Uranium and thorium preconcentration from liquid samples via the use of a polymeric complexing membrane

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The present work summarizes the already implemented research and the subsequent progress in uranium and thorium preconcentration from liquid samples, via the use of a polymeric complexing membrane which consists of a PVC matrix, DBP plasticizer, Aliquat-336, and calcon carboxylic acid complexant. It is produced in liquid form after dissolving the aforementioned ingredients in THF. The technique relies on membrane stabilization within glassware following the dryness of THF. The liquid samples are added above, and the complexation is carried out under continuous stirring. After complexation, the membranes are digested with c. HNO_3, and c. HCl, and are finally dry-ashed. The leftovers are utilized for the separation of radionuclides, either through anion exchange or extraction chromatography. The measurements are performed by alpha spectrometry after electroplating of radionuclides on stainless steel plates.

This technique has already been applied in uranium analysis of water samples, achieving recoveries of the order of 96±5 % for tap water and 93±6 % for seawater [Kallithrakas et al., 2018]. They have also been used in uranium analysis in urine samples with a final recovery of 78±6 % [Xarchoulakos et al., 2022]. The great advantages of the technique are the speed of complexation and that the analysis was very efficient even in seawater.

Currently, the above membrane is applied in thorium analysis in water samples. After membrane digestion and ashing, the residue is dissolved in 8M HNO_3, separated via anion exchange, and eluted in 10M HCl solution [Lee et al., 2005]. The first experiments resulted in thorium recovery of the order of 45% for a 0.25 L sample and a contact time of 4 hours. A flowchart of the thorium analysis is depicted in Figure 1. To optimize thorium recovery, the following factors must be studied:

The equilibration time, the composition of the membrane, the sample's volume, and the complexation temperature. A back-extraction process will also be applied to reduce the time of sample preparation.

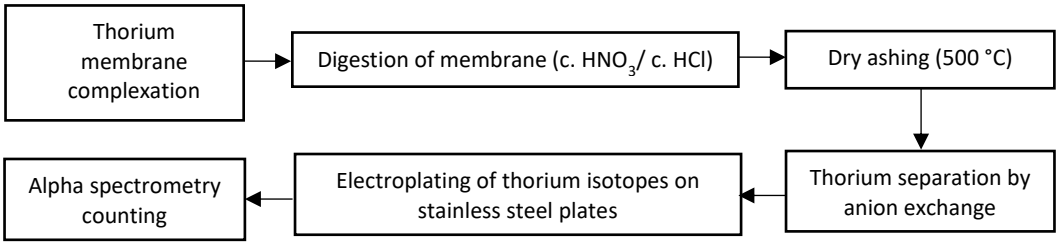

Figure 1. Thorium analysis after preconcentration by membrane complexation.

References

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