EIChroM ideas

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In prior editions, I have used this column to inform our customers about Eichrom's efforts to provide better service and to solicit your ideas on how we could improve. Perhaps nothing typifies our efforts to improve as much as our development of a quality system for the company. I am pleased to announce that last month, Eichrom's quality system was certified to conform to the ISO 9002 standards.

ISO certification was a gratifying achievement that capped two years of effort. It is unquestionably an achievement that we share with those of you who have helped us to improve.

Eichrom's registration was performed by Underwriters Laboratories Inc. and covers 18 quality system elements that encompass manufacturing, inspection and testing. The ISO 9002 certification validates that our production and support systems are consistent with established worldwide quality standards. Just as importantly, it gives customers added assurance that Eichrom's products and services will continue to meet the standards that you expect — and that you helped to define.

ISO 9002 certification requires a commitment to continuous improvement of all of our products, services and quality assurance systems. Every Eichrom employee is committed to this goal, and we will work to improve our quality standards in the future.

Eichrom is fortunate to have a tremendously loyal base of customers. You have helped us define new standards of efficiency and cost-effectiveness in radiochemical sample preparation. We appreciate all that you have done, and hope that our efforts to ensure quality will reinforce your confidence in Eichrom and its employees.

Scott Wallace
President

"ISO certification was a gratifying achievement...

ISO 9002
Reg. #A3624
UL® REGISTERED FIRM

...It is unquestionably an achievement that we share with those of you who have helped us to improve."

Actinide RESIN

Eichrom's new Actinide Resin exhibits an extraordinarily high affinity for the actinide elements (Figure 1). Especially at pH values higher than 0, the retention of actinides is up to several orders of magnitude higher than even the TRU Resin. This makes the resin quite useful for the preconcentration of actinides out of large volume aqueous samples.

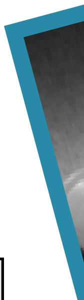
The effect of iron on the retention of the actinides is often a concern in radiochemistry. Figure 2 demonstrates the effect of Fe(III) and Fe(II) on the retention of Am(III) in a variety of HCl solutions. While the effect of ferric ion [Fe(III)] is significant, the effect of ferrous ion is minimal. In samples with suspected high concentrations of iron, the addition of a reducing agent, such as ascorbic acid, will minimize the effect of iron on the retention of americium.

Complexing anions (e.g., sulfate and phosphate) typically can interfere with the uptake of tetravalent actinides. This effect for the Actinide Resin is shown in Figure 3.

Even though the effect is significant, because the magnitude of the k' is so high to begin with, concentrations of these anions up to 0.5M result in k' for Np(IV) of greater than 10^4 and should cause no observable problems in typical analytical schemes.

Dr. E. Philip Horwitz and his group at Argonne National Laboratory measured the uptake of Am by the Actinide Resin from acidified river water. In their study, the ratio of sample size to amount of Actinide Resin was varied. The results suggest that one gram of the resin should be able to extract 99% of Am activity from up to 4L of water and 90% from up to 10L of water.

Eichrom is currently developing a variety of methods using this resin ranging from the concentration of actinides from large volume samples to the elimination of interferences in complex matrices like soil and feces. If you are interested in obtaining these methods when they are ready, please contact us for further information. We encourage you to evaluate Eichrom's Actinide Resin in your laboratory.



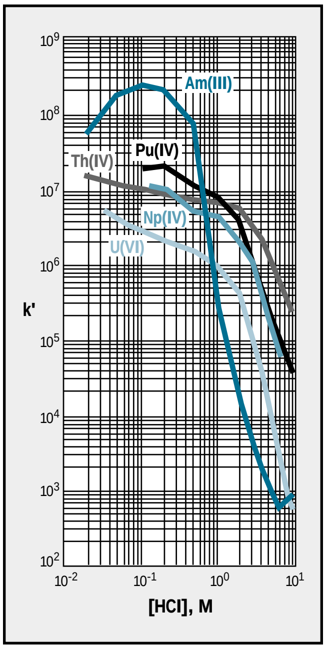
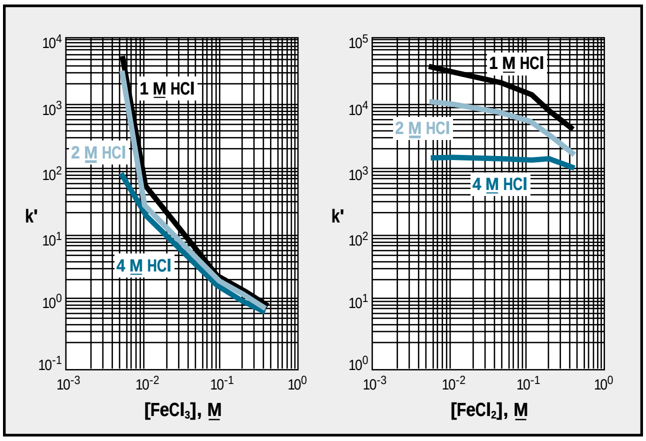


