



## PRODUCT SHEET

### TBP resin

#### Main Applications

- Separation of tin
- Separation of actinides

#### Packing

Order N°.	Form	Particle size
TBP-B25-A, TBP-B50-A, TBP-B100-A, TBP-B200-A	25g, 50g, 100g and 200g bottles TBP resin	100-150 µm
TBP-C20-A, TBP-C50-A	20 and 50 2 mL TBP resin columns	100-150 µm
TBP-B10-S, TBP-B25-S, TBP-B50-S, TBP-B100-S, TBP-B200-S	10g, 25g, 50g, 100g and 200g bottles TBP resin	50-100 µm

#### Physical and chemical properties

Capacity : 75 mg U/g Resin TBP

#### Conditions of utilization

Recommended T of utilization : 20-25°C

Flow rate: A grade: 0.6 – 0.8 mL/min, utilization with vacuum or with pressure for s grade resin

Storage: Dry and dark, T<30°C

*For additional information see enclosed literature study*

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## PRODUCT SHEET

### TBP RESIN

The TBP resin is comprised of an inert support impregnated with Tributylphosphate (TBP, see fig. 1).

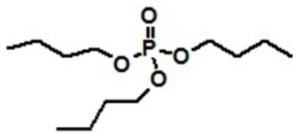


Figure 1: TriButylPhosphate (TBP)

TBP is a widely used extractant, it e.g. finds application in the Purex process, the reprocessing of U and Pu from spent fuel. Other applications include e.g. the separation of yttrium for analytical purpose.

Figure 2 shows the  $D_w$  values of selected actinides on the TBP resin in  $\text{HNO}_3$  and  $\text{HCl}$ <sup>(1,2)</sup>.

In general the actinides show an increasing retention at increasing acid concentrations. However, of all actinides only Pu shows  $D_w$  values higher than 100 in  $\text{HNO}_3$ , whereas the other actinides peak at  $D_w$  values between 60 and 80. Pu is even stronger retained at high  $\text{HCl}$  concentrations ( $D_w > 1000$  on 9M  $\text{HCl}$ ), retention of the other actinides, with exception of Np in 9M  $\text{HCl}$  ( $D_w=140$ ) is rather low, especially Th(IV) shows very little affinity to the TBP resin.

Nora Vajda et al. could show that the TBP resin can be used for the separation of Pu from other actinides and developed a method for its use for the determination of Pu in water samples<sup>(2)</sup>.

