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ASSESSMENT OF RADIATION IMPACT ON THE POPULATION OF FORMER URANIUM MINES

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ABSTRACT

The article presents the results of a study of the current radiation situation in the Yangiabad settlement of Tashkent oblast, which was founded as a working settlement for employees of uranium mines. As part of the research work, the equivalent dose rate of gamma radiation above the soil surface and the effective specific activity of natural radionuclides in soil samples taken in the surface 10-cm layer were measured. In the surveyed territories of Yangiabad settlement the EDR values in 2023-2024 were in the range from 0.10 μSv/h to 0.24 μSv/h, in children and adolescent institutions, polyclinics - from 0.10 μSv/h to 0.14 μSv/h, only in a few houses of private sector EDR reached values of 0.22-0.24 μSv/h due to construction materials. The main contribution to the effective specific activity of surface soil layers is given by radionuclides 232Th, 226Ra. Radiation situation in Yangiabad settlement of Tashkent region can be assessed as satisfactory, but it is not recommended to stay for a long time on the territories close to former uranium mines.

Key words: equivalent dose rate, gamma radiation, uranium mining, natural radionuclides, radiation survey, specific activity.

INTRODUCTION

In the late 1950s, the Republic of Uzbekistan, including the village of Yangiabad in the Tashkent region, was undergoing intensified mining and processing of uranium ore for the development of the USSR nuclear industry. This resulted in the generation of a large amount of radioactive waste. Many uranium

legacy sites in Central Asia had not been rehabilitated before the collapse of the USSR, which leads to environmental contamination and radionuclide intake into the bodies of people and animals living in the adjacent territories [6]. One of the urgent issues is the radioecological situation at uranium tailings located near the Yangiabad settlement in Tashkent region. These tailing dumps are located in an intermountain valley in conditions of high mountains, active manifestation of exogenous physical and geological processes and high seismicity. They occupy an area of about 50 square kilometers, where about 2.6 million cubic meters of radioactive waste is buried. The mine operated from 1959 to 1985. Some of the tailings and dumps are located in close proximity to mountain rivers within populated areas, which together with the danger of avalanches, mudflows, landslides and earthquakes may lead to an ecological disaster [3]. It is undeniable that environmental changes directly affect the economy and human health. One of the tasks of solving this problem is the issues of studying and scientific substantiation of biologically acceptable amount of radioactive substances in environmental objects. It is impossible to solve these issues without a comprehensive study of sources and distribution patterns of radionuclides in environmental objects [5]. The relevance of this direction of research work is conditioned by large-scale and intensive anthropogenic impact on the biosphere, associated with the rapid growth of humanity and the use of resources. In recent years, environmental pollution causes serious concern, as this process is associated with the depletion of vital resources and the increasing use of radioactive substances and sources of ionizing radiation in all spheres of economic activity, which can pose a serious threat. The radioecological situation in a number of regions of the Republic remains rather complicated, therefore the main direction of radioecological safety is to achieve significant improvement of the environment quality in the territories with increased risk for human health and stability of the radioecological system [7].

Research materials and methods:

Radiation survey of the territories of settlements located near former uranium mines is one of the important elements of ensuring radiation safety of the residents of these settlements [2]. Laboratory tests were performed by the Research Radiological Testing Laboratory (RRTL) of the Center for the Development of Professional Qualification of Medical Workers (CDPQMW) of the MoH of RUz in 2023-2024. As part of the research work, the following measurements of radiation background and environmental factors were carried out, which allowed a quick assessment of the radiation situation in the surveyed area:

- measurement of gamma radiation equivalent dose rate (EDR) above the soil surface;

- determination of effective specific activity of natural radionuclides in soil samples taken in the surface 10-cm layer of soil.

The method of continuous pedestrian gamma survey was used to study the EDR using a field radiometer-spectrometer of “Identifinder” type (Certificate of Verification No. 1740, valid until 01.08.2025), dosimeter-radiometer MKC-AT1117 (factory No. 1162, Certificate of Verification No. 421/05, valid until 27.04.2025). Portable dosimeters provide mobility and convenience in the study of various areas of the territory, allowing to quickly measure the radiation level in the field. Measurements were made with georeferencing to the geographic coordinates of residential and public buildings of the settlement [1].

The limit of permissible basic relative error of measurements in the DER range from 0.03 to 2.0 μSv/h of both measuring instruments is not more than 20-25%.

EDR of external gamma radiation was assessed in two stages. At the first stage, a pedestrian gamma survey of the territory was carried out in order to identify and localize possible technogenic-altered zones. At the first stage 1977 EDR measurements were carried out. At the points with maximum values of the field dosimeter, soil was sampled and its radionuclide composition was analyzed. At the second stage, gamma radiation dose rate measurements were carried out at control points located evenly across the territory of the settlement. A total of 328 EDR measurements were made. The points with maximum readings of dosimeters were also included in the number of control points.