FIGURE 1 (above)

Uptake of various actinides by Actinide Resin



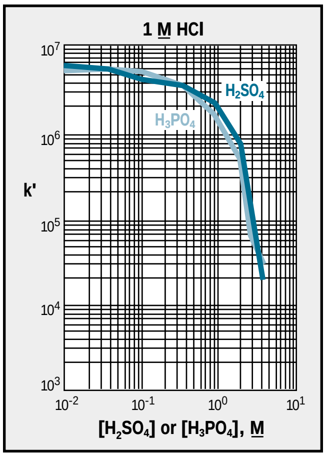


FIGURE 2 (above)

Effect of matrix cations on Am(III) uptake by Actinide Resin

FIGURE 3 (left)

Effect of H_2SO_4 and H_3PO_4 on Np(IV) uptake by Actinide Resin

Tritium

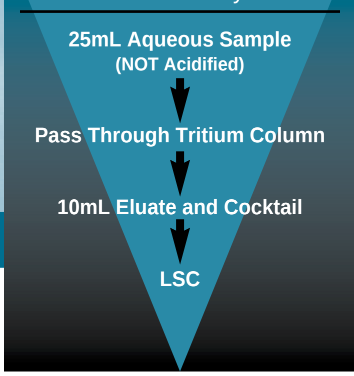
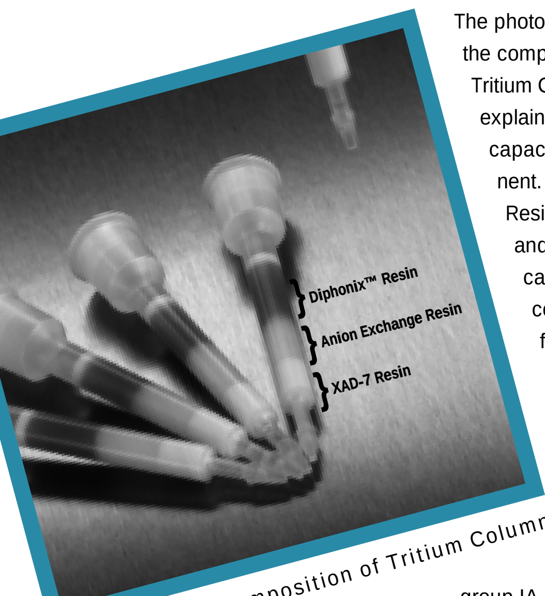


Figure 1
Tritium Analysis

Eichrom's new Tritium Column is designed to replace distillation for most routine tritium analyses of aqueous samples. The column works by removing potential interferences in the LSC spectrum, just as distillation does. It is not intended to be an enrichment procedure, and as such, it should be used only in situations where the required detection limit can be achieved by the direct counting of 10–12 mL of the samples. A flow chart for its use is shown in Figure 1.



The Composition of Tritium Column

The photograph [left] shows the composition of the new Tritium Column and Table 1 explains the purpose and capacity of each component. The Diphonix™ Resin removes cations, and while its theoretical capacity is 0.9 mEq per column, it is selective for transition metals and so its capacity for activation and fission products tends to be unaffected by the presence of high concentrations of group IA and IIA metals. The anion resin is standard analytical grade 1X8 resin. The XAD-7 component removes organically bound carbon-14 and tritium. The eluent from the column will contain only the aqueous tritium.

