SAFE HANDLING GUIDE

Lutetium-177 Handling Precautions

^{177}Lu	
6.71 d	
ß$^-$	0.497
γ	0.208
	0.113
E	0.497

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]
Maximum beta energies: 0.497 MeV (78.7%)
Gammas: 0.208 MeV (11.0%)
0.113 MeV (6.4%)
Maximum range of beta in air: 135 cm (53 in)[2]
Maximum range of beta in water: 1.6 cm (0.06 in)[2]
Unshielded exposure rate at 1 cm from a 1 mCi point source: 181 mR/h[3]
Unshielded exposure rate at 1 m from a 1 MBq point source: 126 pC/kg/h[3]
Half-value layer for lead shielding: 0.6 mm (0.023 in)[3]

Occupational limits[4]

Annual limit on intake: 2 mCi (74 kBq)
Derived air concentration: 9 x 10^{-7} µCi/mL (33 kBq/m^3)

Dosimetry

Gamma emissions from ^{177}Lu presents an external dose hazard. Beta emissions can present an external exposure hazard to skin. It may be assumed that 60%, 2% and 0.5% of ^{177}Lu uptakes in the transfer compartment are translocated to mineral bone, liver and kidneys respectively, and the rest is directly excreted[5]. ^{177}Lu is retained in the bone and liver with a biological half-life of 3500 days and retained in the kidneys with a biological half-life of 10 days[5]. However, the committed dose is significantly reduced due to the short physical half-life of ^{177}Lu[5].

Decay table

Physical half-life: 6.61 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.

Hours	Hours 0	1	2	3	4	5	6	7	8	9
0	1.00	0.996	0.991	0.987	0.983	0.979	0.975	0.970	0.966	0.962
10	0.958	0.954	0.950	0.946	0.942	0.938	0.934	0.930	0.926	0.922
20	0.918	0.914	0.910	0.906	0.902	0.898	0.894	0.890	0.887	0.883
30	0.879	0.875	0.871	0.868	0.864	0.860	0.857	0.853	0.849	0.846
40	0.842	0.838	0.835	0.831	0.828	0.824	0.820	0.817	0.813	0.810
50	0.806	0.803	0.800	0.796	0.793	0.789	0.786	0.783	0.779	0.776
60	0.772	0.769	0.766	0.763	0.759	0.756	0.753	0.750	0.746	0.743
70	0.740	0.737	0.734	0.730	0.727	0.724	0.721	0.718	0.715	0.712
80	0.709	0.706	0.703	0.700	0.697	0.694	0.691	0.688	0.685	0.682
90	0.679	0.676	0.673	0.670	0.667	0.664	0.662	0.659	0.656	0.653
100	0.650	0.648	0.645	0.642	0.639	0.637	0.634	0.631	0.628	0.626

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PerkinElmer has developed the following suggestions for handling Lutetium-177 after working with this beta and gamma emitter.

General handling precautions for Lutetium-177

1. Designate area for handling ^{177}Lu and clearly label all containers.
2. Store ^{177}Lu behind lead shielding.
3. Wear extremity and whole body dosimeters while handling mCi (37 MBq) quantities.
4. Use shielding to minimize exposure while handling ^{177}Lu.
5. Use tools to indirectly handle unshielded sources and potentially contaminated vessels.
6. Prohibit eating, drinking, smoking, and mouth pipetting in room where ^{177}Lu is handled.
7. Use transfer pipettes, spill trays and absorbent coverings to confine contamination.
8. Handle ^{177}Lu compounds that are potentially volatile or in powder form in ventilated enclosures.
9. Sample exhausted effluent and room air by continuously drawing a known volume through membrane filters.
10. Wear lab coat, wrist guards and disposable gloves for secondary protection.
11. Maintain contamination and exposure control by regularly monitoring and promptly decontaminating gloves and surfaces.
12. Use end window Geiger-Mueller detector, NaI(Tl) detector or liquid scintillation counter to detect ^{177}Lu.
13. Submit periodic urine samples for bioassay from 4 to 24 hours after handling ^{177}Lu to indicate uptake by personnel. Consider use of a whole body counter to determine ^{177}Lu retention.
14. Isolate waste in clearly labeled, shielded container and hold for decay. Monitor for potential residual ^{177}mLu contamination prior to disposal.
15. Establish surface contamination, air concentration and bioassay action levels below regulatory limits. Investigate and correct any causes which may threaten these levels to be exceeded.
16. On completing an operation, secure all ^{177}Lu, remove protective clothing, dispose of protective coverings, monitor and decontaminate self and surfaces, wash hands and monitor them again.

Near an unshielded ^{177}Lu source, dose rates from beta radiation can be much higher than dose rates due to gamma radiation. Avoid skin exposure by indirect handling and prompt removal of contaminated clothing. Whole body counting is an effective method for determining ^{177}Lu body burdens. Waste should be held for decay. However, the waste should also be monitored for any residual ^{177}mLu (160 day half-life) and disposed of appropriately.

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. Calculated with computer code “MicroShield v 5.05”. HVL is the initial HVL calculated for broad beam geometry.
4. U.S. Nuclear Regulatory Commission. 10 CFR 20 Appendix B - Standards for Protection Against Radiation, 1994.
5. ICRP Publication 30, Part 3, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1981.

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