Characterization of a TBP Resin and development of methods for the separation of actinides and the purification of Sn

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Introduction

TBP is a widely used extractant in liquid–liquid extraction, especially in the extraction of actinides, one of its most prominent examples being the Purex process. A TBP based extraction chromatographic resin has been characterized with respect to its U capacity and the weight distribution ratios (D_W) of U, Th, Pu, Np and numerous other cations in different concentrations of HNO_3 and HCl. Based on obtained data methods for the separation of Pu from Th and U, and for the purification of Sn, with special focus on decommissioning and radionuclide production, have been developed.

Weight distribution ratios D_W and maximum U uptake

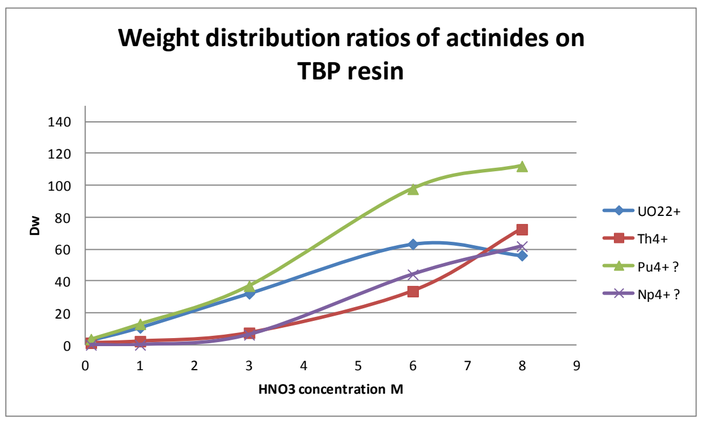

Figure 1: Weight distribution ratios of U, Th, Pu and Np on TBP resin from various HNO_3 concentrations

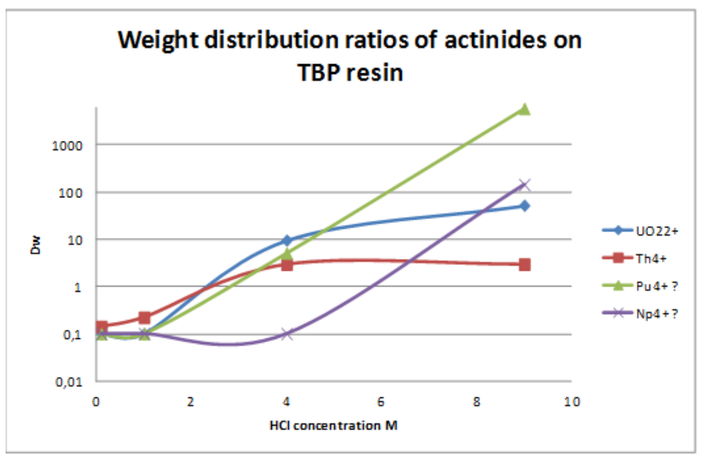

Figure 2: Weight distribution ratios of U, Th, Pu and Np on TBP resin from various HCl concentrations

The maximum uptake of the TBP resin was determined to be in the order of 75 mg $U.g^{-1}$ in 8M HNO_3

