ideas

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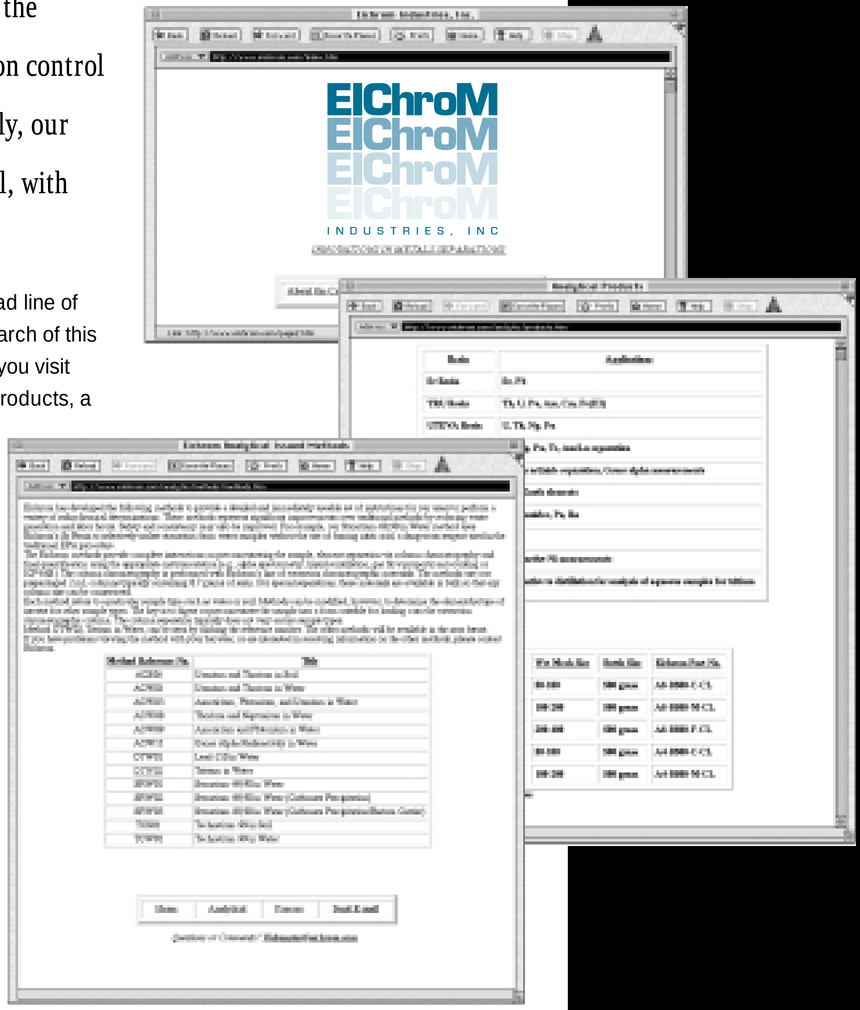
Over the past few years, Eichrom's product offerings have both grown and diversified. On the one hand, we supply small columns of highly selective chromatographic resins to radioanalytical laboratories, and on the other, we install multi-million dollar iron control systems in copper mines. Simultaneously, our business has become increasingly global, with our products in use on all continents.



To facilitate the challenge of providing this broad line of products and services to a global market, in March of this year Eichrom inaugurated our own web site. If you visit the site, you will find a listing of our analytical products, a bibliography of applications and published papers, and a summary of available Eichrom-developed methods. If you find something referenced that you don't have, call or e-mail us **(info@eichrom.com)** and we'll send it to you.

In coming months, we'll also be improving and expanding the scope of our web page. So, if you have any suggestions on how we can better communicate with you, our customers, please let us know. Your input would be invaluable.

UTEV

In the last issue of *Eichrom Ideas*, we began a series of articles which explain the basic characterization information available for each of Eichrom's resins. In the last issue, the TRU Resin was highlighted. In this issue, we present the UTEVA Resin.

UTEVA Resin has been applied to a variety of analytical challenges: uranium measurements in environmental samples, sample preparation of high uranium content samples prior to analysis for other elements, the sequential determination of uranium, plutonium, and americium, the measurement of actinides in urine, and the measurement of actinides in high level waste. Documentation on these applications is available from Eichrom. (Table 1 below, lists Eichrom's reference numbers for each application. Contact Eichrom to obtain a copy of these references or a complete bibliography of references on Eichrom products.)

