Iodine-125 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

Principal radiation emissions[1]
Gamma: 0.035 MeV (6.5%)
Ka x-ray: 0.027 MeV (112.5%)
Kb x-ray: 0.031 MeV (25.4%)
Unshielded exposure rate for 1 mCi point source at 1 cm: 1.4 R/h[2]
Unshielded exposure rate from 1 MBq point source at 1 m: 0.98 nC/kg/h
Half-value layer for lead shielding: 0.02 mm (0.001 in)[2]

Occupational limits[3]

Annual limit on intake: 40 µCi (1.5 MBq) for oral ingestion and 60 µCi (2.2 MBq) for inhalation
Derived air concentration: 3 x 10^{-8} µCi/mL (1.1 kBq/m^3)

Dosimetry

Gamma and x-ray emissions from ^{125}I can present a penetrating external exposure hazard. Individual iodine metabolism can vary considerably[4]. It may be assumed that 30% of an uptake of iodine is translocated to the thyroid and 70% directly excreted in urine[4].

^{125}I

60.14 d

EC

γ 0.035

E 0.177

Iodine in the thyroid is retained with a biological half-life of 120 days in the form of organic iodine. Organic iodine is assumed to be uniformly distributed in all organs and tissues of the body except the thyroid, and retained with a biological half-life of 12 days[4]. 10% of organic iodine is directly excreted in feces and the rest is returned to the transfer compartment as inorganic iodine[4]. Retention in the thyroid is reduced by the short physical half-life of ^{125}I.

Decay table

Physical half-life: 60.14 days[1].

To use the decay table, find the number of days in the top and left hand columns 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.

Days	0	2	4	6	8	10	12	14	16	18
0	1.000	0.977	0.955	0.933	0.912	0.891	0.871	0.851	0.831	0.812
20	0.794	0.776	0.758	0.741	0.724	0.707	0.691	0.675	0.66	0.645
40	0.63	0.616	0.602	0.588	0.574	0.561	0.548	0.536	0.524	0.512
60	0.5	0.489	0.477	0.467	0.456	0.445	0.435	0.425	0.416	0.406
80	0.397	0.388	0.379	0.37	0.362	0.354	0.345	0.338	0.33	0.322
100	0.315	0.308	0.301	0.294	0.287	0.281	0.274	0.268	0.262	0.256
120	0.25	0.244	0.239	0.233	0.228	0.223	0.218	0.213	0.208	0.203
140	0.198	0.194	0.189	0.185	0.181	0.177	0.173	0.169	0.165	0.161
160	0.157	0.154	0.15	0.147	0.144	0.14	0.137	0.134	0.131	0.128
180	0.125	0.122	0.119	0.117	0.114	0.111	0.109	0.106	0.104	0.102
200	0.099	0.097	0.095	0.093	0.09	0.088	0.086	0.084	0.082	0.081
220	0.079	0.077	0.075	0.073	0.072	0.07	0.069	0.067	0.065	0.064
240	0.063	0.061	0.06	0.058	0.057	0.056	0.054	0.053	0.052	0.051

Revvity has developed the following suggestions for handling Iodine-125 after years of experience working with this low-energy x-ray emitter.

General handling precautions for Iodine-125

1. Designate area for handling ^{125}I and clearly label all containers.
2. Store millicurie (37 MBq) quantities of ^{125}I in containers surrounded by 3 mm (0.125-in) thick lead.
3. Wear extremity and whole body dosimeters while handling 10 mCi (370 MBq) quantities of ^{125}I.
4. Use shielding to minimize exposure while handling ^{125}I.
5. Use tools to indirectly handle unshielded multi-millicurie (multi-37 MBq) sources and potentially contaminated vessels.
6. Prohibit eating, drinking, smoking and mouth pipetting in room where ^{125}I is handled.
7. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
8. Handle potentially volatile compounds in ventilated enclosures.
9. Handle millicurie (37 MBq) quantities in closed systems vented through activated charcoal traps.
10. Sample exhausted effluent by continuously drawing a known quantity of air through cartridges containing activated charcoal.
11. Wear disposable lab coat, wrist guards and gloves for secondary protection.
12. Select gloves appropriate for chemicals handled.
13. Maintain contamination and exposure control by regularly monitoring and promptly decontaminating gloves and surfaces.
14. Use NaI(Tl) detector or liquid scintillation counter to detect ^{125}I.
15. Submit urine samples for bioassay from 4 to 48 hours after handling ^{125}I to indicate uptake by personnel.
16. Monitor thyroid periodically with a NAI(Tl) detector to determine thyroid dose.

17. Isolate waste in sealed, clearly labeled containers. Store in ventilated enclosure. Consider holding for decay or dispose according to approved guidelines.

18. Establish surface contamination, air concentration, urinalysis and thyroid burden action levels below regulatory limits. Investigate and correct any conditions that may cause these levels to be exceeded.

19. On completing an operation, secure all ^{125}I, remove and dispose of protective clothing and coverings; monitor and decontaminate self and surfaces; wash hands and monitor them again.

Store $Na^{125}I$ solutions at room temperature because freezing results in subsequent volatilization of radio-iodine. Avoid acidic solutions to minimize volatilization. Some radioiodine compounds may penetrate gloves and skin. Therefore, these compounds should be handled indirectly by using tools and wearing two pairs of gloves. The outer layer of gloves should be changed frequently and whenever they are suspected to be contaminated.

References

1. Kocher, David C., Radioactive Decay Data Tables, Springfield: National Technical Information Service, 1981 DOE/TIC-11026.

2. Calculated with computer code “Gamma” utilizing decay scheme data from Kocher[1] and mass attenuation coefficient for lead and mass energy absorption coefficients for air from the Radiological Health Handbook, Washington: Bureau of Radiological Health, 1970. The HVL reported here is the initial HVL for narrow beam geometry.

3. U.S. Nuclear Regulatory Commission. 10 CFR 20 Appendix B – Standards for Protection Against Radiation, 1994.

4. ICRP Publication 30, Part 2, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1979.

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