TRITIUM IN WATER

1. SCOPE

1.1. This is a method for the separation and measurement of tritium in water.

1.2. This method does not address all aspects of safety, quality control, calibration or instrument set-up. However, enough detail is given for a trained radiochemist to achieve accurate and precise results for the analysis of the analyte(s) from the appropriate matrix, when incorporating the appropriate agency or laboratory safety, quality and laboratory control standards.

2. SUMMARY OF METHOD

2.1. Radionuclide impurities are separated from tritium by the Eichrom tritium column prior to measurement by Liquid Scintillation counter. Cationic and anionic alpha and beta emitting radionuclide ions are removed by the Eichrom tritium column. Tritiated water passes through the tritium column.

3. SIGNIFICANCE OF USE

3.1. This is a rapid, reliable method for measurement of tritium in water samples that is cost-effective and quicker than distillation methods.

4. INTERFERENCES

4.1. Very high levels of other beta emitters and high salt content in the sample may interfere with the accurate determination of tritium. Dilution of samples may be necessary in these cases.

5. APPARATUS

- Centrifuge tubes, 50mL
- Column rack, Eichrom Part: AC-103
- Extension funnels, 25mL, Eichrom Part: AC-120
- Liquid scintillation counter
- Liquid scintillation vials, 20mL, glass

6. REAGENTS

Note: Analytical grade or ACS grade reagents are recommended.

Deionized water, all reagents are prepared with deionized water
Liquid Scintillation Cocktail
Low Background Water (For preparation of tritium standards and background determination) - Water with tritium levels below the minimum detectable activity (most deep well waters are low in tritium content).
Tritium column, Eichrom Part H3-C50-A

7. PROCEDURE

7.1. If required, filter the sample through a 0.45 micron filter.

7.2. For each sample solution, place a Tritium Column in the column rack.

7.3. Place a waste tray below the columns. Remove the column cap and bottom plug from each column, push top frit down to the top of the resin bed and allow the columns to drain. Attach extension funnels to each column.

7.4. Add 10mL of DI water into each column to condition resin. Allow solution to drain.

Note: Allow all rinse solution to drain from the column but do not allow the column to sit long enough to begin to dry out.

7.5. Measure 25mL of sample and add to the top of the column.

7.6. Discard first 5mL of sample.

7.7. Place a clean, labeled beaker or centrifuge tube beneath the column and collect the remaining 20mL of sample.

7.8. Remove an aliquot of sample collected in the centrifuge tube (usually 5-10 mL) and add to a LSC vial. Add the appropriate amount of Ultima Gold or equivalent cocktail, shake the vial to mix and count the vials in LSC.

7.9. Perform separation method on low background water and tritium standard in low background water to determine method background and tritium recovery, respectively.

8. CALCULATIONS

Calculate H-3 standard recovery:

$$Yield = \frac{(C_S - B_S)}{E_S \times A_S}$$

where:

C_s = measured tritium cpm in tritium standard solution
B_S = background, cpm
E_s = counting efficiency for tritium
A_s = Tritium standard activity, dpm, corrected for decay from reference date

Calculate H-3 sample activity:

$$A = \frac{(S - B)}{E \times V \times Y \times 60}$$

where:

A = H-3 activity in the sample (Bq/L)
S = sample activity, cpm
B = background, cpm
E = counting efficiency = measured cpm/dpm of isotopic standard
V = sample volume, L
Y = chemical yield
60 = conversion from dpm to dps

9. REFERENCES

1) ASTM Method D4107-08, “Standard Test Method for Tritium in Drinking Water.”

2) Beals, D.; Cable, P.; Hofstetter, K. ”Savannah River Site Tritium Analysis System,” Eichrom Atlanta Users’ Seminar, Atlanta, GA (1996)