to monitor the chemical yield of $^{237}$Np. A sequential injection extraction chromatographic (SI-EC) system coupled with inductively coupled plasma mass spectrometry (ICPMS) was exploited to facilitate the rapid column separation and quantification. The analytical results demonstrated satisfactory performance of the MnO$_2$ coprecipitation as indicated by the high chemical yields close to 100% and high separation capacity of processing up to 5 L of human urine samples. The MnO$_2$ coprecipitation process is simple and straightforward in which a batch (8–12) of samples can be pretreated within 4 h (i.e., <0.5 h/sample). In connection with the automated column separation and ICPMS quantification, which takes less than 1.5 h in total, the overall analytical time was on average less than 2 h for each sample. The high effectiveness and sample throughput make the developed method well suited for urine bioassay of $^{237}$Np in routine monitoring of occupationally internal radiation exposure and rapid analysis of neptunium contamination level for emergency preparedness.

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