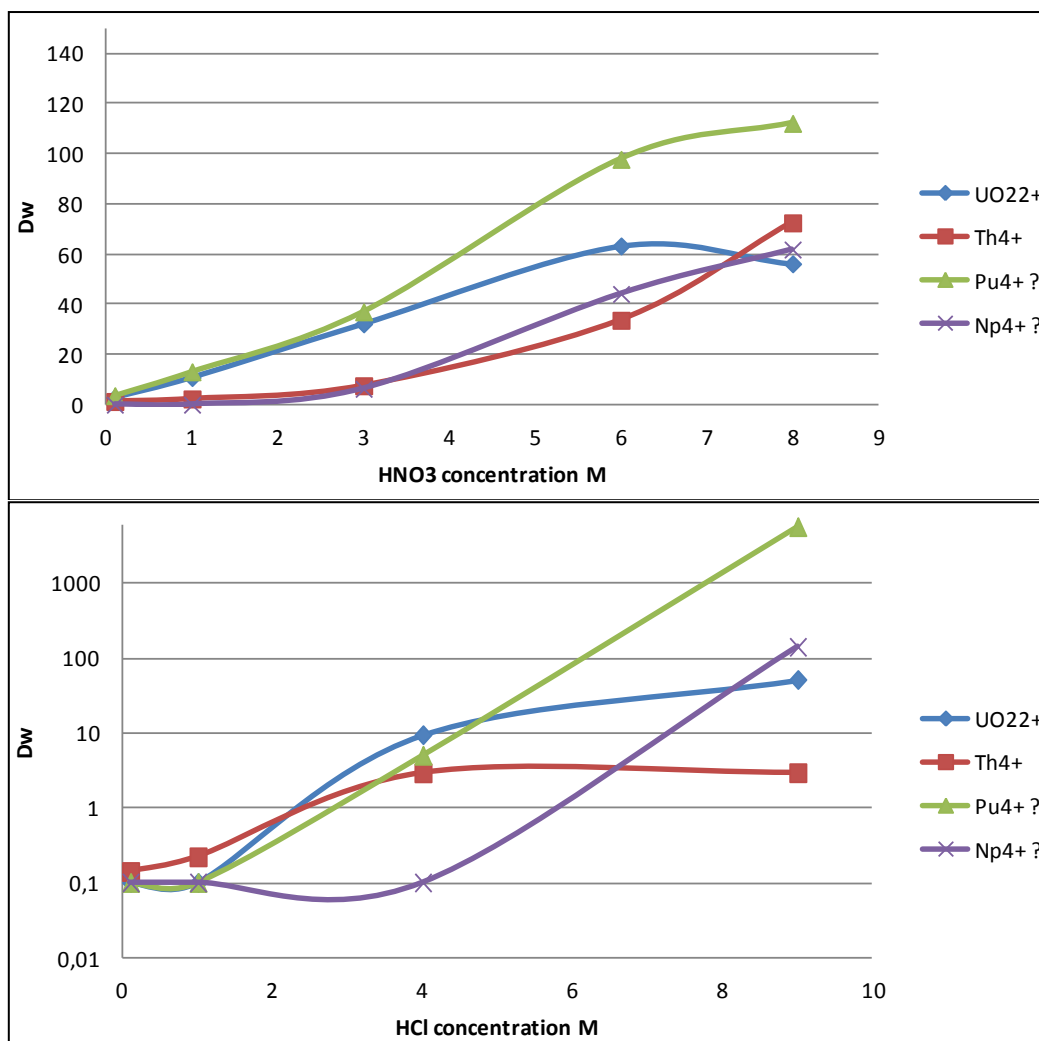


Figure 2 :  $D_w$  values of selected actinides in  $\text{HNO}_3$  and  $\text{HCl}$  media on TBP Resin<sup>(1)</sup>

## LITERATURE STUDY

Vajda et al. also evaluated the influence of Fe(III) and three anionic interferences (oxalic, sulfuric and phosphoric acid) on the U and Pu uptake<sup>(2)</sup>. In 8M HNO<sub>3</sub> a Fe concentration of 0.1M is not interfering with the uptake of U(VI) and Pu(IV), the same is true for Np(IV) and Th(IV). Contrary to that the same Fe concentration very strongly interferes with the retention of U and Pu in 9M HCl.

Figures 3 and 4 show the impact of increasing amounts of anionic interferences on the retention of U(VI) in 8M HNO<sub>3</sub> and of Pu(IV) in 9M HCl.

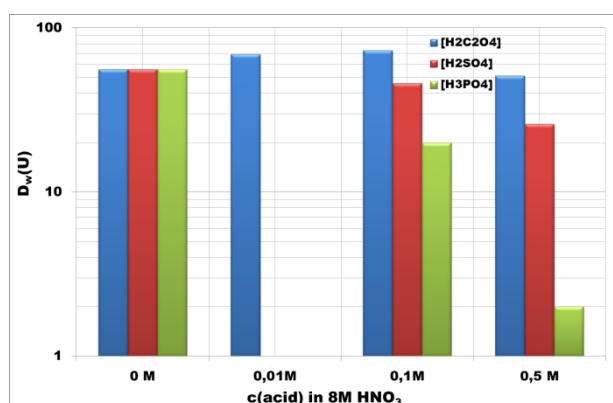


Figure 3 :  $D_W$  values for U in 8M HNO<sub>3</sub>, increasing amounts of anionic interferences<sup>(2)</sup>.

Oxalates show no interference with the U uptake even at concentrations of up to 0.5M. Sulfate, and especially phosphate, interfere significantly when present in elevated amounts.

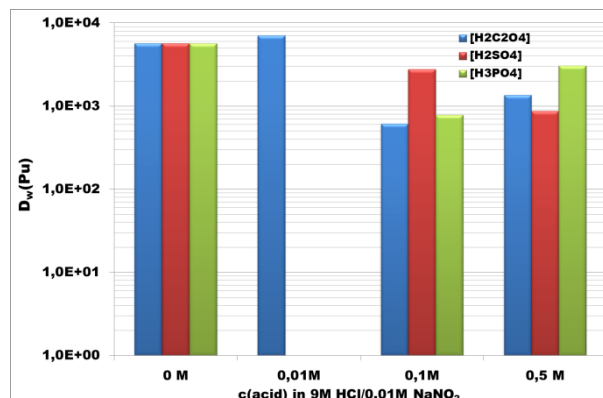


Figure 4 :  $D_W$  values for Pu in 9M HCl, increasing amounts of anionic interferences<sup>(2)</sup>.

