Radionuclide Safety Data Sheet

131

PHYSICAL DATA

Radionuclide:	Iodine-131 (I-131)
Decay Mode:	Beta (followed by gamma/IC)
Beta Energies (primary):	192 keV (89% abundance / average) 606 keV (89% abundance / maximum)
Gamma Energies(primary):	364 keV (82% abundance) 637 keV (7% abundance) 284 keV (6% abundance) 723 keV (2% abundance) 80 keV (3% abundance) 29-34 keV (4.5% / x-rays)
Gamma Constant:	0.22 mR/hr per mCi at 1 meter
Physical Half-Life:	8.05 days
Biological Half-Life:	138 days (unbound)
Effective Half-Life:	7.6 days (unbound)
Specific Activity:	124,068 curies / gram
Half-value Layer (HVL) lead:	0.23 cm = 0.09”
Half-value Layer (HVL) Water/tissue:	6.3 cm = 2.5”
Maximum Beta Range in Water:	2 mm = 0.20 cm = 0.08”
Maximum Beta Range in Air:	165 cm = 65” = 5.4 ft

RADIOLOGICAL DATA

Critical Organ:	Thyroid
Routes of Intake:	Ingestion, Inhalation, Puncture, Wound, Skin Contamination (Absorption)
Radiological Concerns:	External & Internal exposure & contamination
Committed Dose Equivalent (CDE):	1761 mrem/ uCi I-125 ingested (Thyroid) 1080 mrem/ uCi I-125 inhaled (Thyroid)
Annual Limit on Intake (ALI):	30 uCi (Thyroid from ingestion) 50 uCi (Thyroid from inhalation) 1 ALI = 50,000 mrem CDE to the Thyroid

SHIELDING/LABELING

Shielding : Half-value Layer (HVL) lead: 0.23 cm = 0.09”
Half-value Layer (HVL) Water/tissue: 6.3 cm = 2.5”
Tenth-value Layer (TVL) lead: 0.7 cm = 0.28”
NOTE - Plexiglass, acrylic, plastic, wood, or other low-density material will NOT shield I-131 gamma; use lead bricks.

Labeling: Container with $\geq$ 1 uCi must be labeled “Caution, Radioactive Material”

SURVEY INSTRUMENTATION

Survey meter equipped with a GM probe (preferably a GM pancake with 15.5 cm^2 surface area) or NaI probe should be used to survey for I-131
GM probe efficiency for I-131 ~ 8%.
Wipes/smears should be counted on a liquid scintillation counter or gamma well detector to detect I-131 contamination.
Counting efficiency on a Perkin Elmer liquid scintillation counter is approximately 98%
Counting efficiency of a COBRA well detector is 60% (2” NaI crystal) and 70% (3” NaI crystal)

PERSONAL RADIATION MONITORING DOSIMETERS

Personnel dosimetry (whole body & ring badges) recommended when working with I-131
Dose rates from an unshielded 1 millicurie point source of I-131:
1 cm = 2200 mrem/hr 10 cm = 22 mrem/hr 100 cm = 0.22 mrem/hr

BIOASSAYS

The following activities if handled at any one time or processed in a three (3) month period require a thyroid bioassay:

Open room or bench: 0.1 mCi (volatile); 1 mCi (non-volatile)
Certified Hood: 1 mCi (volatile); 10 mCi (non-volatile)

When required, bioassays must be performed at a minimum on a quarterly basis. If more frequent monitoring is desired, it must be performed within 6 to 72 hours after suspected intake.

DOSIMETRY

The thyroid is the critical organ for I-131 uptake. Individual uptake and metabolism vary over a wide range. The thyroid may be assumed to accumulate 30% of soluble radioiodine uptake to the body and retain iodine with a 138 day biological half-life. All radioiodine in the body can be assumed to be eliminated via the urine.