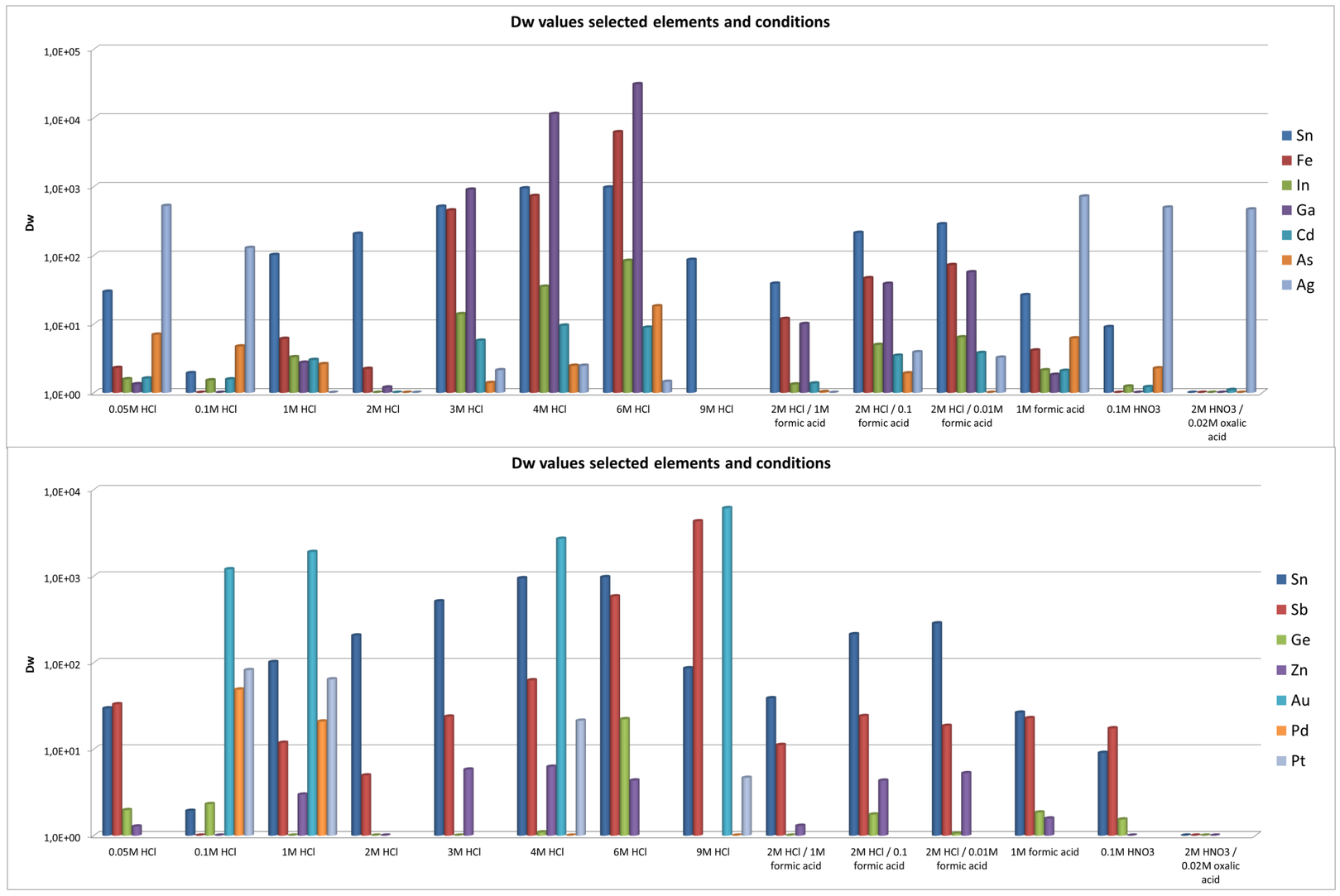

Figure 3: Weight distribution ratios of selected elements from various solutions

- D_W values = 60-110 for tetra- and hexavalent actinides
  - moderate D_W compared to TEVA/UTEVA/TRU/DGA Resins
- Easy strip of actinides at lower acid concentrations
- Interesting selectivities for Sn, Sb and noble metals

Elution studies

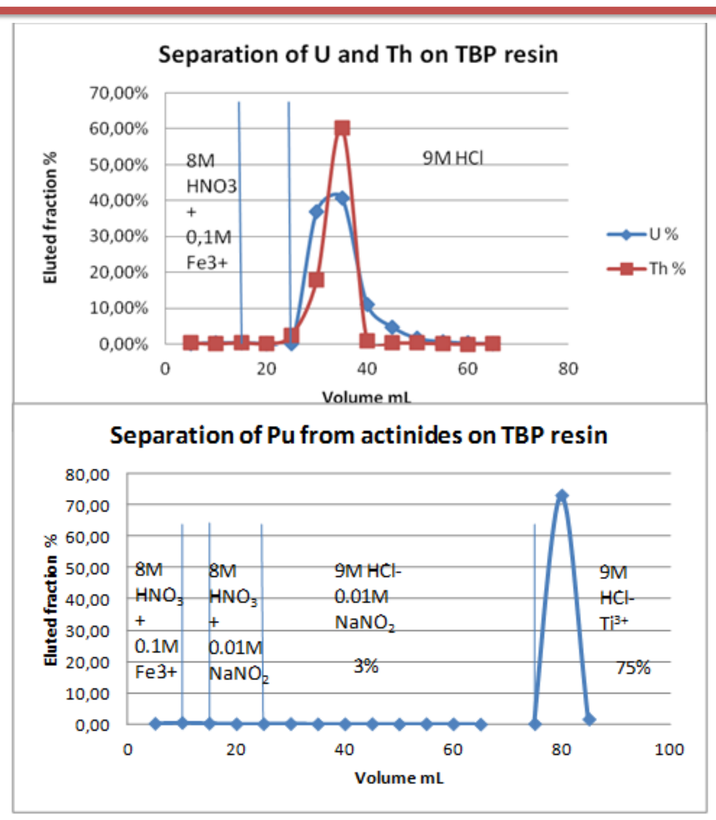

Figure 4: Chromatogram of U, Th and Pu elution from TBP resin column. Each fraction contained 0.01M $NaNO_2$

