



PRODUCT SHEET

Beryllium Resin (BE Resin)

Main Applications

- Separation of Beryllium

Packing

Order N°.	Form	Particle size
Available on request		50-100 µm

Physical and chemical properties

Density : 0.352 g/ml

Capacities :

Element	Capacity (mg ion/g of resin)
Th(IV)	86.1
U(VI)	145.7
Nd(III)	45.4
Fe(III)	32.1
Ca(II)	14.8
Ba(II)	45.0
Be(II)	0.64

Conversion factor D_w/k' : 1.94

Conditions of utilization

Recommended T of utilization: /

Flow rate: Utilization with vacuum or with pressure for s grade resin

Storage: Dry and dark, $T < 30^\circ\text{C}$

For additional information see enclosed literature study

Methods

Reference	Description	Matrix	Analytes	Support
Application note 602	Beryllium analysis – Matrix removal for more reliable ICP-AES analysis	metal, salts, alloys	Beryllium	bulk, cartridges

LITERATURE STUDY

Beryllium resin (DIPEX™)

The Beryllium resin (BE Resin) is used for the separation of beryllium from environmental and industrial matrices. Beryllium metal is frequently used in the nuclear industry due to its thermal and mechanical properties, as well as its capacity as neutron moderator and reflector.

Beryllium is toxic for lung tissue. The main uptake path is the inhalation of dusts or aerosols. The exposition to air with high Be concentration can lead to the acute beryllium disease. The exposition to low concentrations of Be over an extended periods can lead to the so called chronic beryllium disease (CBD); the symptoms can appear up to 30 years after the exposition. With respect to its toxicity its monitoring is of high importance in case of a risk of exposition. Horwitz and McAllister^{(1) (2)} developed a fast and robust method for the determination of Be via ICP-AES in environmental samples and samples from the surveillance of industrial installations handling Be.

The BE resin is composed of an inert support that has been impregnated with the DIPEX™ extractant (figure 1).

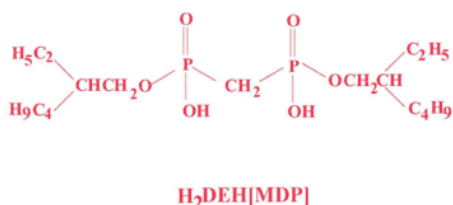


Figure 1 : DIPEX™⁽³⁾ extractant.

Figure 2 shows the extraction kinetics of Be, it indicates that the extraction equilibrium is reached after 40 minutes.

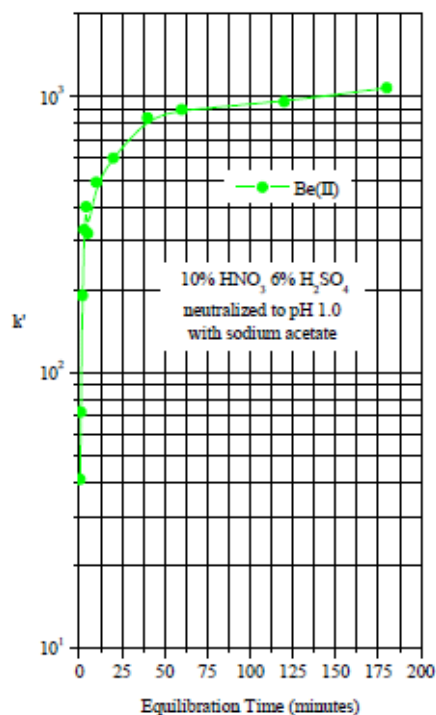


Figure 2 : Kinetic of the Be extraction onto BE resin. Extraction conditions: Be solution 10%-HNO₃ - 6% H₂SO₄ stabilized at pH1 with sodium acetate; 22+/-2°C, 50-100µm resin.