Table 1— Selected Documentation on UTEVA Applications

Application	*Eichrom Reference Numbers*
Uranium in environmental samples	AA192, AM195, CO196, HP293
Preparation of high uranium samples	CK195, GC195
Sequential determination of U, Pu, Am	ACW03, HB196
Actinides in urine samples	LR195
Actinides in high level waste	MS193, MS194

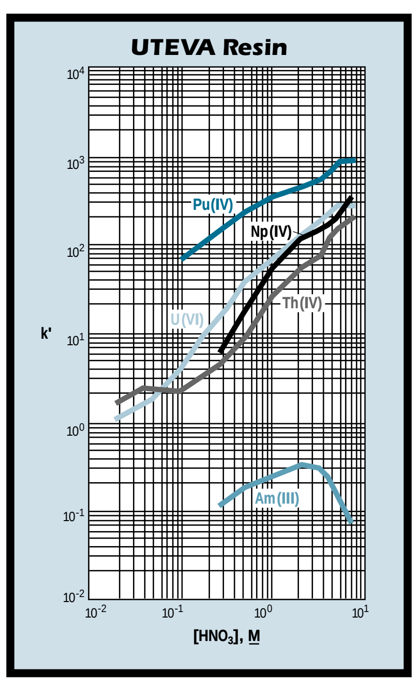


Figure 1: Nitric Acid Dependency of k' for Actinide Ions.

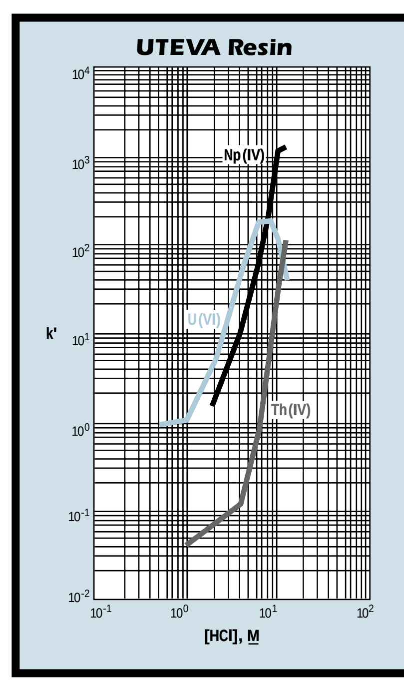
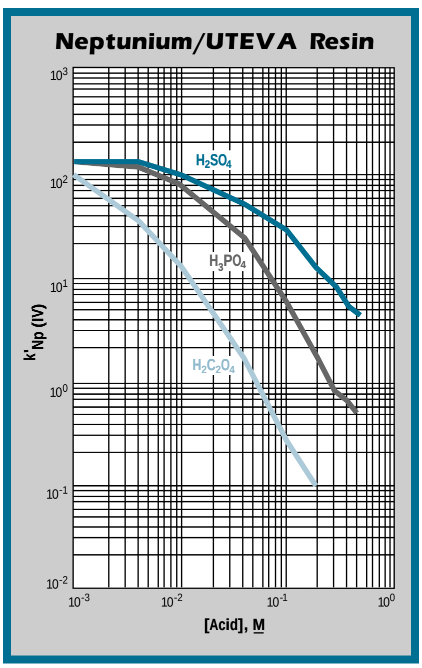
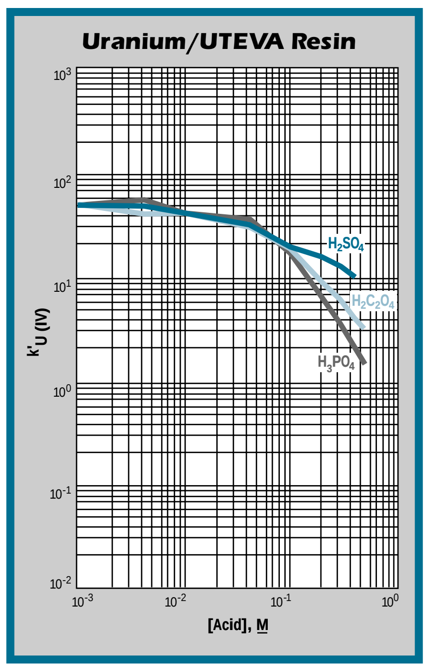


Figure 2: Hydrochloric Acid Dependency of k' vs. for Selected Actinide Ions.

VA Resin





Figures 3 and 4: The Effect of Certain Polyatomic Anions on the k' of Neptunium (figure 3) and Uranium (figure 4) from 2M HNO_3.

