

THE INFLUENCE OF ANTHROPOGENIC FACTORS ON THE PRODUCTION OF GOLD AND URANIUM MINING ON THE ECOSYSTEM

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Production of gold and uranium is one of leading sectors of the economy of every developed country including the Republic of Uzbekistan. Our country is ranked among first ten countries of the world for its row of important valuable minerals such as gold and uranium.

Gold and uranium-extracting mining-metallurgical production in the course of its performance brings damage to the natural balance of ecosystem. The extent of this impact is estimated by the way of analysis of soil, air, underground and sewage industrial water. In the midst of pollutants of the ecosystem detrimental, toxic, radioactive pollutants and their assemblage with soil, air, plants, drinkable water and with both underground water and sewage take special place.

Methods of estimation of influence of man-made factors of gold and uranium production upon the ecosystem are considered in this article.

Estimation of the anthropogenic impact of gold mining production on the ecosystem. Gold in Uzbekistan is mined with open-pit mining method as in many countries of the world. Wherein, diffusion of explosion dust and its sedimentation to sizeable territory that specifies pollution of the soil is observed. The extent of man-made impact depends on powerfulness of the explosion, depth of mining career, wind force's direction, duration of career exploitation and other factors.

The figure 1 illustrates analysis of the soil around anthropogenic object where incomplete enrichment of the soil with anthropogenic elements was occurred at the beginning of career exploitation when career's depth did not exceed 200 m. When imploding works were conducted, dispersed particles from surface of the career scattered around career depending on the wind rose. Further, thank to career's deepening, effect of the pollution reduced and at the moment (when depth of the career exceeds 600 m), ore particles that are lifted in to air during explosions, fall down back to the career. As a result, soil and ground pollution with man-made assemblages practically does not exist.

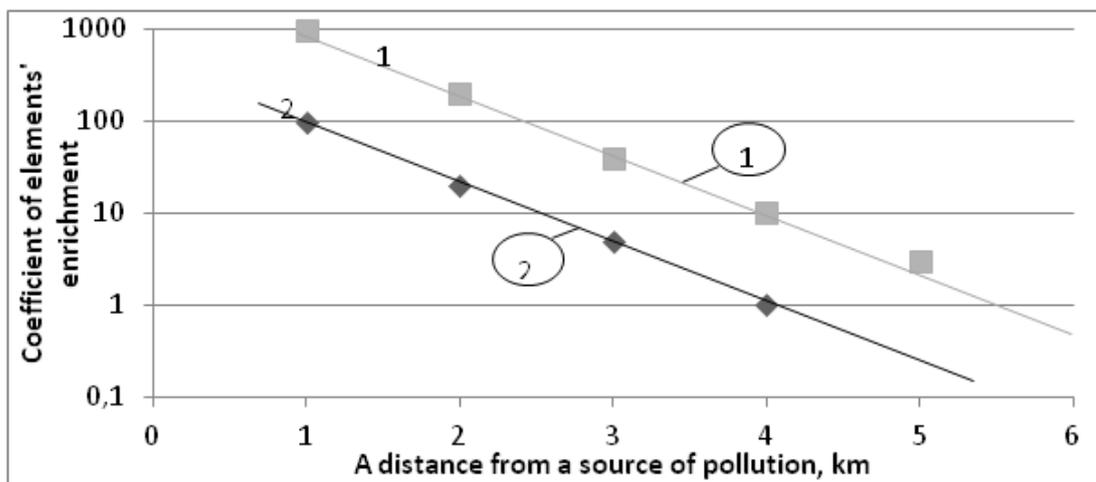


Fig 1. Change of average concentration of man-made elements from a distance to the source of pollution:
1 – curve K of - arsenic, 2 – curve K of - gold

As can be seen from Figure 1 average concentration of elements (arsenic and gold) from a distance to the source decreases on particular distance over 4 km in our case and their concentration is equaled by Clark degree. This means that the impact of anthropogenic objects on the ecosystem is decreased maximally on a distance over 4 km.

Estimation of the anthropogenic impact of uranium mining production on the ecosystem. During the last 10 years we lead systematic control of following harmful and radiation-dosimetric factors:

- **In the soil:** samples were taken away from the depth of 0-0.5 m. from the place where equivalent dose rate (EDR) was measured, then A_{sp} - activity of total specific efficiency and K^{40} , Ra^{226} – specific activity of spontaneous radionuclide of (natural) uranium Th^{232} were measured by gamma-spectrometric method in laboratory conditions.

- **In the air:** concentration of dust was determined by weighting, of HCN, NH_3 , NO_2 , SO_2 , H_2S , H_2SO_4 , Pb, P_2O_5 by photo-colorimetric method, of radon's toron's, EDR's capacity in work rooms and in engines was determined by Search scintillation radiometer SRP-68 or dosimeter-radiometer DKS-96 radiometers, of volumetric activity of radon in the air of populated points and in the air of working zones was determined by ALPHA-GUARD device, of equivalent equilibrium of Equivalent equilibrium volume activity (EEVA) in the air of populated points and working areas was determined by device called "Poisk" and radon-WL-meter, of long living alpha nuclide in the air of populated points, in working areas and working rooms, of capacity of gamma-radiation was determined by sample selection from aspiration filters that work in persistent mode for inspection of aerosol spray into atmosphere.