- Good Pu recovery in small elution volume
- Pu fraction free of Th and Am, U ≤ 1,4%

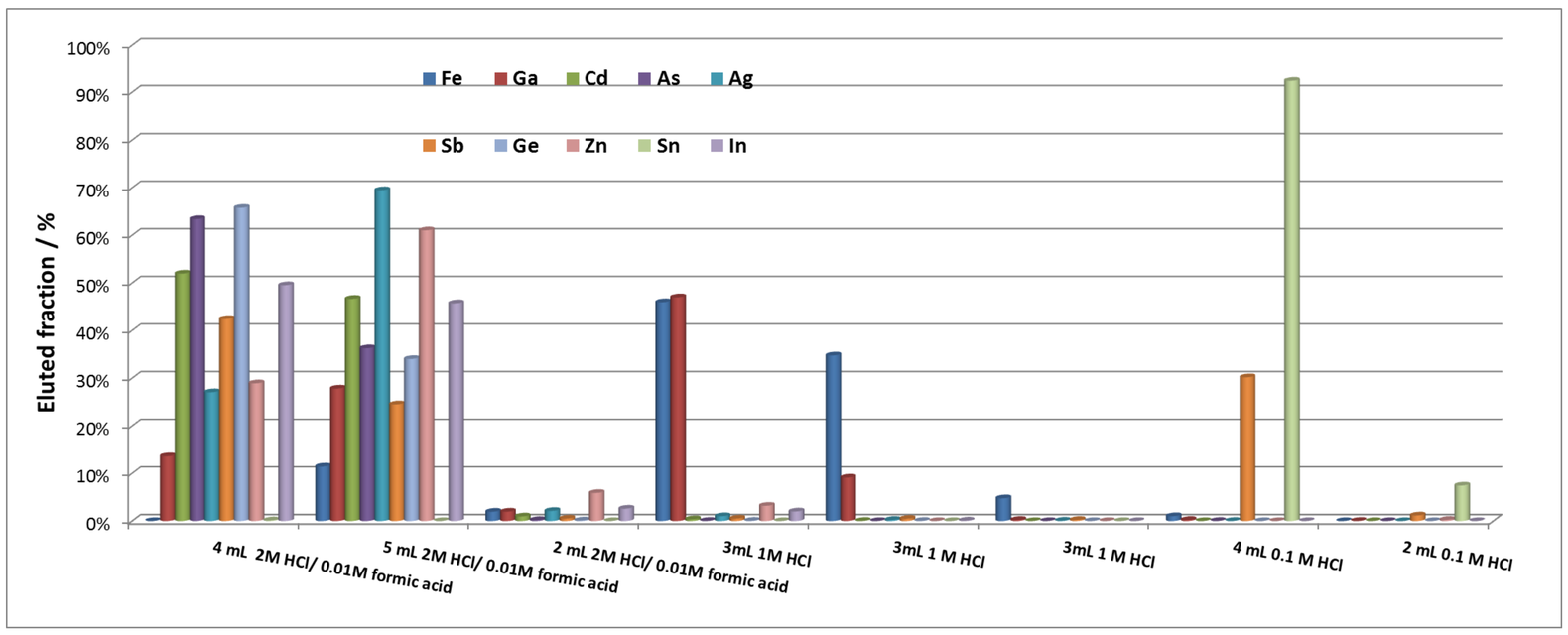

Figure 5: Elution study, Sn separation from multi-element mix, on 0.4g TBP Resin column

- TBP resin well suited for Sn purification
  - Most elements elute under loading conditions (Cd, As, Ag, Ge, Zn, In)
  - Fe/Ga removed with 9mL 1M HCl
  - >90% Sn eluted in 6mL 0.1M HCl
  - Contrary to obtained D_W data 30% Sb co-eluted => Sb(III)/Sb(V) adjustment necessary

Conclusions

- **TBP resin characterized with respect to D_W values and maximum U uptake**
- **Good selectivity for Pu(IV)**
- **Method development via elution studies**
- **Can be applied to Pu separation in water samples, clean Pu separation**
- **High potential for Sn separation/purification**
- **Sn separation method developed**
  - **Fields of application: decommissioning, radionuclide production and geochemistry**
- **Potential application to noble metal and Sb separation/purification**

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