The Pu(IV) extraction from 9M HCl is very robust, although the tested anions do interfere with its uptake when present in concentrations  $\geq 0.1M$ , the  $D_W$  values of Pu still remain greater than 500.

The TBP resin has further been characterized with respect to the uptake of various elements in HNO<sub>3</sub> and HCl, the results are summarized in figures 5 - 9.

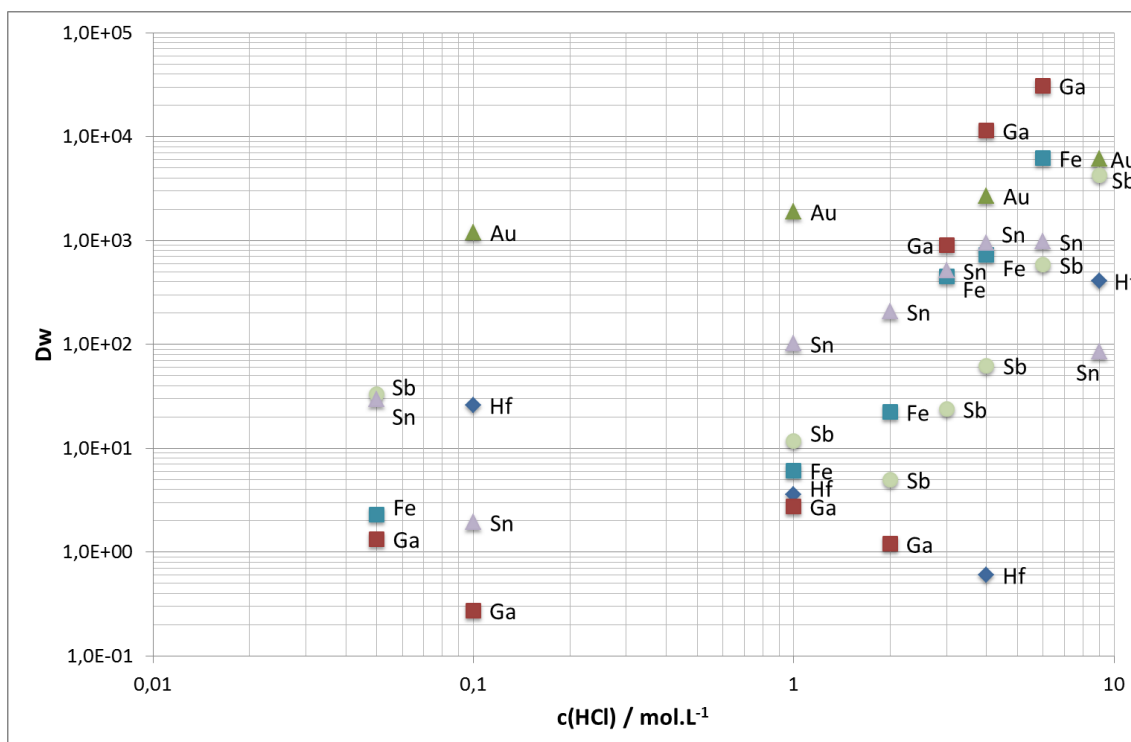


Figure 5 :  $D_W$  values of selected elements on TBP resin in HCl according to (1).

