

Tritium Columns

Introduction: Eichrom's Tritium Column is designed to replace distillation for most routine tritium analyses of aqueous samples. Methods using the Tritium Columns have been developed to shorten the preparation time and decrease waste generation for a variety of sample matrices.

The Approach: The Tritium 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 a 5-10 mL aliquot of the sample (plus cocktail) processed through the tritium column.

Shown in Figure 1 are the three components in the Tritium Column. Table 1 below explains the target contaminates and capacity each of the components in the column. The Diphonix® Resin removes cations in exchange for hydrogen ions and its theoretical capacity is 0.8 mEq per column. The anion resin is standard chloride form analytical grade 1X8 resin. It exchanges anions in the sample for chloride ions. (It is recommended that the sample pH be >1.) The polymethacrylate component removes organically bound tritium and carbon-14. Table 2 shows the average spike recoveries for a variety of sample matrix types passed through the tritium column.

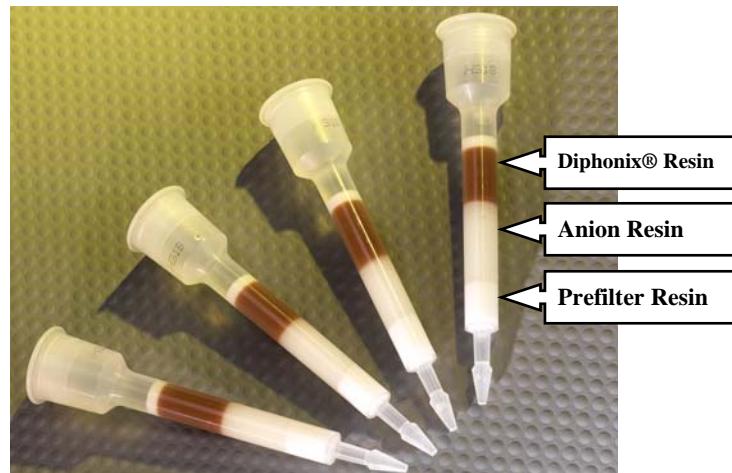


Figure 1: Composition of Tritium Column

Table 1

Component	Target	Capacity
Diphonix® Resin	Cations	0.8 mEq
Anion Exchange Resin	Anions	0.8 mEq
Polymethacrylate Resin	Organic Molecules	50 mg

Table 2

Spike Recovery Results using Tritium Column

Sample Type	Volume	3H Spike	% Recovery
Distilled water	15 mL	97.2 Bq	96.4% (n=4)
Distilled water	25 mL	20.2 Bq	87.6% (n=4)
Distilled water	25 mL	19.5 Bq	94.9% (n=7)
Ground water	25 mL	17.1 Bq	91.2% (n=5)
Sea water	25 mL	4.0 Bq	90.0% (n=6)
Urine	25 mL	85.1 Bq	91.1% (n=4)

The column successfully removes potential radioactive interferences. In a study performed at Eichrom, a mixture of radioisotopes (^{60}Co , ^{137}Cs , ^{233}U , $^{90}\text{Sr}/^{90}\text{Y}$, ^{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. (See Table 3 on the next page)

Table 3
Results of contamination study by Eichrom

Sample Type	Volume	³ H Spike (Bq)	Contaminant spiked (Bq)	Contaminant found (Bq)
Distilled Water	25 mL	19.5	16.9	<MDA (N=2)
Distilled Water	25 mL	20.2	16.9	<MDA (N=2)
Sea water	25 mL	4.0	16.9	<MDA (N=4)

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 4 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 ⁶⁰Co with > 50% counting error was detected in the PWR sample. Because the amount of ⁶⁰Co measured was so low and the error so high, and because the BWR sample contained more than 10 times the ⁶⁰Co 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 4
Carolina Power & Light Samples

Isotope	PWR Sample	BWR Sample
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	1,1200	---
Cs-137	1,320	---
La-140	---	1,550
Ce-144	---	203

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

See our newsletter archive for additional data on the performance of Eichrom's Tritium Column. The studies reported here, and elsewhere on our website, conducted in Eichrom and customer laboratories, demonstrate that the Tritium Column performs equivalently to the traditional distillation technique. We encourage you to try using the Tritium Column as a substitute for distillation of your aqueous tritium samples.



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