U_{nat}

Radioisotope Safety Data Sheet
Uranium (natural and depleted composition)

Half life 4.47 x 10^9 years

General information

Commercially available uranium compounds are prepared from what is termed *depleted* uranium, i.e. natural uranium which has had the concentration of the fissile isotope ^{235}U reduced. Samples of uranyl actetate have shown the following isotopic compositions:

Isotope	Sample concentrations Bq/gram	Natural U concentration Bq/gram
^{238}U	6900	6900
^{234}U	900 to 3300	6900
^{235}U	90 to 185	323
^{234m}Pa	6900	6900
^{234}Th	6900	6900

The process used to extract ^{235}U also lowers the concentration of ^{234}U. In natural (unprocessed) uranium ores, ^{234}U is in secular equilibrium with ^{238}U. Uranium 234 has a long half-life (244 000 years) and consequently there is no appreciable in-growth of the isotope in normal time scales.

Protactinium 234m and ^{234}Th are very short lived isotopes that grow in rapidly after the separation of uranium from its ores and reach secular equilibrium with ^{238}U in about 300 days. Commercially purchased uranium chemicals will have the thorium and protactinium isotopes in secular equilibrium given the time scales involved in ore processing and refining.

Radiations emitted

Uranium natural consist essentially of three uranium isotopes: ^{238}U, ^{234}U and ^{235}U, with ^{238}U having a proportion by mass of between 99.6% and 99.8% depending on the degree of depletion of ^{235}U and ^{234}U.

Beta rays 2281 keV m ax, 81 keV average yield 99% from ^{234m}Pa
466 keV max, 149 keV average, yield 53.1%

Gamma rays 1.2 MeV average of several low yield gamma rays from ^{234}Pa and ^{234m}Pa
Total yield <1%

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

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 and with activities of 1 kBq or greater. A user licence is also required for any persons who use such sources for research purposes.
In addition, the commonwealth Nuclear Safeguards and Non-Proliferation Act requires annual reporting of holdings. This is done by the University Radiation Protection Adviser (RPA) on behalf of the Secretary and Registrar. Users should maintain a log of uranium chemical usage and report this to the RPA annually when requested.

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.