Tritium handling precautions

This document contains general information designed to provide a basic understanding of radiation safety. While we believe the information to be accurate, regulatory requirements may change and information contained herein is not tailored to individual needs. A radiation protection specialist should be consulted for specific applications.

Physical data

Maximum beta energy: 0.019 MeV (100%)[1]
Maximum range of beta in air: 4.7 mm (0.19 in)[2]

Occupational limits[3]

Annual limit on intake: 80 mCi (3 GBq)
Derived air concentration: 2 x 10^{-5} µCi/mL (740 kBq/m^3)

Dosimetry

Millicurie (37 MBq) quantities of tritium do not present an external exposure hazard because the low-energy beta emitted cannot penetrate the outer dead layer of skin. Exposure to an atmosphere containing tritiated water results in intake of ^{3}H by both inhalation and absorption through the intact skin[4]. Three to four hours after intake, ingested, inhaled or absorbed tritiated water is uniformly distributed in all body water[5]. On average, tritiated water is eliminated with a 10-day biological half-life[4]. Elimination rates can be increased by increasing water intake[5].

^{3}H

12.28 y

ß– 0.019

No γ

E 0.019

Decay table

Tritium physical half-life: 12.28 years[1].

To use the decay table, find the number of years in the left hand column and the number of months along the top of the chart, then find the corresponding decay factor. To obtain a precalibration number, divide by the decay factor. For a postcalibration number, multiply by the decay factor.

Visit **www.revvity.com/toolkit** to use our online Radioactive Decay Calculator.

Years \ Months	0	1	2	3	4	5	6	7	8	9	10	11
0	1.000	0.995	0.991	0.986	0.981	0.977	0.972	0.968	0.963	0.959	0.954	0.950
1	0.945	0.941	0.936	0.932	0.928	0.923	0.919	0.915	0.91	0.906	0.902	0.898
2	0.893	0.889	0.885	0.881	0.877	0.873	0.869	0.865	0.86	0.856	0.852	0.848
3	0.844	0.841	0.837	0.833	0.829	0.825	0.821	0.817	0.813	0.81	0.806	0.802
4	0.798	0.794	0.791	0.787	0.783	0.78	0.776	0.772	0.769	0.765	0.762	0.758
5	0.754	0.751	0.747	0.744	0.74	0.737	0.733	0.73	0.727	0.723	0.72	0.716
6	0.713	0.71	0.706	0.703	0.7	0.697	0.693	0.69	0.687	0.684	0.68	0.677
7	0.674	0.671	0.668	0.665	0.661	0.658	0.655	0.652	0.649	0.646	0.643	0.64
8	0.637	0.634	0.631	0.628	0.625	0.622	0.619	0.616	0.614	0.611	0.608	0.605
9	0.602	0.599	0.597	0.594	0.591	0.588	0.585	0.583	0.58	0.577	0.575	0.572
10	0.569	0.567	0.564	0.561	0.559	0.556	0.553	0.551	0.548	0.546	0.543	0.541
11	0.538	0.535	0.533	0.53	0.528	0.526	0.523	0.521	0.518	0.516	0.513	0.511
12	0.509	0.506	0.504	0.501	0.499	0.497	0.494	0.492	0.49	0.487	0.485	0.483

Revvity has developed the following suggestions for handling Tritium after years of experience working with this low-energy beta emitter.

General handling precautions for Tritium (^{3}H)

1. Designate areas for handling ^{3}H and clearly label all containers.
2. Prohibit eating, drinking, smoking and mouth pipetting in room where ^{3}H is handled.
3. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
4. Handle potentially volatile compounds in ventilated enclosures.
5. If enhanced containment is necessary, handle volatile com-pounds in closed systems vented through suitable traps.
6. Sample exhausted effluent and room air by continuously drawing a known volume through a membrane filter followed by an impinger containing water.
7. Wear disposable lab coat, gloves and wrist guards for secondary protection.
8. Select gloves appropriate for chemicals handled.
9. Maintain control by regular monitoring and prompt decontamination of gloves and surfaces.
10. Use open-window ionization detector or liquid scintillation counter to detect ^{3}H.
11. Submit periodic urine samples for bioassay to determine uptake by personnel.
12. Isolate waste in sealed clearly labeled containers according to approved guidelines.
13. Establish air concentration, surface contamination, and bioassay action levels below regulatory limits. Investigate and correct any conditions that may cause these levels to be exceeded.
14. On completing an operation, secure all ^{3}H; remove and dispose of protective clothing and coverings; monitor and decontaminate self and surfaces; wash hands and monitor them again.

Many tritium compounds readily penetrate gloves and skin. Handle these compounds remotely, wear two pairs of gloves and change the outer layer at least every 20 minutes. Tritiated DNA precursors are considered more toxic than tritiated water depending on their route of intake[4] [6]. However, they are generally less volatile and do not normally present a significantly greater hazard.

References

1. Kocher, David C., Radioactive Decay Data Tables, Springfield: National Technical Information Service, 1981 DOE/TIC-11026.
2. Kaplan, Irving, Nuclear Physics, New York: Addison-Wesley, 1964.
3. U.S. Nuclear Regulatory Commission. 10 CFR 20 Appendix B – Standards for Protection Against Radiation, 1994.
4. ICRP Publication 30, Part 1, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1979.
5. ICRP Publication 10, Recommendations of the International Commission on Radiological Protection, Pergamon Press, London, 1968.
6. NCRP Report No. 63, Tritium and Other Radionuclide Labeled Organic Compounds Incorporated in Genetic Material, 1979.

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