Human hair as biomonitor of chronic intake of uranium: Studies at a nuclear fuel fabrication plant.

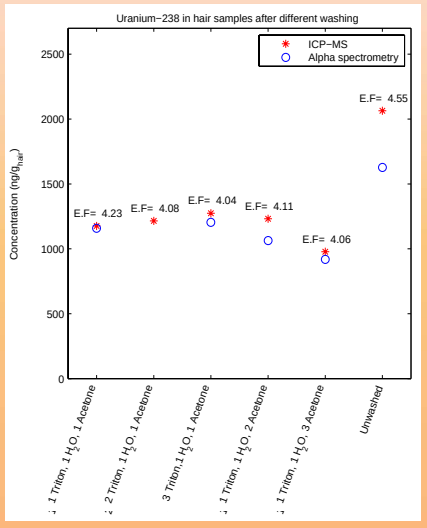
Israelsson, Axel; Mellander, Hans; Pettersson, Håkan
Radiation Physics, Div. of Radiological Sciences, Dept. of Medical and Health Sciences, Linköping University, SWEDEN

Introduction

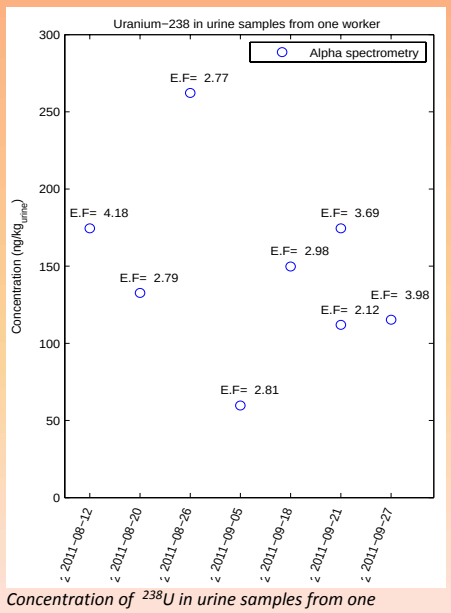
Handling of uranium in various processes of nuclear fuel fabrication may result in significant intake of uranium by the workers. Common methods of monitoring the exposure include urine analyses, measurement of lung burden by γ-spectrometry and air filter analyses. However, intake of heavy metals can also be traced by hair analyses. The aim of this study is to investigate the potential of using human hair as a bio-indicator of intake of uranium and subsequent dose assessment .

Materials and Methods

Hair and urine samples were collected from workers at a nuclear fuel fabrication plant in Sweden. Analyses were performed using both ICP-QMS and alpha spectrometry. All samples except the hair analyzed with ICP-QMS underwent chemical separation prior to measurement. Different washing schemes were tested for the hair with Triton-X, distilled water and acetone in an ultrasonic cleaner, in order to remove exogenic uranium.



^{238}U concentration for different washing schemes of six parts of one hair sample donated in Aug. 2011. Enrichment factors (E.F.) were obtained from ICP-QMS measurements of the ratio of ^{235}U/^{238}U.



Concentration of ^{238}U in urine samples from one individual. Enrichment factors (E.F.) were obtained from ICP-QMS measurements of the ratio of ^{235}U/^{238}U.

Results and discussion

The washing procedure is important in order to remove exogenic U, i.e. U deposited in the hair from airborne dust. The U removed by sequential washing corresponds to about 30% of the total U found in the hair. The enrichment factors (E.F.) obtained for the hair samples are in accord with the typical E.F. of the U handled at the factory, thus reflecting work related exposure. The mode of U intake is under investigation, but the inhalation pathway presumably dominates.

The E.F. of the urine samples are generally lower, reflecting a mixed intake; i.e. intake from work activities and from ingested food containing natural U. The short-term large variations in both E.F. and U concentration shown here and also in other workers samples indicate that urine spot samples may not provide a robust indicator of work related U exposure.