Radionuclide Safety Data Sheet

PHYSICAL DATA

Radionuclide:	Carbon-14 (C-14)
Decay Mode:	Beta (100% abundance)
Beta Energy:	156.4 keV (maximum); 49.5 keV (average)
Physical Half-Life:	5730 years
Biological Half-Life:	10 days (Whole body)
Effective Half-Life:	10 days (Bound/Whole body)
	40 days (Unbound/Whole body)
Specific Activity:	4460 millicuries / gram
Maximum Beta Range in Air:	25.4 cm = 10"
Maximum Beta Range in Water/Tissue:	0.030 cm = 0.012”
	(~ 1% of C-14 betas transmitted through dead layer of skin)
Maximum Beta Range in Lucite/Plastic:	0.025 cm = 0.01”

RADIOLOGICAL DATA

Critical Organ:	Fat Tissue (most labeled compounds)
	Bone (for some labeled carbonates)
Routes of Intake:	Ingestion, Inhalation, Puncture, Wound, Skin Contamination (Absorption)
Exposure Concerns:	Internal exposure & contamination; EXTERNAL EXPOSURE IS NOT A CONCERN
Committed Effective Dose Equivalent (CEDE):	2.09 mrem/uCi (ingestion/inhaled)
Annual Limit on Intake (ALI):	2 mCi (ingestion/inhalation - labeled organic compound)
	2000 mCi (inhalation; carbon monoxide)
	200 mCi (inhalation; carbon dioxide)
	(1 ALI = 5,000 mrem CEDE)

SHIELDING/LABELING

Shielding: None Required (< 3mm plexiglass)

Labeling: Container with $\geq$ 100 uCi must be labeled “Caution, Radioactive Material”

SURVEY INSTRUMENTATION

C-14 can be detected with a survey meter equipped with a GM pancake probe (15.5 cm^2 surface area), but probe must be at a close distance (< 1 inch)

Counting efficiency of C-14 with GM survey meters is about 3%

Wipes/smears should be counted on a liquid scintillation counter to detect C-14 contamination. Counting efficiency on a Perkin Elmer liquid scintillation counter is approximately 95%.

PERSONAL RADIATION MONITORING DOSIMETERS

Personnel dosimetry (whole body & ring badges) are **NOT** needed (C-14 beta energy is too weak).

BIOASSAY REQURIEMENTS

Not normally required. Notify Radiation Safety if an intake of C-14 is suspected

DOSIMETRY

Millicurie quantities of C-14 do not present a significant external exposure hazard because the low energy betas emitted barely penetrate the horny outer skin layer. The critical organ for uptake of many C-14 labeled carbonates is the bone. The critical organ for uptake of many other C-14 labeled compounds is the fat of the whole body. Most C-14 labeled compounds are rapidly metabolized and the radionuclide is exhaled as $^{14}CO_2$. Some compounds and their metabolites are eliminated via the urine. Biological half-lives vary from a few minutes to 35 days. Ten (10) days being a conservative value for most compounds.

RADIOACTIVE WASTE

Isolate waste from other radionuclides in clearly labeled containers. H-3 waste may be mixed with C-14 waste if approved by Radiation Safety.

Sanitary sewer disposal limit is 1 mCi in any one day via a designated “hot” sink provided it is readily soluble, dispersible in water, and contains no hazardous materials. A sewer log must be maintained.

GENERAL RADIOLOGICAL SAFETY INFORMATION (C-14)

(Permission from University of Michigan Radiation Safety Office)

- Inherent Volatility (STP): Not Significant
- Many C-14 compounds readily penetrate gloves and skin. Handle such compounds remotely and wear double gloves, changing the outer pair at least every 20 minutes.
- Care should be taken NOT to generate CO_2 gas that could be inhaled.
- Skin contamination, ingestion, inhalation, and puncture are primary concerns (potential internal doses).
- Always wear a lab coat and disposable gloves when working with C-14.
- Slowly monitor your hands, shoes, clothing and work area using a G-M survey meter for gross C-14 contamination (3% counting efficiency).
- Monitor for surface contamination by smearing, swabbing, swiping, or wipe testing where used and counting in a liquid scintillation counter.
- Typical liquid scintillation counter counting efficiency for C-14 ~ 95%.
- 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.

- The fractional absorption of dietary carbon (uptake to blood) is usually in excess of 0.90.
- ^{14}C-thymidine are specifically incorporated into the DNA of dividing cells and tissues are irradiated much more uniformly from C-14 incorporated into DNA than they are from ^{3}H incorporated into DNA.
- There are three main classes of carbon compounds which may be inhaled: organic compounds, gases (CO or CO_2), and aerosols of carbon containing compounds such as carbonates and carbides.

Organic Compounds - most organic compounds are NOT very volatile under normal circumstances and 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. CO_2 in the blood exists mainly as a bicarbonate.

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