Uranyl acetate and uranyl nitrate - Safety information sheet

Introduction and hazard identification

Uranyl acetate and uranyl nitrate are water-soluble uranium compounds and are often used as stains in electron microscopy. Even with the relatively small amounts used in microscopy, there are associated chemical and radiological hazards which require some basic safety precautions to be adopted; with the emphasis on avoiding the possibility of inhalation or ingestion of the material.

Radiology & toxicology hazards

Uranyl acetate and uranyl nitrate principally contain the isotope 238U of uranium. The specific activity of 238U in laboratory grade uranium chemicals does not exceed 10,000 Bq per gram (where Bq refers to disintegrations per second) and the amount of gamma rays produced is very low. 238U is an alpha emitter and there are also beta and gamma emitting decay products.

a) External radiation hazard

Typical laboratory quantities of uranium salts do not represent a significant external radiation hazard, as the alpha particles do not penetrate the external dead layer of skin. There is beta and gamma emitters in the 238U decay chain, but the betas also do not have enough energy to penetrate the skin, and the amount of gamma radiation is minimal.

b) Inhalation or ingestion hazard

The primary radiological hazard arises from inhalation or ingestion of the uranium compound, which leads to irradiation of lung and bone cells causing an increased risk of cancer. A chemical hazard also arises from inhalation or ingestion, as uranium is a heavy metal and can damage the kidneys. Absorption through the skin is not significant, but contact with the substance can cause irritation and increases the risk of ingestion.

Overall, there is a minimal external risk from the radiation emitted by uranyl acetate and uranyl nitrate, and a relatively large risk arising from internal exposure following inhalation or ingestion. It is therefore essential to adopt appropriate controls when handling unsealed uranium salts to minimise this risk:

- Reduce the amount being handled as much as possible
- Contain the unsealed sources to prevent contamination
- Maintain a high level of cleanliness.
- Hazard control and safe practice

With the most serious hazard arising from inhalation or ingestion, extra care should be taken to prevent any possibility of inhaling fine particles. Gloves must always be worn when handling or weighing out the uranium salts. Under normal circumstances when using the compound infrequently and working with small quantities of up to 10g, respiratory protection is not necessary. Avoid contamination of bench surfaces by using spill trays (metal or plastic) with disposable coverings such as bench coat and clean the surface after use. If an appropriate thin window GM tube survey meter is available, then it can be used to monitor for contamination. Apply the same principles when working in solution.
Storage

Any stock solution or powder must be labeled with the radioactive warning sign and stored in a locked cupboard. When storing in a wooden cupboard, spill trays (metal or plastic) must be used to prevent wood contamination, which is very difficult to remove. Lead shielding is not necessary as the storage cupboard or cabinet easily contains the radiation. Very old containers that have remained unopened may contain significant levels of radon (a radioactive gas) and should be opened with caution, in a fume hood. Storage conditions are intended to provide control and security; therefore access should only be given to appropriate persons who have been made aware of the safety requirements. These conditions are part of the safeguards legislation and further information can be obtained from the Radiation Safety Officer, OLS.

Disposal of waste

Disposal of uranyl acetate and uranyl nitrate solutions is relatively simple. Aqueous and diluted solutions may be poured down a sink designated by your RSO, followed by flushing with plenty of water. The maximum amount of uranyl acetate or uranyl nitrate that may be disposed of to the sewer in any 24-hour period is approximately 50g. Never mix with other staining compounds such as lead citrate or other hazardous chemicals as it is often impossible to dispose of these to the sewer. Any solid waste (such as gloves, benchcote) can be disposed of as ordinary waste, unless heavily contaminated, in which case it should be disposed of as low-level radioactive waste.

Further information

Contact the Radiation Safety Officer, Office of Laboratory Safety:

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