

Carbon-14 (¹⁴C) safety information and specific handling precautions

General:

Carbon-14 is a low energy beta emitter and even large amounts of this isotope pose little external dose hazard to persons exposed. The beta radiation barely penetrates the outer protective dead layer of the skin of the body. The major concern for individuals working with this isotope is the possibility of an internal exposure. Such an exposure may occur if an individual contaminates bare skin, accidentally ingests the material, or breathes it in the form of a gas or vapor (usually radioactive CO₂). The critical organ for most ¹⁴C labelled compounds is the fat of the whole body. The most hazardous chemical form of ¹⁴C is labelled carbonates for which the bone is a critical organ. Ingested carbon is metabolized very quickly and much of the radionuclide is exhaled in the form of radioactive carbon dioxide. Urine analysis is an effective sampling technique to determine if a ¹⁴C uptake has occurred.

Some ¹⁴C labelled compounds may migrate through gloves and skin. ¹⁴C compounds should be handled with gloved hands, and in some cases, with double gloves. Change gloves often. One should be careful not to contaminate the skin as some ¹⁴C beta particles penetrate the dead layer of the epidermis. Special caution should be taken when handling ¹⁴C labeled halogenated acids. These compounds may be incorporated in the skin, causing very large skin doses and a pathway into the body.

Physical Data:

Maximum beta energy: 0.156 MeV, 100% emission

Maximum range in air: about 8.6 inches

Radiological Half-life: 5730 years

Internal Occupational Limits:

Annual Limits on Intake-

Inhalation: 2 mCi

Ingestion: 2 mCi

Precautions:

1. Follow General Safety Precautions for all isotopes.
2. Traps may be necessary to collect radioactive carbon dioxide if large gas or vapor releases are anticipated. This is to reduce the release to the environment.
3. Monitor surfaces routinely and keep records of the results. Geiger counters are sensitive to the beta radiation from ¹⁴C if the probe is used within a 1/2 inch of the surface and the proper probe is used. Radiation Safety recommends a pancake type probe and a meter with a linear scale. With such a probe very low amounts of ¹⁴C may be detected on a surface. Average efficiency for ¹⁴C with a pancake probe is approximately 3%. Do not cover the pancake probe with saran wrap® or parafilm®, etc. when using the probe to monitor for ¹⁴C. This practice will decrease the efficiency of detection. Wipe tests should be taken and counted in a liquid scintillation counter for the most sensitivity when detecting removable surface contamination.
4. Radiation badges are not issued for individuals using ¹⁴C as the badge is very unlikely to detect any radiation because of the short beta range in air.

¹⁴C LAB INFO SHEET

¹⁴C Carbon



Low Energy Beta Emitter
Half-Life: 5730 Years
Max energy: 156 KeV (at 100%)
Max range in air: 8.6 in
ALI = 2 mCi (Ingestion/Inhalation)
Critical Organ: Whole Body
Bioassay: Urine

Detection: GM or LSC
GM meter w/Pancake probe (5-8%) efficient
LSC: (85-95%) efficient

Shielding: None Required

PPE : Double gloves,
Lab coat, Safety glasses

Dosimetry: None Needed

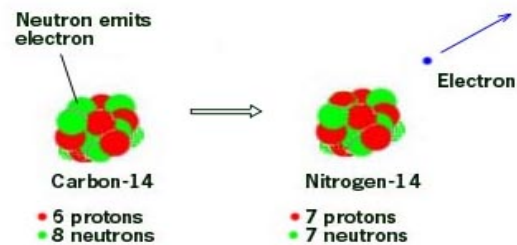


LSC



Notes and Special Precautions

- Liquid Scintillation Counter (LSC) efficiencies for ¹⁴C= 85-95 % - RECOMMENDED.
- Use a Pancake GM for personal post experimental surveys, but note; efficiency is poor (5-8%). Survey technique should be slow and close to the surface without touching.
- Keep in mind that even a few counts above background (bkg) means it is likely that counts are real.
- Very long half-life - 5730 Years. If clothing or shoes become contaminated, items will have to be taken for proper disposal. Please wear proper PPE.
- Expensive to purchase and to dispose of. Please order only necessary quantities.



Class IV Waste \geq 120 days—Can be combined with ³H

EMERGENCY SPILLS
or
SKIN CONTAMINATION

203-785-3555

Yale Environmental Health & Safety 203-785-3550

NO EATING, DRINKING, OR SMOKING in lab.