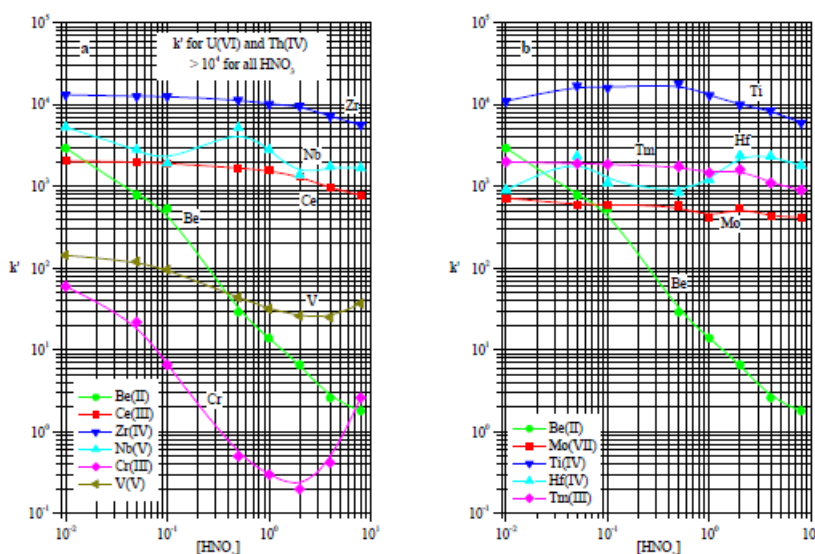


Figure 3 : Retention profile of elements spectrally interfering with Be in ICP-AES^{(1) (2)}.

LITERATURE STUDY

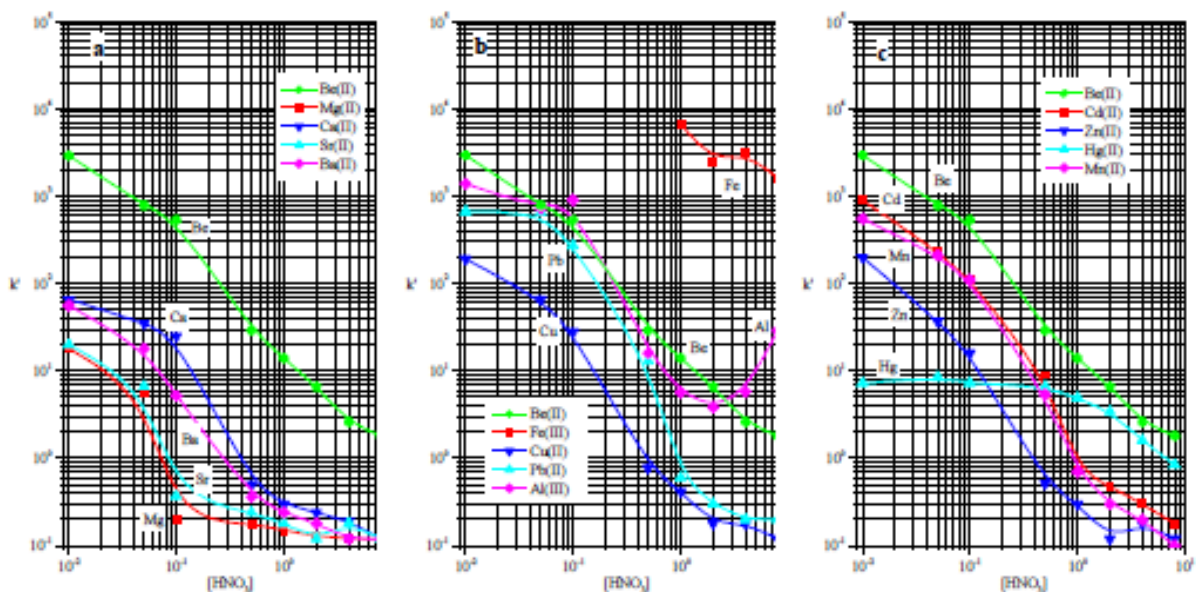


Figure 4 : Retention profile of elements showing a matrix interference with Be in ICP-AES^{(1) (2)} .

McAllister and Horwitz characterized the BE resin not only for Be, but also for other elements that could interfere with the measurement of Be by ICP-AES (figure 3) or that could interfere with its extraction (figure 4).

Be is strongly retained between pH 1 and pH 2 and can be eluted using nitric acid of a concentration greater than 1M. Zr, Nb, Ce, Ti, Hf, Tm and Mo are strongly retained over the whole acid concentration range, these elements will not interfere with the Be measurement with ICP-AES (figure 3).

Cr, Ca, Ba, Pb, Cu, Al, Cd, Mn, Zn and Hg are potential interferents for the retention/elution of Be on the BE resin.