TABLE 1: Tritium Column

Component	*Target*	*Capacity*
Diphonix™ Resin	Cations	0.9 mEq
Anion Exchange Resin	Anions	0.9 mEq
XAD-7	Organic Molecules	50 mg

Table 2 shows the average spike recoveries for a variety of sample matrix types. The results of two side-by-side comparisons of the Tritium Column with a traditional distillation method are presented in Tables 3 and 4. The results show excellent agreement between the two methods with no apparent biases. These three studies together, spike recovery measurements and two side-by-side comparisons with the traditional distillation method, demonstrate that the method gives accurate results in a variety of sample types and across a broad range of tritium concentrations.

TABLE 2: Tritium Column Spike Recoveries

Sample Type	*^{3}H Spike (Bq)*	*Average Recovery*
Distilled Water	97.2	96.4%
Distilled Water	20.2	87.6%
Distilled Water	19.5	94.9%
Ground Water	17.1	91.2%
Sea Water	4.0	90.0%
Urine	85.1	91.1%

TABLE 3: US Power Plant Test Results
^{3}H Concentration Measured (Bq/L)

Sample Type	*Distillation*	*Column*
Surface Water-40	1.66 (± 0.24) x 10^{2}	1.92 (± 0.25) x 10^{2}
Surface Water-26	2.86 (± 0.26) x 10^{2}	2.99 (± 0.27) x 10^{2}
Groundwater-16	1.25 (± 0.041) x 10^{3}	1.26 (± 0.041) x 10^{3}
Groundwater-2C	1.73 (± 0.044) x 10^{3}	1.66 (± 0.044) x 10^{3}
BWR-RCS	1.02 (± 0.004) x 10^{5}	1.01 (± 0.004) x 10^{5}
PWR-RCS	1.62 (± 0.0) x 10^{7}	1.52 (± 0.0) x 10^{7}

Only counting error reported.
D. Cahill, Carolina Power & Light, New Hill, NC

TABLE 4: French Fuel Reprocessing Plant Test Results: ^{3}H Concentration (Bq/L)

Effluent Sample	*Distillation*	*Column*
1	2.05 x 10^{7}	2.04 x 10^{7}
2	4.7 x 10^{4}	4.4 x 10^{4}
3	1.8 x 10^{6}	2.1 x 10^{6}
4	9.2 x 10^{3}	9.6 x 10^{3}
5	6.4 x 10^{3}	6.5 x 10^{3}

J.C. Varin, Cogema, Beaumont-Hague France.

The column also successfully removes potential radioactive interferences. In a study performed at Eichrom, a mixture of radioisotopes (^{60}Co, ^{137}Cs, ^{233}U, $^{90}Sr/^{90}Y$, ^{210}Pb, ^{230}Th, total activity 16.9 Bq) was spiked into eight tritium-spiked solutions (distilled and sea water samples). In every case, after passing the sample through the Tritium Column, the number of counts in the region above the tritium window was not different than the number of counts in the same region of an un-spiked sample. In another experiment, Daniel Cahill of Carolina Power & Light measured the activity of fission and activation products in PWR and BWR reactor coolant samples before and after passing through Eichrom's Tritium Column. Table 5 summarizes the before column activity of each sample. After the column, no measurable activity was detected in the BWR sample and only a trace level of activity of ^{60}Co with >50% counting error was detected in the PWR sample. Because the amount of ^{60}Co measured was so low and the error so high, and because the BWR sample contained more than 10 times the ^{60}Co before the column and none after the column, it is assumed that the trace amount measured in the PWR sample is an artifact due to the background of the gamma counter.

TABLE 5: US Power Plant Testing

Isotope	*PWR Sample (Bq/L)*	*BWR Sample (Bq/L)*
Cr-51	2,900	1,900
Mn-54	518	5,590
Co-58	4,740	4,960
Fe-59	109	—
Co-60	392	5,990
Sn-113	230	—
Nb-95	4,220	116
Zr-95	2,210	—
I-131	14,200	—
Cs-134	1,120	—
Cs-137	1,320	—
La-140	—	1,550
Ce-144	—	203

D. Cahill, Carolina Power & Light, New Hill, NC

Another decontamination study was conducted by Dr. P. Chotard at the French Atomic Energy Commission laboratory at Saclay. An unidentified aqueous sample which contained the gamma emitting radionuclides shown in Table 6, was filtered. The LSC spectrum of this filtered sample is shown in Figure 3. A portion of this sample was distilled and a portion was passed through Eichrom's Tritium Column. The LSC spectra of the two are overlaid in Figure 4. The spectra are nearly identical indicating that Eichrom's Tritium Column decontaminates as well as the traditional distillation procedure.

