Examining the Natural Radiation Background in Surkhandarya

Feruza Ibodullaevna Salomova[a] and Zarina Kenzhebekovna Turabaeva[b]
Tashkent Medical Academy, Tashkent, Uzbekistan

Keywords: Radiation Exposure, Gamma Radiation, Natural Radiation Background, Radiation Safety.

Abstract: This study addresses radiation safety concerns related to natural sources impacting the population in Surkhandarya, Uzbekistan. The region, known for its environmental challenges, was assessed for gamma radiation levels using the Polimaster DKG-RM1703MO-2 dosimeter. Measurements were taken at five strategic points in both open areas and indoor locations. Results showed gamma radiation levels ranging from 0.09 to 0.16 μSv/h outdoors and 0.13 to 0.25 μSv/h indoors, with the highest readings in the Termez region. The findings emphasize the importance of continuous monitoring and effective risk management to ensure public safety. The study also highlights the need for legal mechanisms and differentiated economic conditions to rehabilitate ecologically critical zones. Overall, the research provides valuable insights into the spatial distribution of gamma radiation and its potential health implications.

1 INTRODUCTION

The problem of radiation safety during public exposure to natural sources attracts special attention, since, according to numerous studies, among sources of ionizing radiation, natural sources are the main factor in public exposure throughout the world (Konstantinova, 2019), but also in the world (Nikanov, 2019; Stepanov, 2015).

Radiation in low doses is ubiquitous in our environment. There are known areas inside our state where the Aral Sea region is considered to be in a catastrophic ecological scenario, while numerous districts in the Surkhandarya region are considered to be in an environmentally critical position. These assessments are made at the highest political and international level. When creating programs and action plans for environmental preservation and offering medical and social aid to the populace, these zones receive extra consideration. For many years, the international community has been providing significant financial, technical, and humanitarian assistance to mitigate the impact on the population of adverse factors associated with an environmental catastrophe and environmental crisis, and attempts are being made to stop destructive processes. However, without a permanent legal mechanism aimed at the rehabilitation of such zones, as well as without the introduction of differentiated legal conditions for economic activity, and the provision of economic and social guarantees that take into account extreme environmental conditions, it is impossible to restore the original natural balance to the extent that it depends on the human factor, or to stop population migration, attract new labor resources to such territories and make living conditions attractive.

2 THE OBJECTIVE OF THE STUDY

The Surkhandarya region's radiation and sanitary evaluation of gamma radiation in the atmosphere and in the air of public and residential buildings, as well as the validation of the primary guidelines for guaranteeing radiation safety.

3 MATERIAL AND METHODS

Gamma radiation levels in open areas were meticulously evaluated employing the Polimaster DKG-RM1703MO-2 dosimeter. Strategically positioned at five points within each measured area, the dosimeter prioritized installation in rooms with

[a] https://orcid.org/0000-0003-0070-6209
[b] https://orcid.org/0000-0001-5939-3724

Salomova, F. and Turabaeva, Z.
Examining the Natural Radiation Background in Surkhandarya.
DOI: 10.5220/0012985300003882

In *Proceedings of the 2nd Pamir Transboundary Conference for Sustainable Societies (PAMIR-2 2023)*, pages 1556-1559
ISBN: 978-989-758-723-8

prolonged inhabitant presence. This deliberate approach aimed to capture comprehensive data on potential radiation exposure risks. To ensure data reliability and accuracy, measurements were repetitively conducted five times at each designated point. The use of the advanced Polimaster dosimeter signifies a commitment to safeguarding individual well-being through thorough monitoring.

The emphasis on strategic placement in areas of extended human occupancy underscores the dedication to understanding the nuanced distribution of gamma radiation. This commitment extends to optimizing measurement reliability by conducting multiple readings at each location. The systematic nature of these measurements not only reflects a commitment to precision but also contributes to a more comprehensive understanding of gamma radiation patterns in open areas. Recognizing the potential health implications of radiation exposure, this meticulous approach ensures a robust dataset, facilitating informed decision-making and effective risk management strategies in areas where human activities are prevalent.