Following the obtained data the authors established a method for the separation of Be (figure 5):

- The sample load solution containing $\text{HNO}_3/\text{H}_2\text{SO}_4/\text{H}_2\text{O}_2$ is stabilized at pH 1 to 2 using a 3.4M sodium acetate solution.
- The resin is rinsed with 0.2M HNO_3 .
- Be is finally eluted with 4M HNO_3 at a flow rate of 1mL/min.

The chemical yield of the separation was reported to be greater than 90% for industrial and environmental samples. The authors applied their method amongst other to filter samples, for these they could find results in the range of 0.0428 to 0.1452 μg of Be per 100cm^2 of filter material.⁽⁴⁾

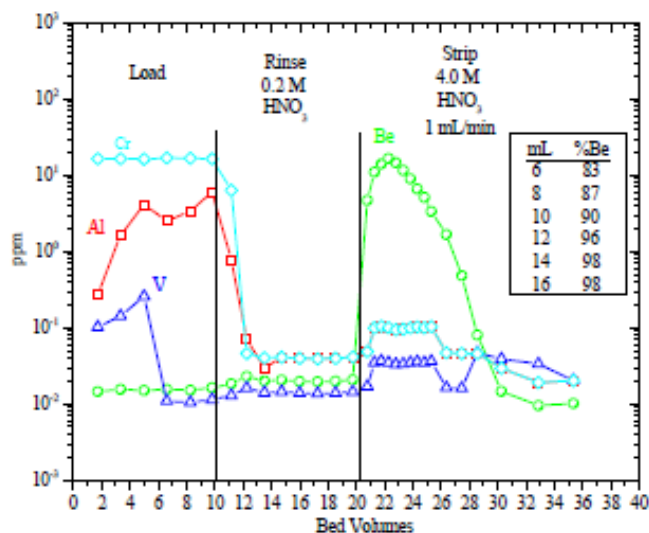


Figure 5 : Elution of Be, Al, Cr and V from a 2mL cartridge of BE resin (50-100 μm) ; 22 \pm 1 $^\circ\text{C}$; matrix : ashless filter 5.5cm diameter spiked with 140 μg Al, Be, Cr and V – wet digested using H_2SO_4 and H_2O_2 , addition of 10mL HNO_3 and stabilization at pH 1 with a 3.4M sodium acetate solution.

LITERATURE STUDY

One of the main interferences of beryllium is uranium. One method of separating Be and U is based on the use of LN2 or LN3 resin. Both resins contain phosphonyl groups which show a very high affinity for U(VI) over a large range of acid concentrations. By using LN2 or LN3 as guard column upfront to the BE resin they extract the U(VI) while Be passes and is then fixed on the BE resin⁽¹⁾ (Table 1).

Bibliography

- (1) D.R. McAlister et E.P. Horwitz, *Talanta*, 67,5 (2005) 873-879 // Eichrom reference MD105.
- (2) E.P. Horwitz et D.R. McAlister, *Solvent Extraction and Ion Exchange* 23,5 (2005) 611-629 // Eichrom reference HP105.
- (3) E. P. Horwitz, R. Chiarizia, et M. L. Dietz, *Reactive and Functional Polym.* 33 (1997) 25-36 // Eichrom reference HP197.
- (4) Application note 602, Eichrom Technologies LLC – 01/06/2006

mg U	2mL BE resin		2mL BE resin +2mL LN2		2mL BE resin +2mL LN3	
	% Be in 12mL ^b	µg U in Be fraction	% Be in 12mL ^b	µg U in Be fraction	% Be in 12mL ^b	µg U in Be fraction
0.14	90	<1,5 ^c	85	<1,5	N/A	N/A
10	92	<1,5	N/A	N/A	N/A	N/A
25	86	<1,5	87	<1,5	97	<1,5
50	61	<1,5	88	<1,5	97	<1,5
75	N/A	N/A	81	<1,5	93	<1,5
100	29	580	88	<1,5	79	<1,5

Table 1: Beryllium yields and uranium impurity vs mg Uranium in Load Solution

^a Whatman filter paper spiked with 0.14mg Be, digested with H₂SO₄/H₂O₂, and neutralized with sodium acetate to pH 1.8

^b Beryllium resin strip solution 4.0 HNO₃

^c Detection limit for uranium by ICP-AES under experimental conditions