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Environmental Radioactivity in Building Materials for the Environmental Radioactivity Measurement Centre at ANSTO

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Abstract

The successful use of gamma-spectrometry to measure very low level radioactivity relies on several factors, including the actual system and shielding, as well as environmental factors. A low-level laboratory needs to be in a geographic location with low background radiation, built with low background materials. The laboratory should ideally be built underground to minimize the interference from cosmic radiation.

Plans for a new Environmental Radioactivity Measurement Centre at ANSTO were developed in late 2009. The plans included the replacement of the Low Level Radiochemistry Laboratory which was built in the early 1960's and a new Gamma-spectrometry laboratory to be located in the basement of the new building. The design of a new Gamma-spectrometry room triggered a comprehensive study of Australian building materials. Initially the building material study focused on the choice between high density concrete and local Hawkesbury sandstone. It was found that the naturally occurring gamma-emmitting isotopes K-40, Pb-210, Ra-226, Ra-228 (Ac-228), Th-228 and U-238 were at similar activities for both local sandstone and commercially (standard) concrete. The levels exceeded 500 Bq/kg for K-40, 20 Bq/kg for the U-238 series isotopes and 70 Bq/kg for the Th-232 series isotopes.

The study proceeded by breaking down the components of the concrete and studying 5 different sources of cement, aggregate and sand. We also sourced different commercially available grades of sandstone and the local sandstone at different depths (2 and 4 m below surface). The benchmark for the study was a special concrete mix used in the building of a gamma-basement in Germany which was of much value to our study. We needed to find building materials of either sandstone or a special concrete mix to be below the following values: K-40 less than 30 Bq/kg, both U-238 and Th-232 series less than 10 Bq/kg.

Following an extensive sourcing of building materials, a "low-level" concrete mix was found.The sandstone shielding option was discarded.

Other materials in or near the Gamma-spectrometry basement were also analysed. The room design shows a glass wall barrier between the office and the actual instrument room. The glass sample was analysed and found relatively low levels of the radioisotopes of interest.

A list of building materials best avoided in building a low background gamma-facility will be presented, showing that by choosing incorrect building materials one can easily reach the dose-limits for external and internal hazard.