Soil samples were taken by the envelope method in the form of a square of a fixed area of at least 10 by 10 cm to a depth of 10 cm (5-point samples of 200 g each in the corners and in the center of the square with a side of 3 m). At the level of 2-3 cm and one meter above the ground surface at the sampling point the gamma dose rate was measured with a field radiometer-spectrometer of “Identifinder” type. All collected samples were placed in a polyethylene bag, which was carefully tied. A sampling report was filled out for all samples, where the site number, address of the sampling site, date of sampling, type of research were indicated. The packed sample together with the completed sampling report was placed in a second polyethylene bag, which was also carefully tied and placed in containers protecting the bags from damage - boxes.

The collected samples were recorded in the laboratory logbooks, which were filled out according to the sampling certificates.

In the laboratory, all soil collected at each sampling point was weighed, thoroughly mixed and dried to air dryness. The total weight of the sample before and after drying was recorded.

The selected sample was placed in measuring containers, weighed and measured on beta-gamma spectrometer “Radek” MKGB-01 according to “Methods of measuring specific activity of natural radionuclides, cesium-137, strontium-90 in samples of environmental objects” using spectrometer-radiometer of gamma and beta radiation MKGB-01 “Radek”. Certificate № 0000299, valid till 07.05.2025. Measurement conditions: T= 21°C, RH. 56%, γ-background 0.14 μSv/h. In total 27 soil samples were investigated.

Results and discussions.

The settlement of Yangiabad, Tashkent Region, is closely connected with the former uranium mines of the USSR. It was founded as a working settlement for employees of uranium mines. After the closure of the mines, the settlement lost its industrial significance, but remained known for its past as a center of uranium mining. For the zoning of the settlement area where people live, an approach oriented to local features and settlement structure (residential buildings, schools, kindergartens, hospitals, border residential areas, etc.) was also used. All zones were conventionally numbered for convenience. Total for 2023-2024. RRTL CDPQMW conducted 2305 measurements of gamma radiation equivalent dose rate (EDR) in the study area. The average and maximum values of the obtained gamma background results in the open area are presented in Table 1.

Table 1

Average and maximum values of gamma radiation EDR in the open area of Yangiabad settlement of Tashkent region for 2023-2024

#	Indicator	Research period	
		2023	2024
1	Number of researches	1262	1013
2	Average values, μSv/h	0,15±0,05	0,14±0,04
3	Maximum values, μSv/h	0,24	0,23

In the surveyed territories of Yangiabad settlement EDR values in 2023-2024 ranged from 0.10 μSv/h to 0.24 μSv/h, which corresponds to background and normative values.

Average and maximum values of the obtained gamma background results in residential and public buildings are presented in Table 2.

Table 2

Average and maximum values of gamma radiation EDR in residential and public buildings of Yangiabad settlement of Tashkent region for 2023-2024

#	Indicator	Research period	
		2023	2024
1	Number of researches	15	15
2	Average values, μSv/h	0,17±0,05	0,16±0,05
3	Maximum values, μSv/h	0,24	0,22

In 2023-2024. EDR of children and adolescent institutions, polyclinic was within the range from 0.10 μSv/h to 0.14 μSv/h, which corresponded to the normative values, only in a few houses of private sector EDR reached the values of 0.22-0.24 μSv/h due to construction materials.

Table 3 presents average values of effective specific activity of natural radionuclides in soil/ground samples.

Table 3

Average and maximum values of effective specific activity of natural radionuclides in soil/ground samples of Yangiabad settlement of Tashkent region for 2023-2024

#	Indicator	Research period	
		2023 г.	2024 г.
1	Number of researches	14	13
2	Average values, μSv/h	184,7±21,9	208,9±17,5
3	Maximum values, μSv/h	270	255

Calculated effective specific activity of natural radionuclides in the studied soil samples in the territory of Yangiabad settlement of Tashkent region corresponded to the requirements for residential and public buildings.

The obtained data show that the average values for all these indicators meet the normative requirements, but in some territories higher content of natural radionuclides is noted in soil, but they belonged to places of short-term stay of people.

Conclusions. The settlement of Yangiabad, Tashkent oblast, is one of the examples of cities in the former Soviet republics of Central Asia where environmental problems associated with uranium mining persist. In the process of uranium mining and its processing there was a release of radioactive elements that even after the closure of the mines, the radiation background of Yangiabad settlement of Tashkent region remains somewhat overestimated. Specific activity of natural radionuclides in the studied soil samples did not exceed 370 Bq/kg, but exceeded the average values for RUz.

Therefore, it is essential for the public and the population to be literate with regard to possible radiation threats. For this purpose, the culture of radiation safety should be instilled starting from the junior grades, especially in those schools located near the sites of uranium ore mining, processing and waste production.

According to the “National Concept of the Republic of Uzbekistan on Remediation of Uranium Ore Processing Waste Tailings Dumps for 2018-2025” the Government of the Republic of Uzbekistan, jointly with international organizations and local authorities, carries out remediation works [4]. Continuous radioecological monitoring of environmental factors is necessary to reduce the risk of radioactive substances entering the human body and to reduce the impact of radiation on the population of the former uranium mines.

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