Table 1: Measurement of gamma radiation in open areas.

Normalized values *	Dose limits		
	Category A	Category B	Category V
Effective dose	20 mSv per year on average for any consecutive 5 years, but not more than 50 mSv per year	5 mSv per year on average for any consecutive 5 years, but not more than 12.5 mSv per year	1 mSv per year on average for any consecutive 5 years, but not more than 5 mSv per year
Equivalent dose per year:			
in the lens of the eye **	150 mSv	38 mSv	15 mSv
skin ***	500 mSv	125 mSv	50 mSv
hands and feet	500 mSv	125 mSv	50 mSv

The annual exposure dose to the population should not exceed the basic dose limits. The defined dose limits pertain to the mean dosage of the key population group, determined by adding the current year's external exposure doses and the dose anticipated to be absorbed by the body over the next 70 years due to ingesting radionuclides. Legislation in the field of nature protection (Article 39 of the Law of the Republic of Uzbekistan on Nature Protection) defines the concepts of zones of environmental emergency and environmental disaster. Banning the operations of the Tajik aluminium factory would not be able to stop the facility's emissions of toxic chemicals into the atmosphere, which have a negative impact on agriculture and public health in some parts of Surkhandarya. Improving and restoring the natural environment lose significance if the causes of ecological disasters or crises are not addressed. The legal status of the people and businesses in these areas is the same as that of the affluent areas.

The Surkhandarya region, the southernmost part of the Republic of Uzbekistan consisting of 14 districts and the administrative centre of Termez, is where the research was conducted. There, the average annual air humidity is 55%. The yearly wind speed is 2.9 m/s on average. It covers 20,800 km^2. The average annual temperature is +17.5 °C, and as of January 1, 2022, there were 2 million 743,196 residents living there.

A Polimaster DKG-RM1703MO-2 dosimeter was used to measure the amount of gamma radiation in open regions. This dosimeter was developed considering the requirements of experts and users of the International Atomic Energy Agency (IAEA) and is widely used to ensure the radiation safety of international events such as the Olympic Games, Pan American Games, etc. The dosimeter is a combination of a search tool and a Geiger-Muller counter-based CsI(Tl) scintillator DER meter for gamma radiation. The device's distinctive features, light weight, and simplicity of use combine to provide excellent functionality and performance.

The dosimeter allows you to register the activity of 134Cs, and 137Cs radionuclides in various samples, such as food, drinking water, various liquids, bulk building materials, soil, etc. In addition, with the help of a dosimeter, it is possible to register the activity of radionuclides in various samples that are in commercial packaging, for example, boxes, boxes, bags, and meat, fish, etc. - in pieces or carcasses weighing up to 50 kg. Utilizing this gadget is simple [5]. There were five dosimeter installations in each measured region. The rooms where the occupants stayed the longest were the ones where the measurement gadget was mostly located. At each point, the measurements were carried out 5 times for reliability.

The data acquired indicates that the average gamma radiation exposure rate measurement values for the locations fall into two categories: 0.09–0.16

μSv/h for open areas inside settlement boundaries and 0.13-0.25 μSv/h for indoor places. The conducted hygienic assessment of potential natural sources of ionizing radiation made it possible to estimate the individual exposure doses of the population of the Surkhandarya region due to natural radiation sources.

Analysis of the gathered data reveals that average gamma radiation dose rate measurements in open areas within settlement boundaries range from 0.09 to 0.16 μSv/h. The Termez region exhibits the highest values, varying between 0.15 and 0.16 μSv/h, indicating potentially elevated radiation levels. In contrast, the Uzun region demonstrates the lowest values, falling between 0.09 and 0.11 μSv/h. The Angorsk and Dzharkurgan regions present relatively lower rates, with measurements ranging from 0.09 to 0.12 μSv/h and 0.11 to 0.12 μSv/h, respectively. Notably, the Sariasi district records the lowest gamma radiation dose rate values. This comprehensive assessment offers valuable insights into the spatial distribution of gamma radiation levels, aiding in understanding potential environmental and health implications across various regions.

