^{234}Th Generator

AN-1621-10

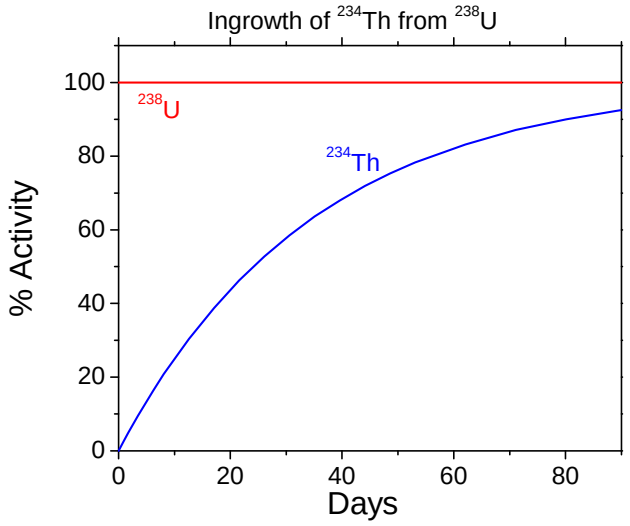
Summary of Method A method for the preparation of ^{234}Th ($t_{1/2}$ = 24.1 days) from natural or depleted Uranium ($t_{1/2}$ = 4.47E9 years) source material is presented. The method utilizes extraction chromatography with a column of DGA, Normal resin and 2mL cartridges of DGA and UTEVA resins to obtain high purity ^{234}Th in small volumes of eluate, while preserving ^{238}U material. The source material is adjusted to 2M HNO_3 and loaded onto a column of DGA, Normal resin. ^{234}Th is retained on DGA Resin from up to 0.2M uranium, while uranium is unretained. The uranium source is recovered and, following a suitable ingrowth period, can be used to produce additional ^{234}Th. ^{234}Th is stripped from the DGA resin column and further purified using 2mL cartridges of DGA and TEVA resins.

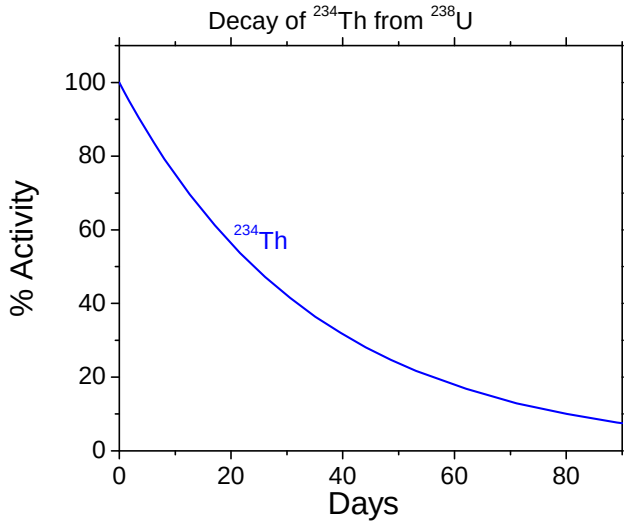
Reagents

TEVA Cartridges (Eichrom TE-R50-S)
DGA Cartridges (Eichrom DN-R50-S)
DGA, Normal Resin (Eichrom DN-B25-A)
Natural or Depleted U Source
Deionized Water
Oxalic Acid
Ammonium Oxalate
HCl
HNO_3

Equipment

Glass/Plastic bottles for storage of Uranium source.
Glass or plastic vials/bottles for collection of ^{234}Th and waste.
10, 20 or 30mL plastic luer lock syringes.
Gamma Spectrometry System or alternative for measurement of ^{234}Th.
ICP-AES or alternative for measurement of U.
1.9cm i.d. glass or plastic column, minimum 15cm height, with 250mL-1L reservoir.
Glass wool or frit material for top bed support.
Peristaltic pump or alternative to increase flow rate.





^{234}Th Separation (50g U/17μCi ^{234}Th)*

(1) Slurry pack a column of 12g DGA, Normal resin (100-150um), 1.9cm i.d. x 12.5cm height.**

(2) Place top bed support on column. Rinse column with 2-3 bed volumes of 0.1M HNO_3. Store column in 0.1M HNO_3 between uses.

(3) Precondition column with 2 bed volumes of 2M HNO_3.

