International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 4, Issue 8, August – 2020, Pages: 287-289

Content of Radionuclides in Soil and Building Materials

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Abstract. *Abstract At the present time, building materials obtained from soil and materials made from it are used in various objects of the Republic. Assessment of their radiation hazard and the effect of radiation emitting from these soils and building materials of human health is an urgent problem of analytical chemistry, radiation chemistry, nuclear physics and radioecoligy [1-3]. To assess the radiation hazard of building materials, the main role is played by determining the value of the specific effective activity - (Aeff). In addition, this article presents the results of radon emanation and the activity index of building materials [5-7]*

Keywords: building materials, radon, thoron, radium, potassium, thorium, actinicity index, specific activity, specific effective activity, radon emanation.

1. INTRODUCTION

Content of radionuclides in soil and building materials. The paper presents the results of studies of the radionuclide composition of soil samples and building materials produced in certain regions of Uzbekistan

Measuring NER content in building materials is important for assessing the effects of radiation on people who spend up to 80% of their time indoors. One of the indicators of the safety of building materials is the specific effective activity (Aeff), the value of which is regulated by national and international documents [1, 2, 3].

Such environmental objects as crushed stone, gravel, sand, rubble and pylon stone, cement and brick raw materials mined at their deposits, as well as industrial waste (ash, slag, etc.) can be used as building materials and raw materials for them. In particular, in Uzbekistan, home-made adobe bricks and blocks made from local clay are widely used for housing in rural areas. Therefore, the question of the activity of natural radionuclides in the soil, which can be used for these purposes, is relevant for assessing the radiation safety of the population.

The Aeff value is determined by the specific activities of natural (natural) radionuclides ^{226}Ra (A_{Ra}) and thorium ^{232}Th (A_{Th}), which are in equilibrium with the rest of the uranium and thorium series and the specific activity of potassium ^{40}K (A_K). The effective specific activity of natural radionuclides is calculated by the formula

$$A_{eff} = A_{Ra} + 1.3 \times A_{Th} + 0.09 \times A_K \qquad (1)$$

According to formula (1), 370 Bq / kg ^{226}Ra, 260 Bq / kg ^{232}Th and 4810 Bq / kg ^{40}K create the same dose. Materials for which are considered safe [4] and [5]. Measurements of the radionuclide composition of building materials and soils were carried out according to the approved VNIIM im. Mendelev's method of performing measurements using a NaI (Tl) scintillation gamma spectrometer. The spectrometer was calibrated with special-purpose volumetric activities with radionuclides Ra-226, Th-232, K-40 and Cs-137 with inert fillers with a density of 200, 900 and 1700 g / l. The background measurement was carried out using a Marinelli vessel of similar geometry filled with distilled water.

In addition to the indicated natural (natural) radionuclides, the specific activity of the technogenic radionuclide cesium ^{137}Cs, which occurs in the soils of Uzbekistan, was also determined.

Table 1 shows the maximum values of the measured specific activities of natural radionuclides ^{226}Ra, thorium ^{232}Th, potassium ^{40}K, effective specific activity (AEF) and specific activity of technogenic radionuclide (TRN) cesium ^{137}Cs.

2. RESULTS OBTAINED AND THEIR DISCUSSIONS

Table 1 - Maximum values of the specific activity of radionuclides in soil

№	Name of the settlement	Specific activity of ERH, Bq / kg			Specific effective activity, Bq / kg	Specific activity of TRN, Bq / kg
		Ra-226	Th-232	K-40	A_{eff}	Cs-137

№	Name of the settlement	Specific activity of ERH, Bq / kg			Specific effective activity, Bq / kg	Specific activity of TRN, Bq / kg
		Ra-226	Th-232	K-40	A_{eff}	Cs-137
1	Samarkand region, Urgut district, village of Mergancha	24,2 ± 2,4	36,1 ± 3,6	549,2 ± 55,0	120,0 ± 7,2	14,4 ± 1,5
2	Samarkand region, Pastdargom district, Dimishkibola, Kamolot mahalla	26,6 ± 5,3	35,3 ± 3,9	982,4 ± 98	161,0 ± 11,5	9,5 ± 1,1
3	Jizzakh region, Jizzakh region, Uchtepa mahalla	26,4 ± 4,6	40,7 ± 4,0	581,0 ± 55,0	132,0 ± 8,6	10,3 ±1,8
4	Jizzakh region, Gallaaral district, Sarbazar mahalla	32,2 ± 5,5	39.0 ± 4,2	615,7 ± 60	138,0 ± 9,5	< 2,9
5	Fergana region, Rishtan district, Rishtan city, Ok-er SHFY, residential area Khozhi	27,2 ± 2,7	35,1 ± 3,5	530,5 ± 53	128,7±7,5	7,2 ± 0,7
6	Namangan region, Turakurgan district, Turakurgan city, Yangi Akhsikent	36,9 ± 3,7	38,5 ± 3,6	724,1 ± 72	163,2±9,3	7,5 ± 1,3

In regulatory documents such as SanSSi No. 0193-06, building materials are divided into IV classes according to specific effective activity.

Class I. If A_{eff} <370 (Bq / kg), then it is allowed to use these building materials for the construction of housing and social facilities;

Class II. If A_{eff} ≤740 (Bq / kg), then it is allowed to use these building materials for the construction of housing, roads and production facilities;

III class. If A_{eff} ≤1350 (Bq / kg), then it is allowed to use these building materials for the construction of roads outside settlements;

IV class. If 1350 (Bq / kg) ≤ A_{eff} ≤ 4000 (Bq / kg), then in order to use these building materials, you need to get the rags from the sanitary and epidemiological service.

Table 2 shows summary data on the content of radionuclides and their total specific effective activity in building materials and products manufactured in the Jizzakh, Samarkand, Fergana, Namangan and Tashkent regions of Uzbekistan.

Table 2 - Limit values of radionuclide activity in building materials and products

№	Name of building materials and products	Ra-226 (Bq / kg)	Th-232 (Bq / kg)	K-40 (Bq / kg)	A_{eff} (Bq / kg)
1	Crushed stone	16,9 - 282,2	10,5 - 104	191 - 1230	52,8 - 612,8
2	Brick	26,2 - 76,7	38 - 56,8	525,8 - 1006,8	130,8 - 264,2
3	Sand	20,8 - 38,7	10,3 - 47,3	182 - 688	56,8 - 173,7
4	a piece of chalk	<6,2 - <9,5	3 - 4	<31,4 - < 47	14,8 - 21,8
5	Marble	< 5,6	< 2,2	< 20,3	12
6	Granite	33 - 99	47 - 88	1075 - 1205	200,8 - 351,6
7	Gypsum	< 9,5	< 4	24 - 40	19,7 - 21,2
8	Cement	6,6 - 48,9	8,5 - 23,4	149 - 343,6	33 - 124,9
9	Lime	4 - 5	< 3	24 - 27	11,3 - 12,8
10	Asphalt	11 - 61	10,8 - 40,8	198 - 1049	46,2 - 226,8
11	Mineral powder	12,2 - 25	8,3 - 16,7	99 - 99,4	35,6 - 63,2
12	Products for sidewalks	40,6	45	584,4	163,9

13	Concrete blocks	13,5 - 64,9	13,3 - 44,6	183,9 - 550,9	51,4 - 191,9

3. CONCLUSION

The maximum A_{eff} value was observed in the crushed stone sample and amounted to 612.8 Bq / kg. The total specific effective activity of other building materials and soils does not exceed 370 Bq / kg, which meets the requirements of the interstate standard [4] and the regulatory document of the Republic of Uzbekistan [3].

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