^{238}U

Radioisotope Safety Data Sheet
Uranium chemicals

Half life 4.5 x 10^9 years

Radiations emitted

Uranium chemicals sold for laboratory use are a mixture of the isotopes ^{238}U, ^{234}Th and ^{234m}Pa, with a small amount of ^{235}U and ^{234}U. These isotopes are alpha and beta emitters that present essentially an internal hazard.

alpha radiation from ^{238}U and ^{234}U (energies from 4.15 to 4.77 MeV)

beta radiation from ^{234}Th and ^{234m}Pa (energies from 76 keV to 2.28 MeV)

Low yield **gamma radiation** from Pa^{234}

Safety precautions

Safety measures should aim at preventing ingestion, inhalation or skin contact. Standard laboratory PPE should always be used. A fume cupboard should be used for processes that could produce an inhalation hazard, e.g. mixing of dry chemicals. Work areas and equipment should be monitored using a suitable survey meter. Because of the very low specific activity and low gamma ray yield, there are no significant external hazards. There is no requirement for shielding when using or storing commercially available quantities of uranium chemicals.

Radiotoxicity data

Since uranium chemicals contain alpha emitters they present significant internal hazards and this is reflected in the low annual limits on intake.

The Annual Limit on Intake by ingestion (ALI_{ing}) is 450 kBq and the most restrictive inhalation limit (ALI_{inhal}) is 2.7 kBq. The chemical toxicity effects are more significant than the radiological ones and consist chiefly of damage to the kidneys (nephrotoxicity) and the production of necrotic arterial lesions.

Licensing requirements

Depleted uranium has a specific activity between 14 to 21 kBq/g depending on the U-234 content. Under the Radiation Safety Regulation 2010, a licence is required for the possession of ^{238}U sources with concentrations of greater than or equal to 1 Bq per gram. For a source with a specific activity of 20 kBq/g then the licensable amount is 0.05g. Typically the uranium solution is diluted to 10% staining solutions for use as a contrasting agent in staining electron microscope slides. This dilution means the diluted amounts can be used by non-licenced users, however a licenced user is required to prepare the dilute staining solutions which are prepared from depleted uranium stock solutions.

In addition, the commonwealth Nuclear Safeguards and Non-Proliferation Act requires annual reporting of holdings. This is coordinated by the University Radiation Protection Adviser (RPA) on behalf of the Secretary and Registrar. Users should maintain a log of uranium chemical usage and provide it to the RPA upon request.

Disposal data

The maximum concentration of uranium in aqueous wastes released to a sewerage system is given in the 2010 Regulation as 3.11 kBq per m^3 i.e. 3.11 Bq per litre.

The concentration of uranium in solid wastes disposed of to the general waste stream must be less than 0.5 Bq per gram (500 Bq per kg) – i.e. half the concentration limit for licensing.

Wastes containing uranium should not be placed in a decay store as there will be no significant diminution in activity and accountability for the waste may be lost. Users should consult with the RPA to determine the most appropriate method of waste disposal.

Radiation detection and monitoring

A Geiger Muller tube monitor is the most suitable type of meter for contamination control. Personal monitoring is not required.

Laboratory requirements

Low level lab guidance activities

Bench: 500 kBq

Fume cupboard: 5 MBq

Medium level lab guidance activities

Bench: 1 MBq

Fume cupboard: 10 MBq

NB: the guidance activities are maximum amounts that should need to be used in most research projects. Should greater activities need to be used, the advice of the University Radiation Protection Adviser should be sought.