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DETERMINATION AND HYGIENIC ASSESSMENT OF RADON CONTENT IN RESIDENTIAL PREMISES OF THE KUMKURGAN DISTRICT

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Annotation

The purpose of the study: radiation and hygienic assessment of radon content in the air of residential premises of the Kumkurgan district and substantiation of criteria for ensuring radiation safety of the population.

Materials and methods of the study. Radon in the air of public and residential buildings was measured using the Radon FTLAB FRD400 device. The radon meter was installed at 5 points in each measured room. The radon meter for measurements was placed mainly in rooms with the longest stay of residents.

Results. The radiation situation in the surveyed buildings of the Kumkurgan district is generally quite acceptable. The situation with population exposure in the Kumkurgan district generally meets the requirements of the Radiation Safety Standards.

Keywords: radiation safety, radon, irradiation.

Аннотация

Цель исследования: радиационно-гигиеническая оценка содержания радона в воздухе жилых помещений Кумкурсганского района и обоснование критериев обеспечения радиационной безопасности населения.

Материалы и методы исследования. Измерение радона в воздухе общественных и жилых зданий проводилось с помощью прибора *Radon FTLAB FRD400.* Радонометр устанавливался в 5ти точках каждого измеряемого помещения. Радонометр для измерений размещали преимущественно в помещениях с наиболее длительным пребыванием обитателей.

Результаты Радиационная обстановка в обследованных зданиях Кумкурганского района в целом вполне приемлемая. Ситуация с облучением населения в Кумкурганском районе в целом соответствует требованиям Норм радиационной безопасности.

Ключевые слова: радиационная безопасность, радон, облучение.

Annotatsiya

Tadqiqot maqsadi: Qumqo‘rg‘on tumanidagi turar-joy binolari havosidagi radon miqdorini radiatsion-gigiyenik baholash va aholining radiatsion xavfsizligini ta’minlash mezonlarini asoslash.

Materiallar va tadqiqot usullari. Jamoat va turar-joy binolari havosidagi radon miqdori Radon FTLAB FRD400 qurilmasi yordamida o‘lchandi. Radon o‘lchagich har bir o‘lchangan xonada

5 nuqtaga o‘rnatildi. O‘lchovlar uchun radon hisoblagichi asosan aholi eng uzoq vaqt yashaydigan xonalarga joylashtirildi.

Natijalar. Qumqo‘rg‘on tumanidagi o‘rganilgan binolarda radiatsiyaviy holat umuman maqbuldir. Qumqo‘rg‘on tumanida aholining radiatsion ta’sir qilish holati umuman olganda Radiatsion xavfsizlik standartlari talablariga javob beradi.

Kalit so'zlar: radiatsiyaviy xavfsizlik, radon, nurlanish.

Introduction

Today, the annual external dose from natural background radiation averages approximately 1 mSv/year, with cosmic contributions being somewhat smaller than terrestrial contributions. The contribution from inhalation is higher than that from external exposure. It is worth noting that: (i) the average annual natural background dose of 2.4 mSv corresponds to a low dose rate of ≈ 0.27 µSv/h; (ii) in several areas of the world, such as Guarapane in Brazil, Ramsar in Iran, Yangjiang in China and Kerala in India, natural background radiation levels are higher than those considered to be “normal background” [5, 6, 9], such that they have been designated as high natural background radiation (HNBR) areas [4, 5, 7, 8]; (III) the assessment of exposure by inhalation and ingestion is strictly related to humans and may not be applicable to other organisms, especially to cultured cells frequently used in radiobiological experiments [1, 3].

Relevance of the problem

Radon and its radioactive decay products make the main contribution to the radiation background of residential and industrial premises. Radon is formed during the decay of natural radionuclides contained in earth rocks and dissipates in the atmosphere. In this regard, during engineering surveys of construction sites, radiation and environmental studies are carried out, an integral part of which is the assessment of the radon hazard of the territory. Currently, there is no universal method for determining the radon hazard of an area in the world. This is explained by the fact that radon concentrations and flows are extremely uneven and depend on both the geological and geophysical characteristics of the natural environment (uranium and thorium content in the soil, the structure of the underlying rocks and the level of groundwater, climatic conditions), and on the design of buildings, building materials and the quality of ventilation systems. Therefore, different countries have their own approaches to determining radon hazard [10].

International organizations (WHO, ICRP) have issued recommendations regarding the level of radon exposure due to its high potential to increase the risk of lung cancer. In December 2013, the Council of the European Union prepared new European Basic Safety Standards (EU BSS). This regulation sets the permissible average annual radon concentration at no more than 300 Bk/m^3 in residential and working areas [8]. Meanwhile, the International Atomic Energy Agency (IAEA), in accordance with IAEA Safety Standards Series No. GSR Part 3, recommends that radon concentrations in the general population and workers should not exceed 300 Bk.m^3 and 1000 Bk.m^3, respectively [6].