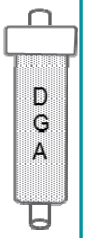
(4) Load 50g U source in 1L 2M HNO_3 at 10-20mL/min. Discard first 20mL of eluate. Collect remaining eluate containing U source material. Save for future ^{234}Th production.

(5) Rinse DGA column with 200mL of 1M HNO_3. First 20mL may be collected and added to source.

(6) Strip ^{234}Th from DGA with 200mL of 0.05M HNO_3-0.05M Oxalic Acid.

(7) Add 29mL of conc. HNO_3 to acidify eluate to 2M HNO_3.

(8) Load onto 2mL cartridge of DGA Resin.



(9) Rinse DGA with 25mL 0.5M HNO_3.

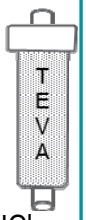
(10) Strip ^{234}Th from DGA with 20mL 0.1M ammonium bioxalate.

(11) Acidify with 8mL conc. HNO_3.

(12) Precondition 2mL TEVA cartridge with 5mL 4M HNO_3.

(13) Load onto TEVA.

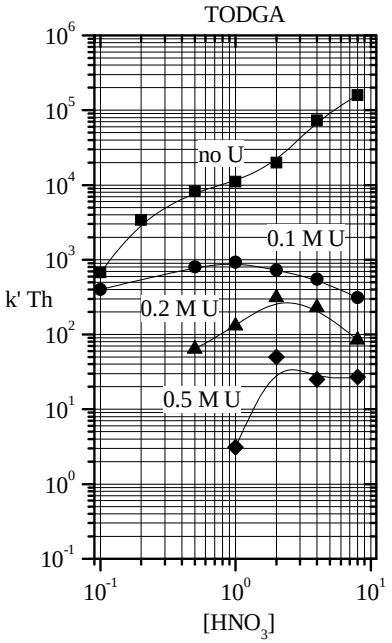
(14) Rinse TEVA w/ 25mL 4M HNO_3.

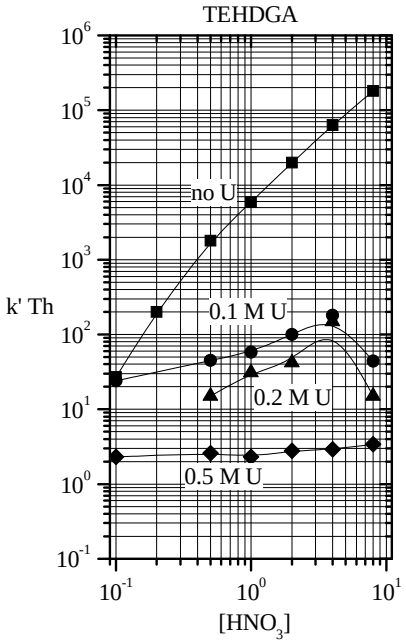


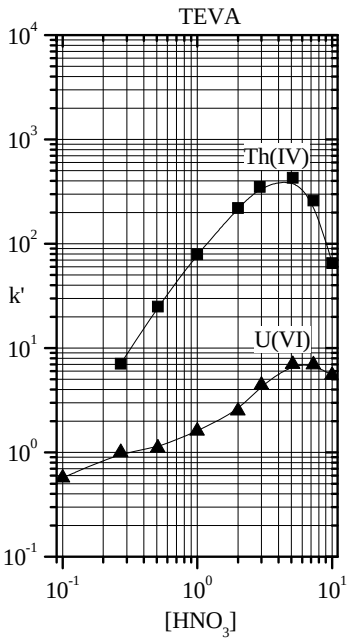
(15) Strip ^{234}Th w/ 15mL 0.5M HCl.

*Separation is scalable. Simply adjust volumes of the initial DGA column and load solution to accommodate other source sizes.

**DGA resin can be difficult to wet. Slurry the resin in 2x its volume of 1.0 -1.5M HNO_3 by gently swirling for 2-3 minutes (avoid vigorous shaking as this can incorporate air bubbles and cause resin to float). Centrifuge resin slurry for 5-10 minutes. Repeat until most of the resin sinks to the bottom of tube. Repeat swirling/ centrifugation, if needed. Use only well wetted resin to pack the column (omit floating resin). The column may be reused many times if stored in dilute acid between uses.







References

1) E. P. Horwitz and D. R. McAlister, "The recovery of trace thorium from large quantities of uranium," *Solv. Extr. Ion Exch.*, 27, 474-488, (2009).