RADIOACTIVE WASTE

Isolate waste from other radionuclides in clearly labeled containers.
Sanitary sewer disposal limit is 10 uCi 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 (I-131)

(Permission from University of Michigan Radiation Safety Office)

- Inherent Volatility (STP): SIGNIFICANT [volatilization is a very significant concern with I-131 especially in a disassociated (free) form or acidic solutions]
- Acidic and frozen solutions enhance radioiodine volatility.
- Store at room temperature: DO NOT FREEZE (whenever possible)
- Radioiodine labeled compounds should be assumed to be potentially volatile because decomposition can give rise to free iodine in solution. Maintaining radioiodine solutions at low (dilute) concentration minimizes radiolytic decomposition.
- Soluble iodide ion is oxidized to elemental (free) iodine that has low solubility in water and a high vapor pressure. Acidic solutions enhance the oxidation of sodium iodide to elemental (free) iodine; thereby, increasing volatility.
- Regulatory limits on personal intakes and environmental releases of I-131 are quite restricted because of the relatively high radiotoxicity relative to other common university-related radionuclides.
- Addition of antioxidants (sodium thiosulfate) to either labeled or sodium iodine solutions of I-131 will help reduce both decomposition and volatilization. Alkaline sodium thiosulfate should be used to chemically stabilize I-131 prior to initiating decontamination of an I-131 spill (0.1 M NaI, 0.1 M NaOH, and 0.1 $Na_2S_2O_3$).
- Drying can form airborne I-131 contamination.
- Radioiodine in the body is eliminated quite rapidly via the urine.
- Most radioiodine accidents are in a soluble form and will be rapidly absorbed via inhalation, ingestion, absorption through the skin, or any combination of these routes.
- Due to its volatile character and ease of absorption, potentially exposed individuals should be monitored after any accident or spill either by in-vivo (thyroid count) or in-vitro (urine) analysis.
- Thyroid counts made within 12-hours after a suspected intake of I-131 often may be unreliable due to skin contamination.
- Of the iodine entering the transfer compartment of the body, approximately 30% is taken up by the thyroid and the remainder (70%) is assumed to be excreted in the urine (ICRP 54).
- Iodine is lost from the thyroid in the form of organic iodine. This organic iodine uniformly distributes among all organs & tissues of the body, other than the thyroid, and is retained with a biological half-life of 12 days. 90% of the organic iodine lost from the thyroid is returned to the transfer compartment and the rest is excreted via the feces.
- The administration of stable iodine (KI or Lugals Solution) blocks the transfer of radioiodine to the thyroid. The onset of inhibition (thyroid blocking) occurs rapidly after administration of stable iodine.
- NOTE: The use of stable iodine blocking agents is a personal choice.
- The urinary excretion rate decreases by more than two orders of magnitude within 5 days after intake. Thus, uncertainties in interpretation of urinary excretion that arise because of the unknown time of intake in routine monitoring may be large unless exposure is avoided for 5 days before sampling.
- Expelling I-131 solutions through syringe needles and pipette tips can generate airborne aerosols.
- Always wear a lab coat and disposable gloves (preferably, two pairs) when handling I-131.
- Monitor hands, lab coat, shoes, work areas, and floors using a G-M survey meter equipped with a pancake/frisker probe for gross contamination.

- Monitor for removable surface contamination by smearing, swiping, swabbing, or wipe testing where I-131 is used. Count smears or swabs in a liquid scintillation counter (LSC) or gamma counter
- Iodinations are to be conducted in an approved exhaust hood.
- Iodinations are to be conducted using a "closed" system (no pipetting & no open containers during iodination process). Only use rubber-septum sealed vials or containers and syringes.
- Whenever possible, perform iodination reactions in the original sealed shipping vial when handling potentially volatile radioiodine.
- Vent the airspace of stock and reaction vials through an activated charcoal-filled syringe trap during iodination procedures.
- Remove potentially contaminated syringe needles from stock an reaction vials through absorbent material (tissue paper, cotton, etc.).
- Store I-131 contaminated objects (syringes, stock vials, waste, etc.) in sealed containers (zip-lock bags, plastic containers, etc.).
- A solution of sodium thiosulfate should be on-hand during iodination procedures.