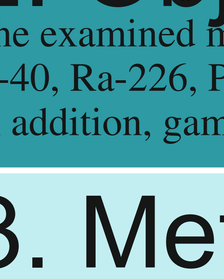
Examination of the Environmental Radioactivity nearby the Uranium Mining and Milling Facility

S. Akhromeev[1], S. Kiselev[1], E. Metlyaev[1], D. Isaev[1], A. Titov[1], L. Zhuravleva[2]



Ahromeevs@mail.ru

[1]Burnasyan Federal Medical Biophysical Centre, 123182, Zhivopisnaya st. 46, Moscow, Russia
[2]FSBHU "Centre of Hygiene and Epidemiology-107" FMBA Russia, 674576, Krasnokamensk, Post box 203, Russia

1. Introduction

Priargun industrial mining and chemical association (PPGChO) is a multi-enterprise, the main task of which is uranium ore mining and milling. The uranium mine management (UMM), hydrometallurgical plant, thermal power plant (TPP) and tailing dumps are the main PPGChO facilities important for the radiation exposure to the environment. The UMM shafts and ventilation boreholes as well as TPP pipes release radionuclide mixtures of U, Rn-222,

2. Objectives

The examined media were: soil, grass covering and local foods (milk and potato). The specific activities of the natural radionuclides U-238, Th-232, K-40, Ra-226, Pb-210 have been determined in samples.
In addition, gamma dose rates have been measured on-site and in above-grade structures.

3. Methods

The specific activities of gamma emitting natural radionuclides (NORM) in samples of the environmental media and foods was being determined by gamma spectrometry methods using the gamma spectrometers equipped with semiconductor and scintillation detectors.
To determine Ra-226, Po-210 and Pb-210 contents we also used the radiochemical separation method followed by the specific activity measurement using the radiometry installation.
The drive and walk gamma survey was used to measure gamma dose rate.

4. Results

Figure 1 shows dose rates measured on the PPGChO site, while those in the buildings are shown in figure 2.

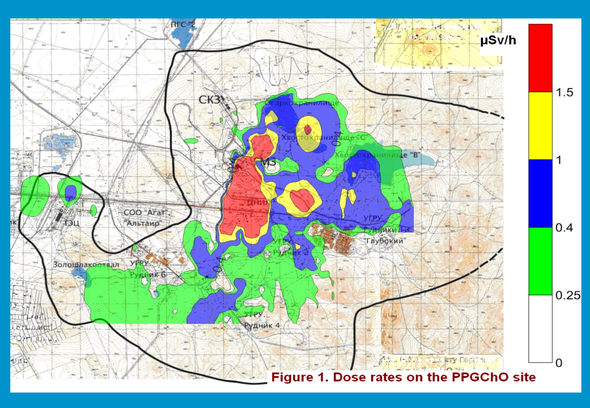


Figure 1. Dose rates on the PPGChO site

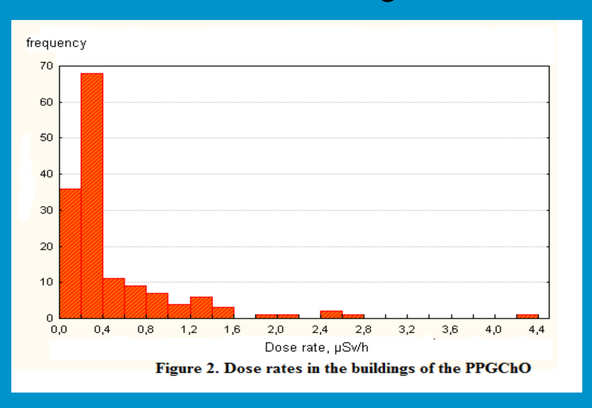


Figure 2. Dose rates in the buildings of the PPGChO

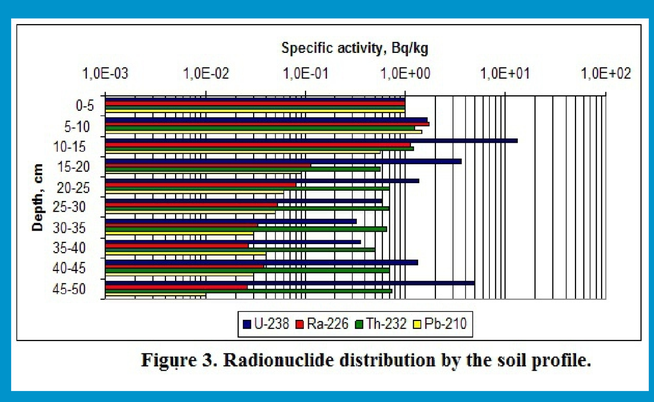


Figure 3. Radionuclide distribution by the soil profile.

