Saint Mary's University

Electron Microscopy Centre

Title: **SAFELY USE OF URANYL ACETATE**

Equipments: ULTRASTAINER

Revision: **1.0**

Effective Date: **30/09/2005**

Author: **X. Yang**

Nature of the Hazard

Uranyl acetate is a uranium salt used in the preparation of specimens for electron microscope examination. Although the amounts used are relatively small, both the chemical and radiological toxicities of these compounds are significant and require that some precautions be observed, with the main emphasis on avoiding the possibility of inhalation of fine particulates or vapours.

Uranyl acetate contains three isotopes of uranium (^{238}U, ^{235}U and ^{234}U) one of thorium (^{234}Th) and two of protactinium (^{234m}Pa and ^{234}Pa). Only ^{238}U need concern us since the concentrations of the other isotopes are very low in commercially supplied uranium compounds. The specific activity of ^{238}U in laboratory grade uranium chemicals is only 7000 Bq per gram and the gamma ray yield is very low. The most abundant radiations are alpha and beta rays. This means that there is only a minimal hazard from external exposure to the radiation produced by uranium compounds; the radiological hazard arises from inhalation or ingestion of the actual material, leading to irradiation of lung and bone cells, which could result in lung or bone cancer.

The chemical toxicity effects following ingestion or inhalation of soluble compounds such as uranyl acetate, consist chiefly of damage to the kidneys (nephrotoxicity) and the production of necrotic arterial lesions.

The chemical hazards of uranyl acetate are considered to be greater than the radiological hazards, although the control measures are essentially the same. The radiation control requirements call for efforts to be made to keep exposures as low as reasonably achievable (the ALARA principle), i.e. well below the relevant exposure limit. Application of this approach will provide a satisfactory margin of safety for both the chemical and radiological hazards.

Inhalation is substantially more hazardous than ingestion and the dose conversion coefficients published by the International Commission on Radiological Protection reflect this.

The exposure standards for airborne uranium adopted in Australia (based on chemical toxicity) are as follows:

Time weighted average (TWA) 0.2 mg/m^3

Short term exposure limit (STEL) 0.6 mg/m^3.

Compliance with these standards will control both chemical and radiological inhalation hazards.

Hazard Control

The preparation of the working solutions from uranyl acetate in dry powder form is potentially the most hazardous operation. This work should always be performed in a fume cupboard and the operator provided with appropriate personal protective equipment, including gloves, lab coat and safety glasses or goggles. In addition, gloves should always be worn when handling the stock jars.

As with all radiochemical work, no eating, smoking, drinking or application of make-up is to be permitted in the laboratory. **Mouth pipetting should be prohibited.** In addition, the US National Institute of Occupational Safety and Health has recommended against the wearing of contact lenses when working with soluble uranium compounds such as uranyl acetate.

All staining operations should be performed over trays covered with absorptive paper so as to prevent contamination of bench surfaces. Small spills of uranyl acetate solutions may dry rapidly, resulting in a contamination problem which could present both inhalation and ingestion hazards. Care taken to minimise spills and the frequent replacement of contaminated paper will control the hazard.

The faint yellow stain left when the solvent evaporates is a good indicator of the presence of uranyl acetate contamination, although an appropriate thin window GM tube survey meter should always be used when checking for contamination as the nature of the surface may make the stain invisible.

Storage

Storage conditions should aim to provide security and containment. Access should be permitted only to authorized persons who are aware of the required safety measures. Since the external radiation fields are minimal, no shielding or distance restrictions are needed. A simple lockable cabinet or laboratory cupboard would be adequate in most cases.

The small jars in which the Uranyl Acetate powder is supplied should be stored on trays to prevent the spread of contamination. This is particularly important in wooden cupboards as contamination of the surfaces will be virtually irremovable.

The storage cupboard should be labeled with an appropriate warning sign incorporating the radiation trefoil. The name and contact number of the person responsible should also be included.

Waste Disposal

Extremely dilute uranyl acetate solutions may be disposed of to the sewer but it is very important that these wastes are not mixed with other heavy metal staining agents as this would make sewer disposal impossible. Measures need to be taken to preventing splashing during disposal and the connection of the sink drain to the sewer should be as direct as possible, that is, other sinks should not join the drain before it enters the sewer external to the building.

The concentration limit for sewer disposal calculated in accordance with Section 11 of the Radiation Safety Regulation 1999 is 2 mg of uranyl acetate per litre of water.

Licensing and other regulatory requirements

Workers shall be kept free from exposure to Uranyl Acetate whether the concentration of an airborne chemical agent or the level of ionizing or non-ionizing radiation is likely to exceed 50 per cent of the values referred to Canada Occupational Health and Safety Regulations, subsection 10.19(1) or the levels referred to in subsections 10.26(3) and (4). (http://laws.justice.gc.ca/en/l-2/sor-86-304/31739.html)

Reference: the content of this document is adopted from The University of Queensland, Occupational Health & Safety with minor modifications.

THE UNIVERSITY OF QUEENSLAND OH&S
OCCUPATIONAL HEALTH & SAFETY Unit