The extractant in the UTEVA Resin, diamyl, amylphosphonate (DAAP), forms nitrato complexes with the actinide elements. The formation of these complexes is driven by the concentration of nitrate in the sample solution. Therefore, the uptake of the actinides increases with increasing nitric acid concentration. Figure 1 is a plot of the k' (a measure of uptake corresponding to the number of free column volumes to peak maximum) vs. nitric acid concentration.

It can be seen that the uptake from nitric acid is very similar for each of the tetravalent actinides and uranium. All have strong retention (k'>100) above 5M nitric acid. Note that Am is not retained at any nitric acid concentration. This fact is important in developing analytical separation schemes. Plutonium can be reduced to Pu(III) with ferrous sulfamate. At this valence state, it behaves the same as Am(III).

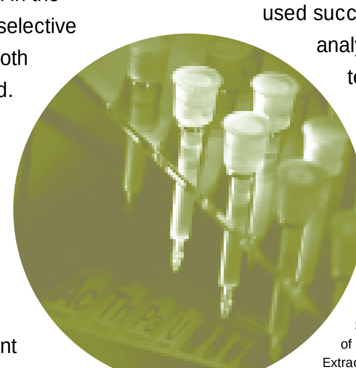
Figure 2 is a similar graph, but shows the effect of HCl on the retention of tetravalent neptunium and thorium and hexavalent uranium on UTEVA Resin. The large difference in k' for uranium and thorium in the range of 4–6M HCl allows for the selective elution of Th from the resin after both Th and uranium have been loaded.

Figure 1 implies that uranium can be stripped efficiently from the UTEVA Resin with a relatively small volume of very dilute nitric acid (*e.g.,* 0.01–0.05M). In practice, however, it appears that very dilute HCl is more efficient in stripping uranium and it is recommended that where possible, HCl be used in place of nitric acid.

As in most analytical situations, the presence of significant concentrations of matrix elements can affect the proper operation of methods based on UTEVA Resin. Figures 3 and 4 show the effect of certain polyatomic anions on the retention of neptunium and uranium, respectively, from 2M nitric acid. It should be noted that the effect on tetravalent neptunium is more significant than the affect on uranium. It has been seen in practice that thorium is affected similarly to neptunium by these anions.

Because phosphate occurs quite commonly in a variety of biological and environmental samples, its effect is most relevant. Fortunately the addition of aluminum to the sample matrix can significantly reduce this issue. Phosphate anion will readily complex tetravalent actinides. This phosphato complex is not extracted by the DAAP. Added aluminum can effectively tie up the phosphate preventing its interference with neptunium (or thorium) uptake by the resin. In some methods, as much as 1M $Al(NO_3)_3$ might be added to counteract the effects of phosphate.

As demonstrated by the application papers listed in Table 1, the UTEVA Resin has been used successfully for years in the analysis of uranium and tetravalent actinides. If you would like a copy of any of the papers referenced, contact Eichrom.



SOURCE: E.P. Horwitz, M.L. Dietz, R. Chiarizia, H. Diamond, A.M. Essling, and D. Graczyk; Separation and Preconcentration of Uranium from Acidic Media by Extraction Chromatography," *Analytica Chimica Acta*, 266 (1992) 25-37.

Frequently Asked Questions

1 What is the capacity of UTEVA Resin for uranium?

The total experimentally measured capacity of UTEVA Resin is 37 mg of uranium per milliliter of resin. This value corresponds to 74 mg per 2mL prepacked column or approximately 100 mg per gram of resin. When using UTEVA Resin for the analysis of uranium, we recommend you not exceed a useful working capacity of 20% of the measured total capacity or 15 mg uranium per prepacked UTEVA Resin column.

2 Can aluminum interfere with the separation of uranium on the UTEVA Resin?

Aluminum by itself appears to cause no problems in the successful separation of uranium on the UTEVA Resin. In the presence of fluoride, however, it can be of concern. Aluminum fluoride (AlF_3) has been observed to follow uranium through the column separation and appear as a fine, white solid in the source preparation. If this is observed, the column eluent (uranium fraction) can be taken to dryness a few times with boric acid. This process will drive off the fluoride as BF_3 and eliminate AlF_3.

3 What is the shelf life of Eichrom Resins?

Eichrom warrants all of our resin products to meet our specifications for a period of one year from the date of purchase.

References

Recent Papers Highlighting Eichrom Products...

Bunzl, K., Flessa, H., Kracke, W., and Schimmack, W., "Association of Fallout $^{239+240}$Pu and ^{241}Pu with Various Soils Components in Successive Layers of a Grassland Soil," *Environmental Science and Technology,* vol. 29, p. 2513 (1995).

