Summary

CONTRIBUTION OF POTASSIUM, THORIUM AND URANIUM IN FORMING NATURAL BACKGROUND RADIATION IN POLAND

Natural background gamma radiation is constantly present in human life. It consists of cosmic radiation and terrestrial radiation of natural radioactive elements dispersed in the environment. Terrestrial natural background gamma radiation mainly consists of gamma rays of ^{40}K and gamma rays of gamma emitters from ^{238}U and ^{232}Th decay series, present in various components of the environment. Concentrations of U and Th, measured by means of gamma spectrometers, are reported as specific activities (in Bq/kg) or as i.e. equivalent contents of U (eU) and thorium (eTh) in ppm, assuming the existence of secular equilibrium within the decay series. In the thesis U and Th symbols are used for eU and eTh, respectively. In the case of potassium, its content is often reported as total K (all isotopes) in %.

The main objective of the thesis was to estimate the contribution of K (properly ^{40}K), U (properly gamma emitters of ^{238}U decay series) and Th (properly gamma emitters of ^{232}Th decay series) in forming terrestrial natural background gamma radiation in Poland, which has not been the subject of research until now.

Gamma spectrometric measurements of K, U, Th contents and absorbed dose rate of terrestrial natural background gamma radiation (1) outdoor – in open space, in places with varied bedrock lithology, (2) outdoor – in urban space and (3) indoor – in residential buildings were performed. On the basis of obtained results, the contribution of K, U, Th in forming absorbed dose rate of terrestrial natural background gamma radiation in various environments was determined.

Performed studies showed that outdoor, in open space outside urban areas, the contribution of K, U and Th in forming terrestrial natural background gamma radiation depends on the type of bedrock and its formation conditions, as well as on human intervention in the environment and the anthropogenic changes in the form of waste heaps after the exploitation or processing of mineral resources. The place of occurrence of (1) Triassic sandstones of the Intra-Sudetic Basin, (2) quartz-graphitic schists from the Brodziszów region (Niemcza Zone) and (3) beach sands of the west coast enriched in heavy minerals were analyzed in detail. These sites differed in the dominant

component of the terrestrial natural background gamma radiation. In the place of occurrence of Triassic sandstones of the Intra-Sudetic Basin potassium made the main contribution (reaching a maximum of 85%) in forming absorbed dose rate of terrestrial natural background gamma radiation. In the place of occurrence of quartz-graphitic schists from the Brodziszów region uranium made the main contribution (reaching a maximum of 88%) in forming absorbed dose rate of terrestrial natural background gamma radiation. In the place of occurrence of beach sands of the west coast, enriched in heavy minerals, thorium made the main contribution (reaching a maximum of 71%) in forming absorbed dose rate of terrestrial natural background gamma radiation.

Outdoor, in urban space, terrestrial natural background gamma radiation is formed by building materials used for the construction of roads and pavements and for the construction of buildings. Regardless of the type of artificial surface, i.e. the surface made of asphalt, basalt, concrete, granite, stoneware tiles or gravel, potassium made the main contribution in forming absorbed dose rate of terrestrial natural background gamma radiation. Only in places with relatively natural substrate (soil) thorium made the main contribution. However, the contribution of thorium was only slightly higher than the contribution of potassium.

Absorbed dose rate of terrestrial natural background gamma radiation indoor, in residential buildings, depends on the main raw material of the walls, finishing materials, covering the walls, but also depends on the time of rooms ventilation. Potassium or thorium made the main contribution in forming absorbed dose rate of terrestrial natural background gamma radiation indoor. The contribution of uranium was lower. However, analyzing terrestrial natural background gamma radiation in particular rooms, it was noted that the contribution of uranium was slightly higher in bathrooms, which is most likely related to the weaker ventilation of these rooms and the accumulation of radon in the air. Uranium content is calculated on the basis of ^{214}Bi – the main gamma emitter in uranium ^{238}U decay series – which is radon progeny.

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