SAFE HANDLING GUIDE

Sodium-22 Handling Precautions

^{22}Na
2.602 y
ß$^{+}$ 0.546
γ 1.28
E 2.842

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 energy: 0.546 MeV (89.8%)
Gamma: 1.275 MeV (100%)
Annihilation photons: 0.511 MeV (180%)
Maximum range of beta in air: 140 cm (56 in)[2]
Unshielded exposure rate at 1 cm from a 1 mCi point source: 11.8 R/h[3]
Unshielded exposure rate at 1 m from a 1 MBq point source: 8.23 nC/kg/h[3]
Half-value layer for lead shielding: 6.5 mm (0.26 in)[3]

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

^{22}Na positron and gamma emissions present both penetrating and shallow external exposure hazards. The biological half-life of ^{22}Na in the body varies considerably between individuals and is strongly influenced by the level of stable sodium in the diet[5]. It maybe assumed that 30% of an uptake of ^{22}Na is deposited in the skeleton and mostly retained with a biological half-life of 10 days; 1% of the deposited fraction being retained with a biological half-life of 500 days[5]. All other ^{22}Na in the body can be assumed to be retained with a biological half-life of 10 days[5].

Decay table

Physical half-life: 2.602 years[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.perkinelmer.com/toolkit** to use our online Radioactive Decay Calculator.

Days	0	10	20	30	40	50	60	70	80	90
0	1.000	0.993	0.986	0.978	0.971	0.964	0.957	0.950	0.943	0.937
100	0.930	0.923	0.916	0.910	0.903	0.896	0.890	0.883	0.877	0.871
200	0.864	0.858	0.852	0.846	0.839	0.833	0.827	0.821	0.815	0.809
300	0.804	0.798	0.792	0.786	0.780	0.775	0.769	0.764	0.758	0.752
400	0.747	0.742	0.736	0.731	0.726	0.720	0.715	0.710	0.705	0.700
500	0.694	0.689	0.684	0.679	0.675	0.670	0.665	0.660	0.655	0.650
600	0.646	0.641	0.636	0.632	0.627	0.623	0.618	0.614	0.609	0.605
700	0.600	0.596	0.592	0.587	0.583	0.579	0.575	0.570	0.566	0.562
800	0.558	0.554	0.550	0.546	0.542	0.538	0.534	0.530	0.526	0.523
900	0.519	0.515	0.511	0.508	0.504	0.500	0.497	0.493	0.489	0.486

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PerkinElmer has developed the following suggestions for handling Sodium-22 after years of experience working with this positron and high-energy gamma emitter.

General handling precautions for Sodium-22

1. Designate area for handling ^{22}Na and clearly label all containers.
2. Store ^{22}Na behind thick lead shields.
3. Wear extremity and whole body dosimeters while handling mCi (37 MBq) quantities.
4. Use shielding to minimize exposure while handling ^{22}Na.
5. Do not work over open containers.
6. Use tools to indirectly handle unshielded sources and potentially contaminated vessels.
7. Practice routine operations to improve dexterity and speed before using ^{22}Na.
8. Prohibit eating, drinking, smoking and mouth pipetting in room where ^{22}Na 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 a membrane filter.
12. Wear disposable lab coat, gloves and wrist guards 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 ^{22}Na.
15. Submit urine sample for bioassay at least four hours after handling ^{22}Na to indicate uptake by personnel.
16. Isolate waste in sealed, clearly labeled, shielded containers and dispose according to approved guidelines.
17. Establish surface contamination, air concentration and urinalysis action levels below regulatory limits. Investigate and correct any conditions that may cause these levels to be exceeded.
18. On completing an operation, secure all ^{22}Na; remove and dispose of protective clothing and coverings; monitor and decontaminate self and surfaces; wash hands and monitor them again.

Near an unshielded ^{22}Na source, dose rates due to beta radiation can be much higher than dose rates due to gamma radiation. Avoid direct eye exposure by interposing transparent shields or indirect viewing. Avoid skin exposure by indirect handling and prompt removal of contaminated protective clothing. Multi-hundred mCi (multi 3.7 GBq) quantities need to be completely surrounded by shielding material to prevent positrons from escaping and creating a source of secondary annihilation radiation outside the shielding.

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 'Gamma' utilizing decay scheme data from Kocher(1) and mass attenuation coefficients 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.
4. U.S. Nuclear Regulatory Commission. 10 CFR 20 Appendix B – Standards for Protection Against Radiation, 1994.
5. ICRP Publication 30, Part 2, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1980.

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