## LITERATURE STUDY

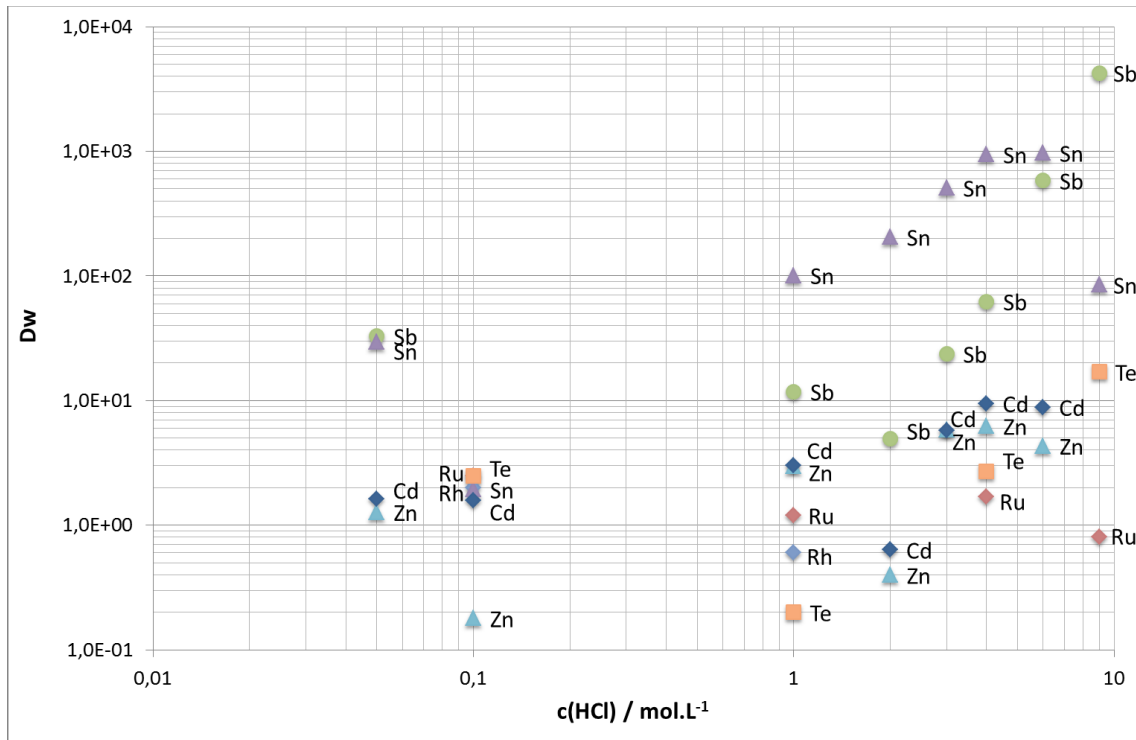


Figure 6 :  $D_w$  values of selected elements on TBP resin in HCl according to (1).

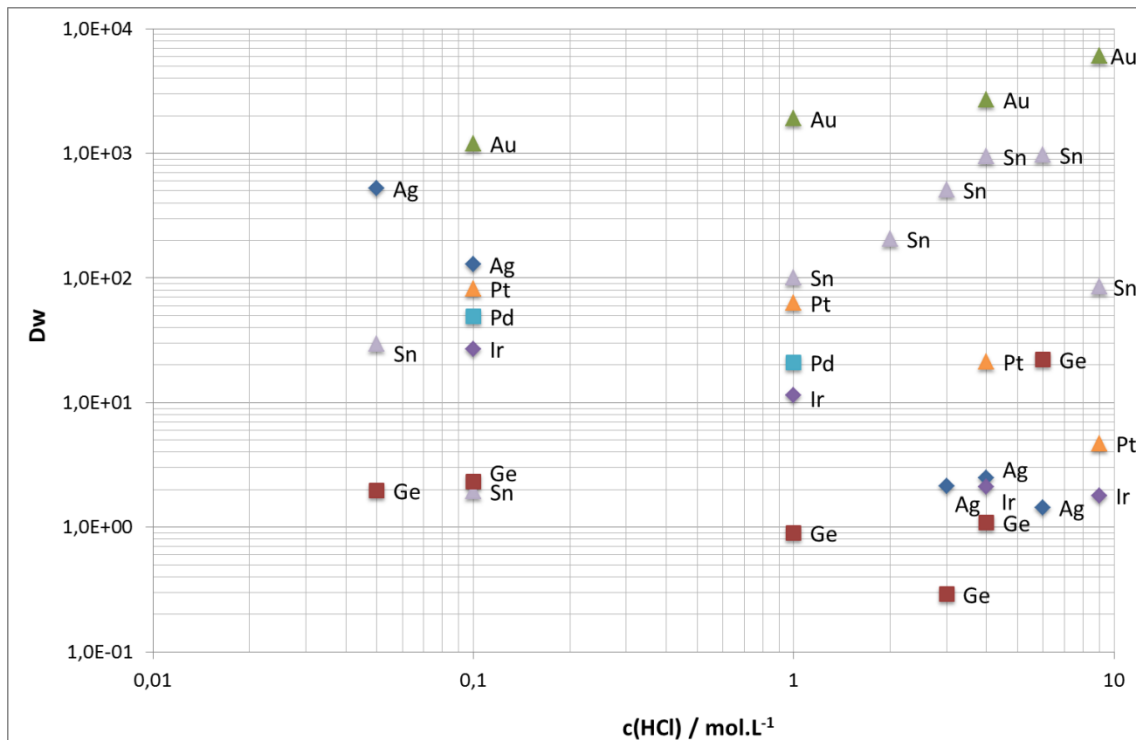


Figure 7 :  $D_w$  values of selected elements on TBP resin in HCl according to (1).