Table 2: Research of gamma radiation in the open area of the Surkhandarya region.

No	Locality name	Range	Average value	Permissible rate
1	Termez	0,12-0,13	±0,124	0,3
2	Angor district	0,09-0,12	±0,106	0,3
3	Baysun district	0,11-0,14	±0,132	0,3
4	Bandikhan district	0,12-0,13	±0,126	0,3
5	Denau district	0,12-0,14	±0,128	0,3
6	Jarkurgan region	0,11-0,12	±0,112	0,3
7	Kumkurgan district	0,11-0,14	±0,12	0,3
8	Kizirik district	0,12-0,13	±0,124	0,3
9	Muzrabad region	0,12-0,13	±0,126	0,3
10	Altynsay district	0,11-0,13	±0,12	0,3
11	Sariasi district	0,11-0,12	±0,114	0,3
12	Termez district	0,15-0,16	±0,152	0,3
13	Uzunsky district	0,09-0,11	±0,102	0,3
14	Sherabad region	0,13-0,14	±0,134	0,3
15	Shurchi district	0,11-0,14	±0,124	0,3

The average values of measurements of the dose rate of gamma radiation indoors in the Surkhandarya region are in the range of 0.13-0.25 μSv/h. The highest values are observed in Shurchinsky district: 0.21-0.25 μSv/h, Termez region: 0.19-0.25 μSv/h, the same values were found in Denau region: 0.19-0.25 μSv/h, while the lowest measurements of the dose rate of gamma radiation indoors were found in Bandikhan district: 0.13-0.18 μSv/h and Muzrabad district: 0.14-0.18 μSv/h.

Table 3: Equivalent dose rate of gamma radiation in the premises of buildings in Surkhandarya region.

No	Locality name	Range	Average value	Permissible rate
1	Termez	0,16-0,24	±0,202	0,3
2	Angor district	0,16-0,19	±0,172	0,3
3	Baysun district	0,18-0,21	±0,196	0,3
4	Bandikhan district	0,13-0,18	±0,152	0,3
5	Denau district	0,19-0,25	±0,22	0,3
6	Jarkurgan region	0,16-0,19	±0,176	0,3
7	Kumkurgan district	0,15-0,19	±0,174	0,3
8	Kizirik district	0,18-0,22	±0,2	0,3
9	Muzrabad region	0,14-0,18	±0,156	0,3
10	Altynsay district	0,15-0,20	±0,176	0,3
11	Sariasi district	0,17-0,20	±0,178	0,3
12	Termez district	0,19-0,25	±0,216	0,3
13	Uzunsky district	0,19-0,24	±0,214	0,3
14	Sherabad region	0,15-0,19	±0,17	0,3
15	Shurchi district	0,21-0,25	±0,232	0,3

The research conducted by V.P. Ramzaev and A.N. Barkovsky from 1996 to 2010 also revealed average values of dose rates that corresponded to permissible standards. The results of our investigation did not show a relationship between the population's morbidity and death from malignant neoplasms and the overall radiation doses received.

4 CONCLUSIONS

The data acquired indicates that the average gamma radiation exposure rate measurement values for the locations fall into two categories: 0.09–0.16 μSv/h for open areas inside settlement boundaries and 0.13-0.25 μSv/h for indoor places. Without a doubt, there are many places in the country where the dose rate of gamma radiation in open areas significantly exceeds the indicated values (near rock deposits with a high content of natural radionuclides, industrial facilities, etc.). Still, in this case, we are talking only about gamma background on the territory of places of permanent residence of people, since it is he who makes the main contribution to the dose of external exposure of the population.

REFERENCES

Konstantinova, E. D. (2019).
Nikanov, A. N. (2019).
Stepanov, E. G. (2015).
RSS-2006, BSRERS-2006.
Pro-Spec. (n.d.). Dosimeter Polimaster DKG-RM1703MO-2. Retrieved from https://pro-spec.ru/catalog/sredstva-obnaruzheniya-radioaktivnykh-materialov-i-khimicheskikh-veshchestv/dozimetr-polimaster-dkg-rm1703mo-2.