Concentrations of the NORM in soil of the examined area vary over the wide range, and in some parts are much higher than the natural concentrations of these radionuclides in soils достигая up to $2.6 \cdot 10^4$ Bq/kg for ^{226}Ra, up to $1.5 \cdot 10^4$ Bq/kg and $9.9 \cdot 10^3$ Bq/kg for ^{210}Pb and ^{210}Po, respectively.
The NORM concentrations in the grass covering are also high there (up to 63. 37 and 11 Bq/kg for Ra^{226}, Pb^{210} and Po^{210}, respectively).
In the area of the cinder storage facility there is some local part of the area contaminated due to leakage through the tailing dump dam. Since that time, radionuclides have migrated in soil at 15 cm depth (see fig.3)
Figure 4 shows radionuclide specific activity in foods in Octyabrsky village (in the PPGChO site) and Soktuy village (30 km from PPGChO)..
Over the year, total beta activity in drinking water varies over the range from 0.14 to 0.54 Bq/kgFigure 5 shows total alpha activity in drinking water. Similar to the 222Rn specific activity alpha total activity is practically always higher than the Intervention Level, equal to 0.2 и 60 Bq/kg, respectively.

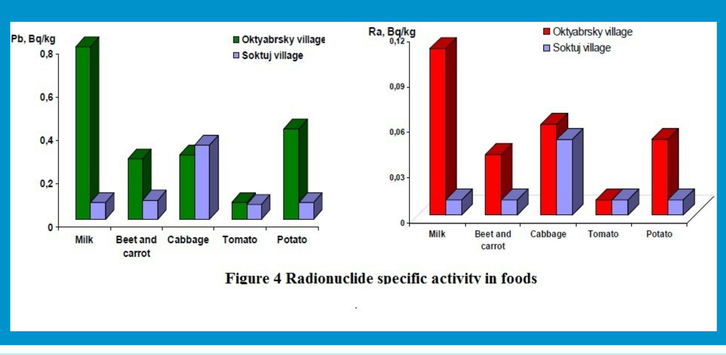


Figure 4 Radionuclide specific activity in foods

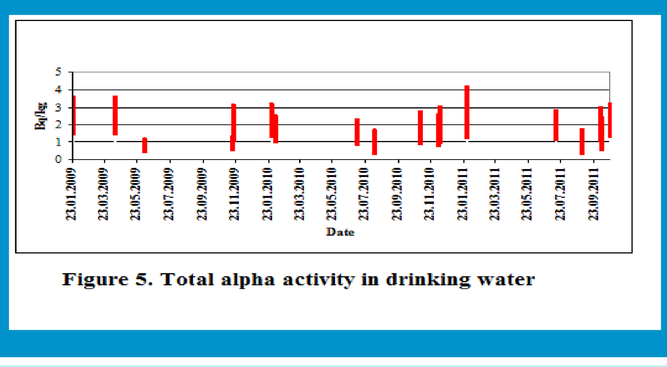


Figure 5. Total alpha activity in drinking water

5. Discussion

The highest dose rates have been registered near the surface ore storage facility and in the local areas close to the cinder storage facility and pithead.
In the majority of workplaces of the group B personnel the dose rate is not higher than 1.6 μSv/h.
In the contaminated areas the increased ^{226}Ra content in comparison with other NORMs.
The NR concentrations in milk and potato are within the range of averaged Russian data (in potato - up to 0.65, 0.07 and 0.01 Bq/kg, in milk up to 0.43, 0.14 and 0.02 Bq/kg for Ra^{226}, Pb^{210} and Po^{210}, respectively). However, the difference is observed in the activity ratios of some radionuclides. So, the activity ratio of ^{210}Pb and ^{226}Ra in milk and potato is 2.5-2.3 over Russia on average, while for local foods this value is much lower than 1 (0.29 for milk and 0.13 for potato). This can be explained by higher concentration of man-made ^{226}Ra in soils, soil-weather conditions and physical-and-chemical properties of radionuclides.
The East-Urulyunguy ground water deposit located downstream of all potential sources of contamination serve as a drinking water source. Total runoff from the PPGChO industrial sites is directed towards the deposition.
Total beta activity in drinking water is below the IL established by NRB-99/2009 (1 Bq/kg). However, there are excess ILs by total alpha activity and by some radionuclides including ^{222}Rn in drinking water.

6. Conclusion

The radiation situation on the PPGChO site varies over the wide range.The gamma dose rate outdoors varies from 0.11 to 5.4 μSv/h.The total area of natural lands contaminated with NORM is 8.275 km, where the specific activity in soil reaches 12800 Bq/kg and 510 Bq/kg by ^{226}Ra and ^{232}Th, respectively.
Generally, radiation impact of the PPGChO activity on the environment is restricted by the PPGChO site borders.
Nevertheless, radionuclide migration from the industrial sites results in contamination of ground waters, which are also the source of drinking water supply for Krasnokamensk city.
Today, annual effective internal dose to the public due to the ingestion intake of such water is 0.14-0.28 mSv.