## LITERATURE STUDY

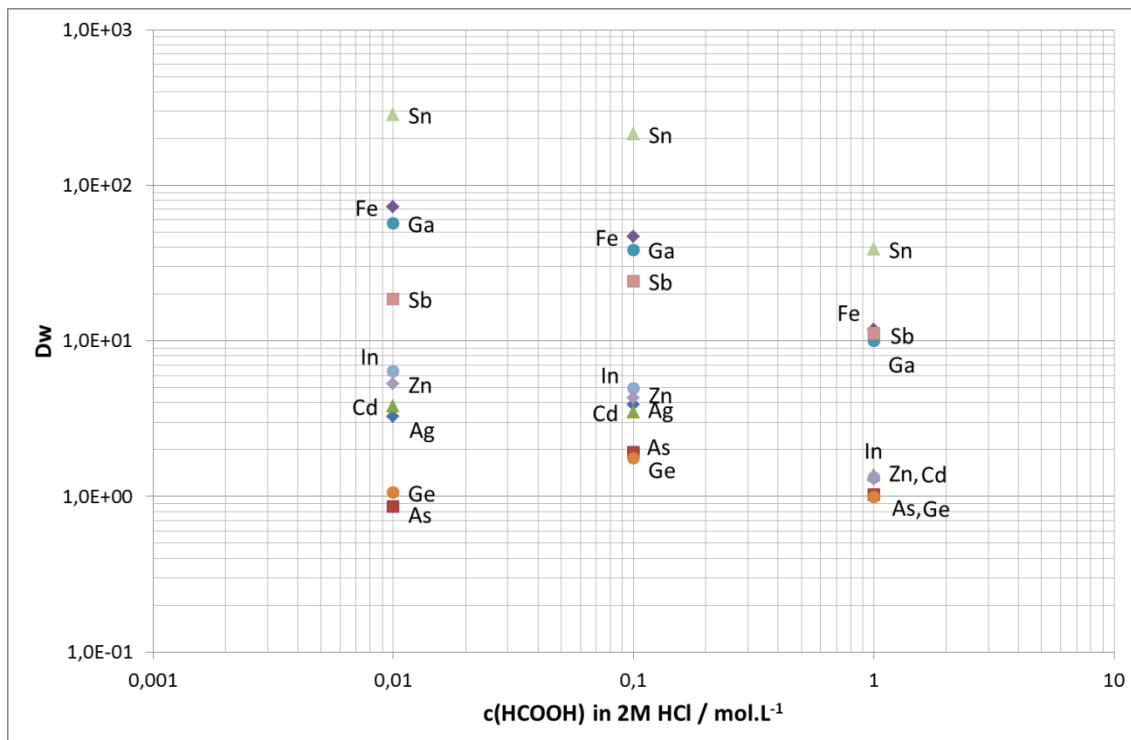


Figure 8 :  $D_w$  values of selected elements on TBP resin in 2M HCl / varying concentrations of formic acid according to (1).