Agaplina, G.I., Tikhomirov, F. A., Shcheglov, A.I., Kracke, W., and Bunzl, K., "Association of Chernobyl-derived $^{239+240}$Pu, ^{241}Am, ^{90}Sr, and ^{137}Cs with Organic Matter in the Soil Solution," *J. Environ. Radioactivity,* vol. 29, no. 3, pp. 257–269 (1995).

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Horwitz, E.P., Chiarizia, R., Dietz, M.L., "DIPEX: A New Extraction Chromatographic Material for the Separation and Preconcentration of Actinides from Aqueous Solution," *Reactive & Functional Polymers,* 00 (1997) REACT1088, pp. 1–12.

Rogers, R.D., Bond, A.H., Griffin, S.T., Horwitz, E.P., "New Technologies for Metal Ion Separations: Aqueous Biphasic Extraction Chromatography (ABEC™). Part 1. Uptake of Pertechnetate," *Solvent Extraction Ion Exchange,* 14, 919 (1996).

Chiarizia, R., Ferraro, J.R., D'Arcy, K.A., and Horwitz, E.P., "Uptake of Metal Ions by a New Chelating Ion Exchange Resin. Part 7: Alkaline Earth Cations," *Solvent Extraction Ion Exchange,* 13, 1063–1082 (1996).

Chiarizia, R., D'Arcy, K.A., Horwitz, E.P., Alexandratos, S.D., and Trochimczuk, A.W., "Uptake of Metal Ions by a New Chelating Ion Exchange Resin. Part 8: Simultaneous Uptake of Cationic and Anionic Species," *Solvent Extraction Ion Exchange,* 14, 519–542 (1996).

Chiarizia, R., Horwitz, E.P., D'Arcy, K.A., Alexandratos, S.D., and Trochimczuk, A.W., "Uptake of Metal Ions by a New Chelating Ion Exchange Resin. Part 9: Silica Grafted Diphosphonic Acid," *Solvent Extraction Ion Exchange,* 14, 1077–1100 (1996).

Methods for Eichrom Products Included in the DOE Methods Compendium

RP280	Determination of Lead-210 in Water Using Extraction Chromatography
RP300	Nickel-59 and Nickel-63 Determination in Aqueous Samples
RP501	Determination of Total Radioactive Strontium in High-level Samples using Extraction Chromatography (Rev. 1)
RP550	Technetium-99 Analysis Using Extraction Chromatography
RP725	Group Actinide Screening Using Extraction Chromatography
RP800	Sequential Separation of Americium and Plutonium by Extraction Chromatography

Upcoming Events...

AUTUMN 1997

- **Symposium on "Recent Advances in Metal Ion Separation and Preconcentration" at the 214th ACS National Meeting**
  September 7-11, 1997 .... Las Vegas, Nevada

- **37th ORNL-DOE Conference on Analytical Chemistry in Energy Technology**
  October 7-October 9, 1997 .... Gatlinburg, Tennessee

- **The 43rd Annual Conference on Bioassay, Analytical and Environmental Radiochemistry**
  November 9-13, 1997 .... Charleston, South Carolina

- **French Users' Meeting**
  Date to be determined .... To be announced

If you are interested in receiving additional information on any of these events please call...

Lynda Gates in the US at: **(800) 422-6693** —or— **(630) 963-0320**
Lesley Robertson in the UK at: **+44 (0) 1337 827 715**

Symposium Announcement

"Recent Advances in Metal Ion Separation and Preconcentration"

at the

214th American Chemical Society National Meeting
Las Vegas, Nevada
September 7-11, 1997

Symposium Organizers:

Mark L. Dietz, *Argonne National Laboratory*
Robin D. Rogers, *University of Alabama*
Andrew Bond, *Eichrom Industries, Inc.*

For more information about the seminar, or to submit a paper, contact Andrew Bond at Eichrom **(630) 963-0320** or send us an e-mail message (info@eichrom.com)

In This Issue...

Eichrom On-Line • UTEVA Resin • Upcoming Events

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Did You KNOW...

...That ASTM published a method in 1995 entitled, "Radionuclides in Soils by ICP-MS Using Flow Injection Preconcentration" (C1310-95). This method uses TEVA and TRU Resins from Eichrom.

...The latest issue of the DOE Methods Compendium includes six methods which use Eichrom Resins. A listing of these methods is included in the References section of this issue of Eichrom Ideas.

...Eichrom products are sold and used in over 25 countries on six continents.

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