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Analysis and Evaluation for Consumer Goods containing NORM in Korea

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Content

To protect the public from natural radioactive materials, the "Act on safety control of radioactive rays around living environment" was established in Korea focusing on natural resources, byproducts, products, and cosmic rays. For products, not only building materials containing NORM, as special case founded in Korea, some consumer goods to promote health such as anion bracelets, necklace and mats contain naturally occurring radioactive material (NORM). Some of them can cause problems by high radioactivity. In the regulations, there is an annual effective dose limit of 1mSv for products, but the activity concentration limits is not established yet. To derive the activity concentration limits for products, it is necessary to analyze the radioactivity for used products and to evaluate the dose by products using usage scenario. In the case of building materials, room models to predict the external exposure by gamma radiation from building materials have been developed and used in the last 20 years. However, for the consumer goods in contact with bodies, because they have a variety of shape, size and usage position, it is very difficult to evaluate the exposure dose by each consumer goods. In this research, we analyzed twenty consumer goods such as anion bracelets, necklace and mats sold by on-line market in Korea and evaluated the external dose. In the case of radioactivity measurement, we analyzed the U238 and Th232 using the Inductively Couples Plasma-Mass Spectroscopy (ICP-MS) instead of gamma spectroscopy because of small quantities. The analysis results are from 1.11 Bq/kg to 2810 Bq/kg for uranium and from 0.54 Bq/kg to 11859 Bq/kg for thorium. For dose evaluation by consumer goods, we assumed the "small room model" surrounding the ICRP reference phantom to simulate the consumer goods in contact with bodies, from the idea of room model. We reduced from the room size to phantom size and assumed the thickness from 0.001 cm to 1 cm considering usage quantities. It is possible to evaluate any type of consumer goods using this model and to derive activity concentration limits considering usage quantities. Using the Monte Carlo code MCNPX, we evaluated the effective dose rate for the ICRP reference male in a small room model. The results are from 7.67E-14 to 7.57E-11 Sv/h per Bq/kg for uranium and from 1.07E-13 to 1.05E-10 Sv/h per Bq/kg for thorium. Using the analysis results and the effective dose rate, we calculated the effective dose by consumer goods assuming usage time and derived the activity concentration limits.

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