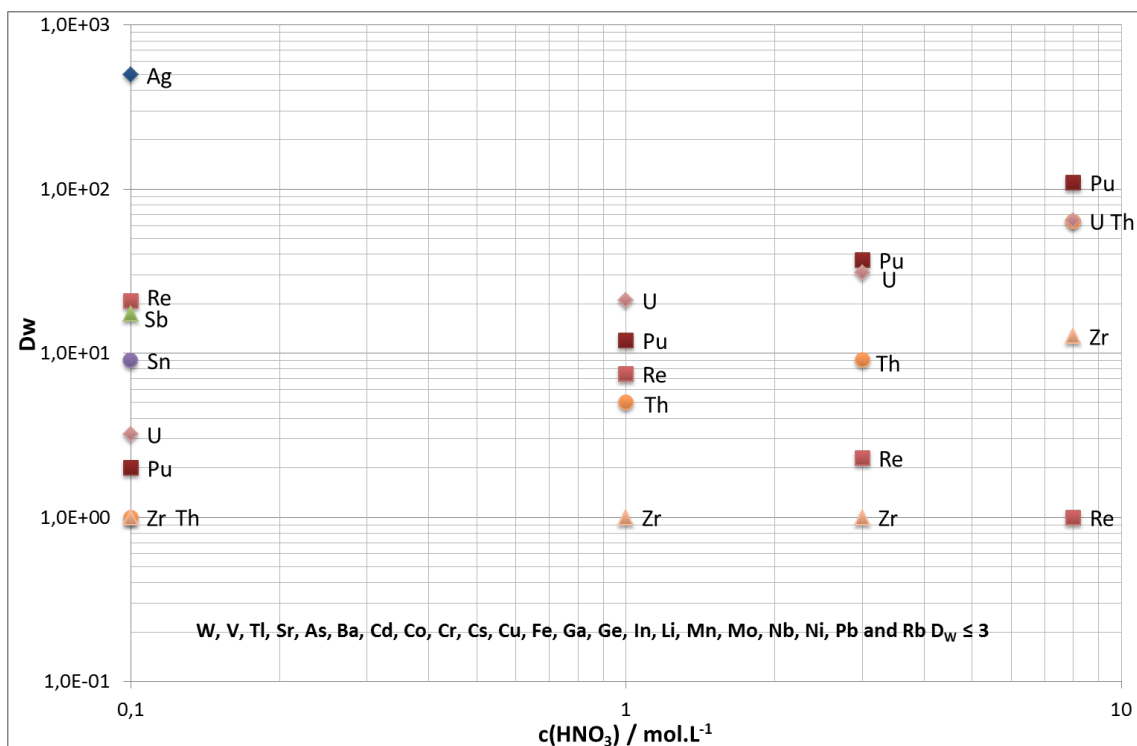


Figure 9 :  $D_w$  values of selected elements on TBP resin in HNO<sub>3</sub> according to (1)

## LITERATURE STUDY

Beside Pu(IV) and Np(IV) several other elements such as Au, Hf, Fe, Sn and Ga also show high affinity for the TBP resin in HCl (figure 5).

While Au remains retained under all tested conditions, making its elution rather difficult in HCl, the other elements only show high  $D_W$  values at elevated acid concentrations, and low  $D_W$  values at lower concentrations. In 1 M HCl for example only Sn shows elevated  $D_W$  values whereas Fe, Ga, Sb... show very little affinity to the resin, allowing for its separation from these elements. Sn can then be eluted e.g. with 0.1M HCl.

The influence of different concentrations of formic acid on the extraction of selected elements from 2M HCl has been tested in order to evaluate the impact of reducing conditions; results are shown in Fig. 8.

The TBP resin generally shows very good selectivity for Sn over Te (Te-126 is an isobaric interferences for the mass spectrometric

determination of Sn-126, a long-lived beta emitter frequently determined in decommissioning and radioactive waste samples) and Cd which is frequently used as target material for the production of Sn-117m, a conversion electron emitter used in nuclear medicine. The resin also shows interesting selectivity for Sb, however its oxidation state needs to be carefully controlled.

Of all tested elements only the actinides (at elevated  $\text{HNO}_3$  concentrations), and Ag (at low  $\text{HNO}_3$  concentrations), are retained on the resin.

Based on the obtained data, Dirks et al. developed a procedure for the separation of Sn from various elements, fig. 10 shows a scheme of the proposed method using a 2 mL TBP column. Fig. 11 shows the results of an elution study performed using this procedure<sup>(1)</sup>.

