Yttrium-90 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: 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/m³)

Dosimetry
The high-energy beta emissions from ⁹⁰Y can present a substantial skin and eye dose hazard. Multi 10-millicurie (multi 370 MBq) quantities of ⁹⁰Y can produce significant secondary radiation, presenting a more penetrating external exposure hazard. It may be assumed that of ⁹⁰Y 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 ⁹⁰Y(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.
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)

References