TABLE 6: French Research Facility
Decontamination from Effluent Sample

γ-Emitting Radionuclide	*Activity (Bq/L)*
Mn-54	1.3 ± 0.5
Co-58	66 ± 5
Co-60	40 ± 5
Ag-110m	5.6 ± 0.9
Sb-125	2.0 ± 1.1
Cs-134	2.7 ± 0.6
Cs-137	24 ± 2

P. Chotard, CEA, Saclay, France.

The studies reported here, conducted in Eichrom's and customers' laboratories, demonstrate that the Tritium Column performs equivalently to the traditional distillation technique. We encourage you to try using this column as a substitute for distillation of your aqueous tritium samples.

FIGURE 3: LSC Spectrum of Filtered Sample

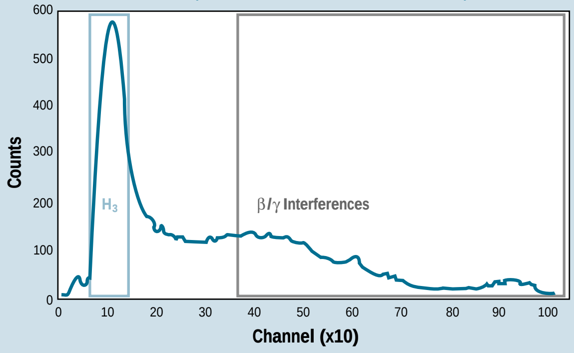
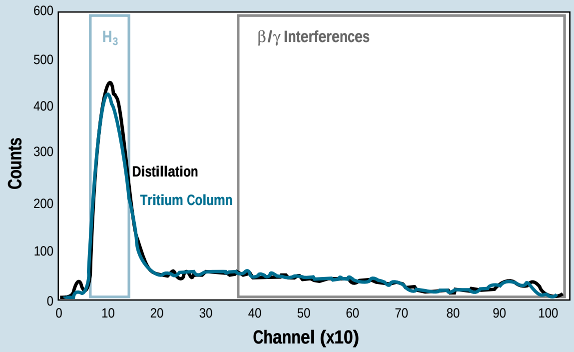


FIGURE 4: Distilled vs. Column



Events Calendar

Winter 1996

- **Rocky Mountain Users Seminar** — **Golden, CO**

Spring 1996

- **Southeast Users Seminar** — **Atlanta, GA**
- **Central/Northeast Users Seminar** — **Cincinnati, OH**
- **European Seminars** — **Germany, United Kingdom, France**

Summer 1996

- **Low Level Environmental Meeting** — **Japan**
- **West Coast Users Seminar** — **Oakland, CA**

Autumn 1996

- **Thirty-Seventh ORNL-DOE Conference on Analytical Chemistry in Energy Technology** — **Gatlinburg, TN**
- **42nd Annual Conference on Bioassay, Analytical and Environmental Radiochemistry** — **Charleston, SC**

Eichrom is considering holding several "hands-on" users workshops in both the U.S. and Europe in 1996. Each workshop would be approximately one week in length and there would be a fee associated with attending. If you might be interested in such a workshop, please call Susan Rajkovich in the U.S. at (800) 422-6693 or (708) 963-0320, or Richard Shaw in Europe at +44 (0) 1337 827715.

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Nickel Resin

Eichrom is pleased to announce that its new Nickel Resin is commercially available. The Nickel Resin has been successfully beta site tested; the results are excellent. Eichrom's Nickel Resin eliminates the need for laboratories to perform the messy dimethylgloxime precipitations, which are currently the most commonly used ^{59,63}Ni separation technique. If ^{55}Fe is present, it must be removed prior to using the nickel column. This can be performed by either an iron hydroxide precipitation or by performing a sequential separation, from a single sample aliquot, of ^{55}Fe on Eichrom's TRU Resin followed by ^{59,63}Ni on Eichrom's Nickel Resin. If Fe is not present, nickel isotopes can be separated directly on the Nickel Resin.