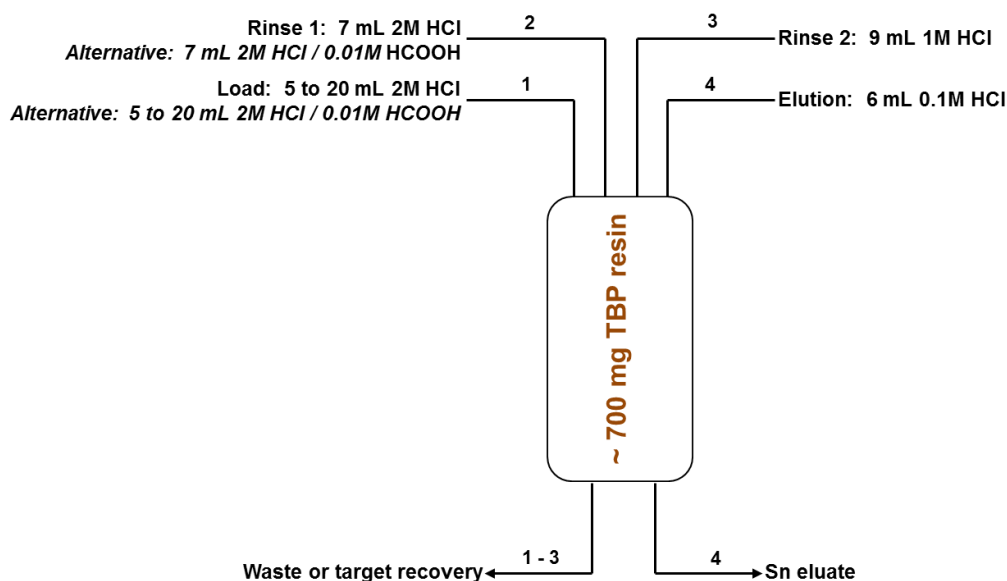


Figure 10 : Separation scheme Sn separation on TBP resin according to (1).

## LITERATURE STUDY

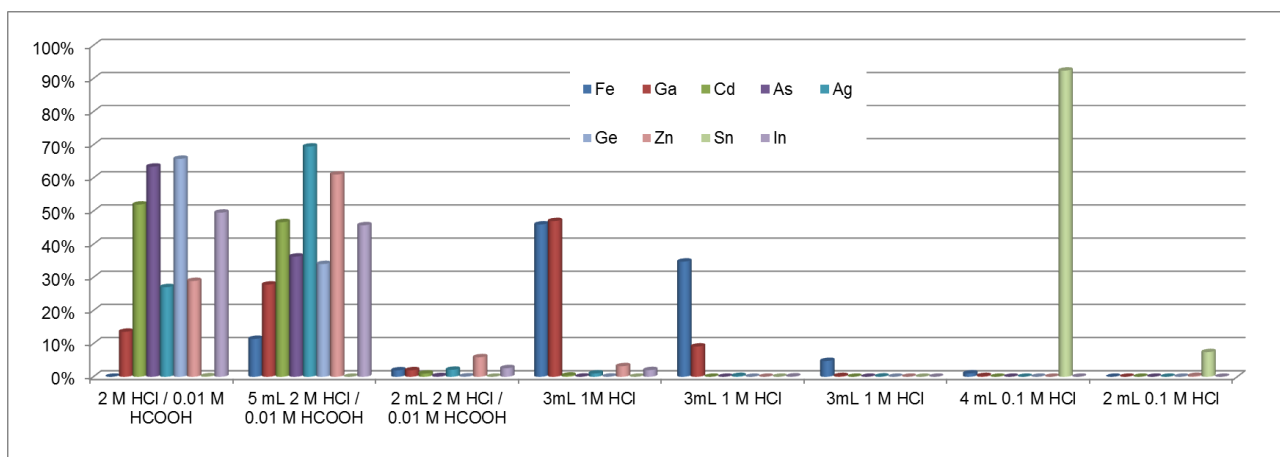


Figure 11: Elution study Sn separation on TBP resin<sup>(1)</sup>.

Most of the tested elements are not retained during load and first rinse. Sn and part of the Ga and Fe are retained. The latter two are first removed with 1M HCl, Sn is then quantitatively eluted with 6mL 0.1M HCl in high purity. For samples containing elevated amounts of Fe it will be necessary to either remove Fe before loading (e.g. by anion exchange) or to assure complete reduction of Fe to Fe(II).

### Bibliography

- (1) Dirks C, Vajda N., Kovács-Széles E., Bombard A., Happel S.: "Characterization of a TBP Resin and development of methods for the separation of actinides and the purification of Sn" Poster presented at the 17th Radiochemistry conference, Mariánské Lázně (Czech Republic), 11 - 16 May 2014
- (2) Dirks C et al. "Characterization of a TBP Resin and development of methods for the separation of actinides and the purification of Sn", presentation at the TrisKem International Users Group Meeting in Bath (UK), 16.09.14: [http://www.triskem-international.com/iso\\_album/tbp\\_resin\\_separation\\_of\\_actinides\\_and\\_the\\_purification\\_of\\_sn.pdf](http://www.triskem-international.com/iso_album/tbp_resin_separation_of_actinides_and_the_purification_of_sn.pdf)