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Standard Operating Procedure for Using Uranyl Acetate (UA) and Other Naturally-Occurring Radioactive Material (NORM) Compounds

Purpose: Outlines the procedure for utilizing NORM compounds at Dartmouth College.

Hazard Overview:

NORM as defined by the New Hampshire Rules for the Control of Radiation He-P 4001.07(cs) means any naturally occurring radioactive material, and excludes byproduct, source, or special nuclear material. NORM such as uranium and thorium are **radioactive** and potentially **toxic.** The routes of internal exposure entry into the body are through inhalation, ingestion or absorption (Bones and kidneys are the critical target organs). Uranium salts are corrosive and irritating to skin, eyes and mucous membranes. Uranyl nitrate and thorium nitrate are potentially powerful explosives and oxidizers.

Uranyl Acetate (UA) is the most commonly used NORM compound at Dartmouth College. UA is used in the staining techniques for electron microscopy because it provides the contrast needed to differentiate the cellular features in the biological samples. *Uranyl Formate* can also be used for negative staining.

The Radiation Safety Committee has oversight of any NORM use at Dartmouth College. In keeping with the Dartmouth College ALARA goal, the RSC has limited where NORM can be used. If you wish to use NORM, please contact the Radiation Safety Officer for more information.[1]

Contact EHS before purchasing UA or any NORM compound. Thorium Nitrate and Uranyl Nitrate use and storage are not authorized at Dartmouth College.

[1] As of June, 2018, areas where UA/UF can be used are Vail 408, Remsen EM wing. In the Life Science Center, the 2 RAD rooms. In Borwell, the iodination lab on the 5th floor. In Rubin, the 2 RAD rooms. No use in Burke or Williamson. Steele and Wilder have NORM in the form of rocks, etc. For those areas, if renovation is to occur, a MARSSIM survey would be required.

Procedure:

Procurement

- Prior to placing an order of UA or any other NORM, contact EHS at Environmental.Health.and.Safety@dartmouth.edu.

- Upon receipt of the notification, EHS will inspect the proposed use area. EHS will ensure the lab is provided with the necessary working trays and/or waste containers.

- If the research requiring UA/NORM, will utilize only a small amount, the laboratory may contact the EM facility for assistance. The EM facility may be able to provide the materials (UA) needed to make the stains, however the EM facility will require an EHS authorization letter prior to dispensing the necessary materials and/or aliquot. *EHS strongly recommends that labs utilizing UA consult with the EM facility staff.*

- Once an aliquot is provided, the lab shall make microscope stains in the designated RAM use area that has previously been approved by EHS.

Use, Transfer & Weighing

- The minimal required personal protective equipment while UA or any other approved NORM compound is
    - Nitrile gloves
    - Lab coat
    - Safety glasses / Splash goggles

- Upon completion of UA work and prior to leaving the laboratory, remove all PPE and thoroughly wash the hands and forearms with warm water and soap.

- Inhalation and ingestion are the most serious routes of internal entry. No eating, drinking, smoking, chewing tobacco or applying cosmetics in the areas where UA is present.

- Transferring of solid UA and the staining operations shall be performed in a UA designated still air environment to avoid dispersion of the particles. Tare an empty container then transfer an approximate quantity of UA to the empty container. The container shall be weighed again, so an appropriate volume of diluent can be added for the desired final concentration. The UA designated area shall be labeled, "caution radioactive material."

- All UA work shall be performed on the yellow trays provided by EHS. These trays shall be labeled "caution radioactive material."

- All spills shall be treated as a RAM spill and therefore cleaned up immediately. Simple clean up with mild soap and water solution. Place all clean-up debris in a clear bag and label as "uranyl acetate waste". Contact EHS for a pick-up and survey of the area.

Storage of UA/NORM

- All stocks of UA and other NORM compounds shall be stored in a single secure location within each authorized lab.

- All storage cabinets shall be labeled "caution radioactive material."

- All primary containers shall be stored in secondary containment that is large enough to hold any liquid that may spill/leak from the primary container. A tray with sides, plastic bag or other container to adequately prevent the spread of contamination in the event of a spill/leak should be sufficient.

Waste Disposal

- UA/NORM Contaminated dry solid waste (paper towels, pipettes, gloves and/or other plastic ware) shall be collected in a plastic bag, sealed, and labeled with a radioactive waste tag. Contact EHS for a waste pick-up.

- All UA/NORM contaminated liquid, whether aqueous and non aqueous, shall be collected in an approved sealed container, labeled with a radioactive waste tag. . Mixtures of UA with methanol, the percentage of methanol shall be below 10%, dilute as appropriate to obtain this percentage. Absolutely **NO DRAIN DISPOSAL**.

- Contact EHS for guidance in the disposal of all empty or unwanted stock containers.

Surveys

- The Radiation Safety Officer may conduct initial radiation and contamination surveys.

- Laboratory personnel utilizing the UA/NORM shall perform routine contamination surveys of the work area. Using the Ludlum Model 3 with a

pancake probe (model 44-9) the area shall be surveyed at the end of the working day when UA/NORM is being used. The action limit for removable contamination is **220 cpm/100cm²**. Any indication above this limit, usually indicated by a reading that is three times above the background is considered to be contamination. If contamination is detected, contact the Radiation Safety Officer. Meters may be borrowed from EHS for short periods of time.

Personnel Monitoring

- The quantities (usually < 25 grams) of UA solution that are used in the staining procedures, is well below the criteria for personal monitoring devices, and therefore there is no need for personnel monitoring of users.

For more information on working with "particularly hazardous substances" please consult the *Chemical Hygiene Plan*.

Reviewed: November 2023