Indoor radon concentrations vary widely, including within small geographic areas, and range from less than 10 Bk/m^3 to about 50,000 Bk/m^3 in Norway. Key geological parameters for assessing radon potential include uranium concentration and soil permeability. Although good statistical correlations can be achieved [8, 9], in practice it has proven almost impossible to make reasonable predictions of radon concentrations in a given building based on information about the geology or indoor radon in nearby buildings. The Norwegian Radiation Protection Authority (NRPA) therefore recommends radon measurements in all homes (except apartments on the second floor and above), workplaces and other buildings with high occupancy [5].

The purpose of the study: radiation and hygienic assessment of radon content in the air of residential premises in the Kumkurgan district and substantiation of criteria for ensuring radiation safety of the population.

Materials and Research Methods

Natural sources of ionizing radiation (NSIR) – gamma radiation from the soil, cosmic radiation and, mainly, radon make the main contribution to the radiation dose of the population – up to 70% [1]. At least 10% of lung cancer cases registered annually in the world are caused by radon [1,2]. It is the second risk factor for the development of lung oncopathology after smoking. Since human exposure to radon occurs indoors, monitoring the levels of population exposure indoors is of particular importance. In the regulatory documents NRB-2006 [3], in order to limit population exposure, restrictions are established on exposure to natural sources: in residential and public buildings, the average annual equivalent equilibrium volumetric activity (EEVA) of radon in the air of premises should not exceed 200 Bk/m^3.

Assessment of radon content in the air of residential buildings

Radon in the air of residential buildings was measured using the Radon FTLAB FRD400 device. The FRD400 radon monitor combines a user-friendly interface, elegant gray optics, accurate measurement results and powerful hardware. The device is equipped with an ionization pulse chamber, the first readings are available 30 minutes after the start of the measurement. The device is also equipped with a multi-color 1.8-inch LCD display, there is hourly storage of measured data, which can be transmitted via Bluetooth or USB, and there is also data analysis using computer software. The highest radon concentrations are usually found on the lowest floor of the building. However, due to the structure of the chimney, radon also rises to the floors above. Therefore, we recommend always measuring at least one room on the first or second floor to obtain comparative values. Radon penetration paths usually vary from room to room. It is advisable to measure all rooms on the lowest floor

The radon meter was installed at 5 points in each measured room. The radon meter for measurements was placed mainly in rooms with the longest stay of inhabitants. The first readings were recorded 30 minutes after the start of the measurement, further readings were updated every 10 minutes. At each point, measurements were taken 5 times for reliability.

Results and Its Discussion.

The Kumkurgan district is one of the largest districts in the Surkhandarya region. It stretches across the central part of the region, forming a narrow strip that widens to the south. The district is crossed by the region's main transportation arteries: a highway and a railway linking Termez with the capital of Tajikistan, Dushanbe. The district also includes mountainous areas (the Baysuntau and Babatag ranges) and plains (the Surkhandarya River valley). The largest body of water is the South Surkhan Reservoir, created on the Surkhandarya River. The

region's subsoil is rich in oil and raw materials for construction. Agriculture is supported by a network of irrigation canals. The main crops are cotton, grain, horticulture, viticulture, and various livestock farming. The industrial sector is represented by construction, light industry, and the food industry.

According to measurements conducted at measurement points in the Kumkurgan district during the cold period, the EEVA values of radon isotopes and their decay products (DPs) in the atmospheric air range from 14 to 70 Bk/m^3. The average value for the district is 39.5 Bk/m^3 (Table 1).

Table 1

Radon content in residential air in the Kumkurgan district during the cold season

№	Name of urban settlements	Range
1	Azlarsay	20-56
2	Aksai	25-36
3	Bogara	21-48
4	Jaloir	14-40
5	Jiydali	27-70
6	Karsakli	31-48
7	Navbahor	33-48
8	Oil workers	45-64
9	M. Khuzhamkulov	44-69
10	Hurriyat	25-54
11	Elbayon	17-60
12	Elbayon	14-42

According to measurements conducted at measurement points in the Kumkurgan district during the warm season, the EEVA values of radon isotopes and their decay products (DPs) in the atmospheric air range from 39 to 85 Bk/m^3. The average value for the district is 63.3 Bk/m^3 (Table 2).

Table 2

Radon content in the air of residential premises in the Kumkurgan district during the warm period

№	Name of urban settlements	Range
1	Azlarsay	56-62
2	Aksai	48-69
3	Bogara	59-80
4	Jaloir	39-58
5	Jiydali	41-75

6	Karsakli	70-85
7	Navbahor	41-82
8	Oil workers	58-79
9	M. Khuzhamkulov	71-84
10	Hurriyat	59-79
11	Elbayon	47-65
12	Elbayon	45-68

Conclusions. The radiation situation in the surveyed buildings of the Kumkurgan district is generally acceptable. The population's exposure to radon generally complies with the requirements of the Radiation Safety Standards. Most cases of radon-related lung cancer are caused by low and moderate radon concentrations rather than high ones. Therefore, the goal should be to reduce the individual risk of the most exposed individuals to a reasonably achievable level, as well as the overall risk for the entire population. However, completely eliminating radon exposure is impossible.

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