Chromium-51 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: 0.320 MeV (9.8%)
X-ray: 0.005 MeV (22.3%)
Auger electron: 0.004 MeV (66.9%)
Unshielded exposure rate at 1 cm from a 1 mCi point source: 0.18 R/h[2]
Unshielded exposure rate at 1 m from a 1 MBq point source: 0.13 nC/kg/h
Half-value layer for lead shielding: 1.7 mm (0.067 in)[2]

Occupational limits[3]

Annual limit on intake: 40 mCi (1.5 GBq) for oral ingestion and 20 mCi (740 MBq) for inhalation
Derived air concentration: 8 x 10^{-6} µCi/ml (300 kBq/m^3)

Dosimetry

Gamma emissions from ^{51}Cr presents an external dose hazard. The retention of uptakes of ^{51}Cr in the body is very dependent on its chemical form[4]. It may be assumed that uptakes of ^{51}Cr are retained in the transfer compartment with a biological half-life of 0.5 days[4]. 5% of the uptake is then transferred to bone and retained with a biological half- life of 1000 days. 30% is directly excreted. 65% is distributed to other organs and tissues in the body; with 40% of the uptake retained with a biological half-life of 6 days and 25% retained with a biological half-life of 80 days[4].

^{51}Cr

27.7 d

EC

γ 0.320

E 0.752

Decay table

Physical half-life: 27.7 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 to use our online Radioactive Decay Calculator.

Days	Days									
		0	1	2	3	4	5	6	7	8	9
	0	1.000	0.975	0.951	0.928	0.905	0.882	0.861	0.839	0.819	0.798
	10	0.779	0.760	0.741	0.722	0.705	0.687	0.670	0.654	0.638	0.622
	20	0.606	0.591	0.577	0.563	0.549	0.535	0.522	0.509	0.496	0.484
	30	0.472	0.461	0.449	0.438	0.427	0.417	0.406	0.396	0.387	0.377

General handling precautions for chromium-51

1. Designate area for handling ^{51}Cr and clearly label all containers.
2. Store ^{51}Cr behind lead shielding.
3. Wear extremity and whole body dosimeters while handling mCi (37 MBq) quantities.
4. Use shielding to minimize exposure while handling ^{51}Cr.
5. Use tools to indirectly handle unshielded sources and potentially contaminated vessels.
6. Prohibit eating, drinking, smoking and mouth pipetting in room where ^{51}Cr is handled.
7. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
8. Handle ^{51}Cr 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 detectors, NaI(Tl) detector or liquid scintillation counter to detect ^{51}Cr.
13. Submit urine samples for bioassay at least four hours after handling ^{51}Cr to indicate uptake by personnel.
14. Isolate waste in clearly labeled, shielded containers and hold for decay.
15. 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.
16. On completing an operation, secure all ^{51}Cr, remove and dispose of protective clothing and coverings, monitor and decontaminate self and surfaces, wash hands and monitor them again.

^{51}Cr is slowly eliminated from the body. Whole body counting provides a more sensitive method than urinalysis for determining ^{51}Cr body burdens. Whole body counting may be used occasionally to verify the urinalysis results.

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, 1980.

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