

CARBON-14 [¹⁴C]

PHYSICAL DATA

- Beta Energy:
156 keV (maximum)
49 keV (average) (100% abundance)
- Physical Half-Life:
5730 years
- Biological Half-Life:
12 days
- Effective Half-Life:
12 days (Bound)
- Effective Half-Life:
40 days (Unbound)
- Specific Activity:
4460 mCi/gram
- Maximum Beta Range in Air:
24.00 cm = 10 inches

Maximum Beta Range in Water/Tissue:

0.28 mm = 0.012 inches (Fraction of ¹⁴C beta particles transmitted through dead layer of skin: At 0.007 cm depth = 1%)

- Maximum Range in Plexiglas/Lucite/Plastic:
0.25 mm = 0.010 inches

RADIOLOGICAL DATA

- Critical Organ:
Fat Tissue
- Routes of Intake:
Ingestion, Inhalation, Skin Contact
- External exposure
Deep dose from weak ¹⁴C beta particles is not a radiological concern
- Internal exposure & contamination:
primary radiological concerns

SHIELDING

- none required (≤ 3 mm plexiglas)

SURVEY INSTRUMENTATION

- Can detect ^{14}C using a thin-window G-M survey meter; survey meter probe **must** be at close range (1 cm.)
- G-M survey meters have very low counting efficiency for ^{14}C (5%)
- Liquid scintillation counter (indirect counting) may be used to detect removable ^{14}C on wipes

RADIATION MONITORING DOSIMETERS

- Not Needed (beta energy too low)
- Dose Rate from a 1 mCi isotropic point source of ^{14}C :

<u>Distance</u>	<u>Rad/Hr</u>
1.0 cm	1241.4
2.0 cm	250.4
15.2 cm	0.126
20.0 cm	0.0046

GENERAL RADIOLOGICAL SAFETY INFORMATION

- Urinalysis: Not required; however, prudent after a ^{14}C radioactive spill or suspected intake.
- Inherent volatility (at STP): Not Significant.
- Possibility of organic ^{14}C compounds being absorbed through gloves.
- Care should be taken **NOT** to generate $^{14}\text{CO}_2$ gas which could be inhaled.
- Internal Dose is the concern: Skin contamination, ingestion, inhalation, and puncture
- Always wear a lab coat and disposable gloves when working with ^{14}C .
- The concentration of carbon in adipose tissue, including the yellow marrow, is about 3 times the average whole body concentration. No other organ or tissue of the body concentrates stable carbon to any significant extent.

- Three main classes of carbon compounds may be inhaled: organic compounds, gases (CO or CO₂), and aerosols of carbon containing compounds such as carbonates and carbides.

Organic Compounds - most organic compounds are NOT very volatile under normal circumstances; the probability of these being inhaled as vapors is therefore small. In circumstances where such substances are inhaled, it would be prudent to assume that once they enter the respiratory system they are instantaneously and completely translocated to the systemic circulation without changing their chemical form.

Gases - the inhalation of CO and its retention in body tissues has been studied extensively. Since gas has a relatively low solubility in tissue water, doses due to absorbed gas in tissues are insignificant in comparison with doses due to the retention of CO bound to hemoglobin. CO₂ in the blood exists mainly as a bicarbonate.

Carbonates & Carbides - It is assumed that inhaled or ingested ¹⁴C labeled compounds are instantaneously and uniformly distributed throughout all organs & tissues of the body where they are retained with a biological half-life of 12-40 days.