SAFE HANDLING GUIDE

Yttrium-90 Handling Precautions

^{90}Y
64.1 h
ß⁻ 2.28
No γ
E 2.28

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: 2.28 MeV (100%)[1]
Maximum range of beta in air: 9 m (30 ft)[2]
Maximum range of beta in water: 11 mm (0.43 in)[2]

Occupational limits[3]

Annual limit on intake: 400 µCi (15 MBq) for oral ingestion and 600 µCi (22 MBq) for inhalation
Derived air concentration: 3 x 10^{-7} µCi/ml (11 kBq/m^3)

Dosimetry

The high-energy beta emissions from ^{90}Y can present a substantial skin and eye dose hazard. Multi 10-millicurie (multi 370 MBq) quantities of ^{90}Y can produce significant secondary radiation, presenting a more penetrating external exposure hazard. It may be assumed that of ^{90}Y leaving the transfer compartment, 25% of the uptake is directly excreted; 50% is translocated to the skeleton; 15% is translocated to the liver; and 10% is uniformly distributed throughout all other organs and tissues[4].

It is also assumed that yttrium not directly excreted is retained indefinitely, however, the committed dose is significantly reduced due to the short physical half-life of ^{90}Y[4].

Decay table

Physical half-life: 64.1 hours[1].

To use the decay table, find the number of hours in the top row and left hand column 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 \ Days	0	1	2	3	4	5	6	7	8	9
0	1.000	0.989	0.979	0.968	0.958	0.947	0.937	0.927	0.917	0.907
10	0.897	0.888	0.878	0.869	0.859	0.850	0.841	0.832	0.823	0.814
20	0.805	0.797	0.788	0.780	0.771	0.763	0.755	0.746	0.738	0.73
30	0.723	0.715	0.707	0.700	0.692	0.685	0.677	0.670	0.663	0.656
40	0.648	0.642	0.635	0.628	0.621	0.614	0.608	0.601	0.595	0.588
50	0.582	0.576	0.570	0.563	0.557	0.551	0.545	0.540	0.534	0.528
60	0.522	0.517	0.510	0.506	0.500	0.495	0.489	0.484	0.479	0.474
70	0.469	0.464	0.459	0.454	0.449	0.444	0.439	0.434	0.43	0.425
80	0.420	0.416	0.412	0.407	0.403	0.398	0.394	0.390	0.386	0.382
90	0.377	0.373	0.369	0.365	0.361	0.358	0.354	0.350	0.346	0.342
100	0.339	0.335	0.331	0.328	0.324	0.321	0.317	0.314	0.31	0.307
110	0.304	0.301	0.297	0.294	0.291	0.288	0.285	0.282	0.279	0.276
120	0.273	0.27	0.267	0.264	0.261	0.258	0.256	0.253	0.25	0.247

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PerkinElmer has developed the following suggestions for handling Yttrium-90 after years of experience working with this high-energy beta emitter.

General handling precautions for Yttrium-90

1. Designate area for handling ^{90}Y and clearly label all containers.
2. Store ^{90}Y behind lead shielding.
3. Wear extremity and whole body dosimeters while handling mCi (37 MBq) quantities.
4. Handle millicurie (37 MBq) quantities of ^{90}Y behind 1.3-cm (0.5-in) thick Lucite® shielding. Where necessary, increase shielding by attaching 3-mm to 6-mm (0.125-in to 0.25-in) thick lead sheets to the outside of the Lucite® to reduce secondary radiation.
5. Do not work over open containers.
6. Avoid skin exposure by using tools to indirectly handle unshielded sources and potentially contaminated vessels.
7. Practice routine operations to improve dexterity and speed before using ^{90}Y.
8. Prohibit eating, drinking, smoking and mouth pipetting in room where ^{90}Y is handled.
9. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
10. Handle potentially volatile compounds in ventilated enclosures.
11. Sample exhausted effluent and room air by continuously drawing a known volume through membrane filters.
12. Wear lab coat, wrist guards and disposable gloves for secondary protection.
13. Maintain contamination and exposure control by regularly monitoring and promptly decontaminating gloves and surfaces.
14. Use pancake or end-window Geiger-Mueller detector, NaI(Tl) detector or liquid scintillation counter to detect ^{90}Y.
15. Take breathing zone air samples or radiochemically analyze large volume urine samples to indicate uptake by personnel.
16. Isolate waste in sealed, clearly labeled shielded containers and hold for decay. Monitor for potentially residual ^{90}Sr contaminant prior to disposal.
17. Establish surface contamination, air concentration and urinalysis action levels below regulatory limits. Investigate and correct any conditions which may cause these levels to be exceeded.
18. On completing an operation, secure all ^{90}Y; remove protective clothing; dispose of protective coverings; monitor and decontaminate self and surfaces; wash hands and monitor them again.

The dose rate at the mouth of an open NENSure™ vial containing 1 mCi (37 MBq) of ^{90}Y in 1 ml of liquid is roughly 32 rem/hour (320 mSv/hour)[5]. Since this dose rate will not be attenuated significantly by air, shielding materials should be placed between the source and personnel to absorb most of the radiation. The best shield for a ^{90}Y source is a material like Lucite® 1.3-cm (0.5-in) thick or other plastic, which will absorb the beta particles while generating little secondary radiation. For millicuire (37 MBq) amounts of ^{90}Y, thin, high density shielding such as lead 3-mm to 6-mm (0.125-in to 0.25-in) thick should be added to the exterior of the Lucite® shield to absorb the more penetrating secondary radiation.

A high local dose can be received if the radioactive material is touched and allowed to remain on the skin or gloves. Both the hands and face can receive a considerable dose of radiation near an open container of ^{90}Y, particularly if the radioactivity is in a concentrated form. Therefore, never work over an open container of ^{90}Y.

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 2, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1980.

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007048C_01 Aug. 2010