Nickel is retained because of the strong Ni-DMG complex that is formed. The physical characteristics of Eichrom's Nickel Resin are:

- 11% (w/w) DMG loading
- Resin Density ~ 0.25 g/mL
- Working Capacity ~ 3 mg Ni

Figure 1 [below] outlines the nickel procedure.

Dan Cahill's group at Carolina Power & Light evaluated the Nickel Resin. Table 1 presents the results of a side-by-side comparison of the nickel column with the standard DMG precipitation method.The chemical yields for the nickel columns were 90–105% versus 55–70% for the conventional method. The LLD was <6.5E-8 µCi/mL.

Figure 1
Nickel Procedure

Iron Hydroxide Precipitation
(or Fe-55 separation on TRU Resin)

↓

Dissolve and adjust pH to 8–9

↓

Load on column
(Ni seen in red band)

↓

Elute with 3 M HNO_3

↓

Measure Ni-63 by LSC
(Ni-59 by x-ray)

Table 1: Precipitation *vs.* Column
Ni-63 Activity Measured (µCi/Unit)

Sample Type	*Precipitation*	*Column*	*Ratio*
Laundry Waste	2.30×10^{-6}	2.38×10^{-6}	0.97
Lab Radwaste	2.66×10^{-6}	2.49×10^{-6}	1.07
RWCU Resin	1.83×10^{0}	2.05×10^{0}	0.89
Ni-59 Spike	1.00×10^{-2}	1.07×10^{-2}	1.07
Ni-63 Spike	5.07×10^{-4}	5.35×10^{-4}	1.06

Table 2: Precipitation *vs.* Column
Ni-63 Activity Measured (µC/Unit)

Sample Type	*Precipitation*	*Column*	*Ratio*
PWR Reactor Coolant	6.89×10^{-6}	5.80×10^{-6}	1.19
Waste Condensate Tank	4.31×10^{-6}	4.17×10^{-6}	1.03
Radwaste Filter	7.40×10^{-1}	7.79×10^{-1}	0.95
PWR Reactor Coolant	1.93×10^{-6}	1.60×10^{-6}	1.21
Duplicate PWR Coolant	1.84×10^{-6}	1.71×10^{-6}	1.08

D. Cahill, Carolina Power & Light, New Hill, NC.

Significant hands-on time savings of 12 hours for a group of six samples was realized using the nickel columns.

Additional data comparing the nickel columns to the precipitation method was generated and can be found in Table 2. The data was comparable.

The decontamination the nickel column provides is excellent, as seen in Table 3, where decontamination factors for a sample of RWCU resin are shown.

Table 3: Decontamination Factors

RWCU Resin Sample	
Cr-51	>37,000
Mn-54	270,000
Co-58	110,000
Co-60	113,000
Nb-95	13,700
Cs-134	>9,000
Cs-137	58,000

Waste reduction, in this particular laboratory, was realized because the new procedure allowed them to switch from Instagel® to Ultima Gold A/B®, an "environmentally friendly" cocktail.

The studies performed here demonstrate that the nickel column performs equivalently to the standard DMG precipitation method. Eichrom encourages all customers to try the nickel columns on your own samples and let us know what you think.

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Announcements

New Test Method Approved

A method for radioactive strontium in water, based on Eichrom's Sr Resin, has recently been approved by ASTM, an internationally recognized standards organization. The official approval date was October 11, 1995, but Eichrom's "Test Method for Strontium-90 in Water" has had international acceptance for many years. This method is significantly less costly, safer, easier to use and generates less waste than traditional methods. Printed copies of this method should be available from ASTM within 6 to 8 weeks. In the meantime, draft versions are available from Eichrom.

Charge It!

Eichrom Industries announces that we now accept VISA® and MasterCard®.

If you would like to place an order using your VISA or MasterCard, please call Cheryl Rollins or Sue Lukasik in our Customer Service Department at 800-422-6693 or 708-963-1481. We will require a confirmation copy of items ordered via fax or mail.

For additional information, contact:

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