Comparative analysis of the uranium content in the urine of personnel of group A and persons not exposed

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The hydrometallurgical plant of the Stepnogorsk Mining and Chemical Combine was established in the fifties of the last century. The main activity of the Hydrometallurgical Plant is the extraction and processing of uranium ore.

Uranium content in urine in people whose profession is not related to sources of ionizing radiation from different sources is from 0.04 to 0.4 micrograms per liter [1]. Referring to the US normative guidance 8.22 "Bioanalyses in uranium mines" as a conditional normative value for workers in the uranium industry will be designated 15 μg/l [2].

In this paper, the results of the study of the uranium content in the average daily urine of the staff of the mining and smelting plant in Stepnogorsk are compared with those who do not contact with ionizing radiation. The uranium content in urine was determined by the inductively coupled plasma mass spectrometry model "Agilent 7800 ICP-MS". The results of mass spectrometric analysis showed that the minimum uranium content in urine was 4.5 μg/l, and the maximum value was 28 μg/l, and for workers not working with ionizing radiation the minimum value was 0.05 μg/l, the maximum value was 0,08 μg/l.

We calculated the expected effective dose of internal irradiation from the urine sample analysis for uranium content according to the formula below.

$$D=\frac{T*Aurina}{\sum_{i=1}^{T} m(T+t-i)} * d \quad (1)$$

where, A_{urina} is the activity of uranium isotopes in the daily urine sample, which is calculated by the formula $A = \frac{0.693*m}{T_{1/2}} * \frac{N_A}{\mu}$;

m (T + t-i) - function of excretion of uranium in urine for chronic intake during time T;

t-time elapsed after the end of the receipt until the time of collection of the daily urine sample, provided that the monitoring was carried out 2 times a year;

d - the dose equivalent or effective dose rate for the given pathway.

When calculating the expected effective dose of internal irradiation from the inhalation pathway of uranium intake, the particle sizes (average aerodynamic diameter of activity) equal to 5 μm were taken into account. Due to the lack of information on the types of incoming uranium compounds, the calculation was made for all types of chemical forms: fast (F), medium (M) and slow (S), but the results of the medium soluble uranium type were most suitable for close values [3,4].

The calculation shows that the expected effective dose of personnel depending on the chemical forms and the average uranium content in urine can vary with a minimum value of 4.5 μg/l ~ 10 mSv/year, with a maximum value of 28 μg/l ~ 67 mSv/year.

For workers who do not have contact with ionizing radiation, the expected effective dose at a minimum value of 0.05 μg / L ~ 0.012 mSv / year, with a maximum value of 0.08 μg / L ~ 0.021 mSv / year.

High levels of uranium in the urine of staff, which in comparison with the "nominal rate" exceed by 1.8 times, that when calculating the expected effective dose exceeds the values of the maximum dose of 20 mSv per year by 3 times, indicates the need for further monitoring studies.

References

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