In the water, underground and industrial sewage: dry residue, weighted substances, pH, oil products, anions

of - Cl⁻, NO₂⁻, NO₃⁻, CO₃⁻, HCO₃⁻, SO₄⁻; cations of - Ca, Mg – by tetrometric method, Si⁺, F⁺, As⁺, Mo⁺, Al⁺ - by photo-colorimetric method, nitrates, K, Na, Fe_{total}, Cu, Mn, Pb, Co, Ni, Zn, Cr – by atomic-absorption method, selection of water samples and determination of spontaneous uranium, radium-226, polonium-210, torium-232, radon into their content was executed by emanation method and total alpha and beta activity was measured with apparatus alpha-beta radiometer for measurements of small activities “UMF-2000”.

Besides above mentioned measurements not less important role plays systematic determination of size of radio-ecologic factors that are associated with affairs of uranium mining companies and appreciably affecting to radio-ecologic stability and purity of surrounding; particularly: extent of radioactive emissions to the atmosphere during calcinations of uranium final product.

Inspection over radio-ecological conditions of uranium production. Amount of air from ventilation systems of departments that process gold and uranium inputs may reach 700 m³/min. Particularly large jeopardy of air pollution is in departments of crushing in case of gold and in packaging points and in calcinations as well - in case of uranium. This requires application of the most efficient engineering decisions for maximal prevention of dust appearance in working atmosphere of departments, especially, external environment.

Admittedly, for the assessment of radioactive influence on health of working personal and on population systematic control of environment (air) is required. As far as uranium production is associated with treatment of radioactive materials, it is the most important and predetermining factor.

It is clear from the specter of Figure 2 that amount of specific activity depends on ²³⁴U concentration of natural mixture of isotopes. The question is that ²³⁴U owns high specific activity- (2.3*10⁸ Bk/g), whereas, specific activity of natural uranium mixture accounts for only 2.5*10⁴ Bk/g. Consequently, such difference of specific activity can be explained with the breach of isotope equilibrium of uranium isotopes because of the growth of ²³⁴U isotope portion. This fact was confirmed by the results of our result products.

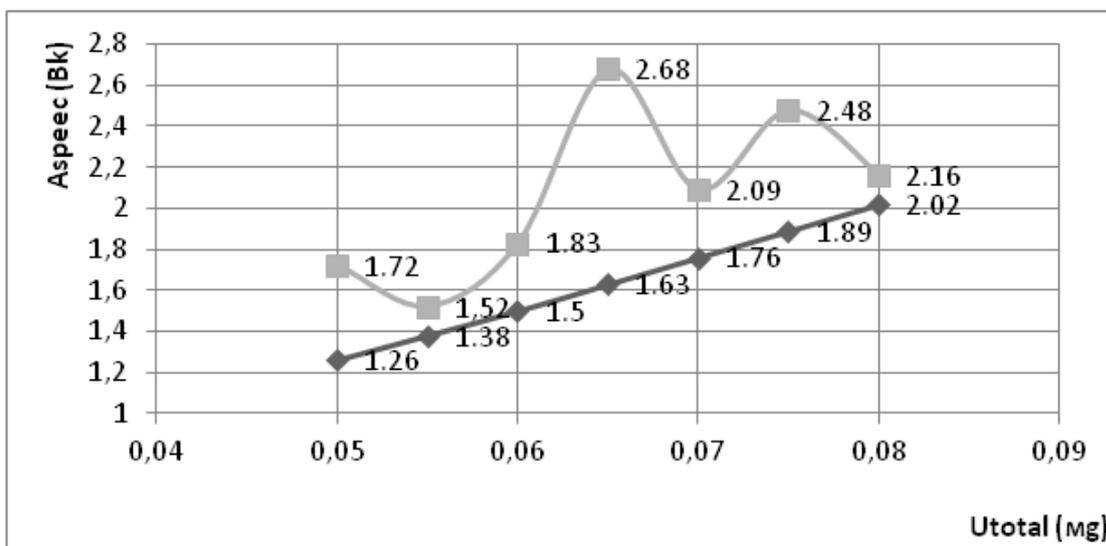


Fig 2. Dependence of specific air activity on uranium concentration:
1-lower line of dependence of specific activity of the air on uranium concentration in the time of radioactive equilibrium of uranium isotopes, 2-upper line of dependence of specific activity of the air on uranium concentration in the time of radioactive equilibrium breach of uranium isotopes

It is widely known that maximum permissible concentration of uranium in the air of working zone accounts for 0.088 mg/m³ in the industrial emissions maximum permissible discharge – 6.0 mg/s. large dispersed particles are less movable than small dispersed ones. In accordance to this, it is offered to eliminate appearance of small dispersed particles (aerosols) in to environment because of prolonged time of their appearance in the air. Appliance of nuclear filters which are made in united institution of nuclear research (Russia, Dubna city) with the size of pores 0.7-4.0 mkm in combination with conventional filters allowed develop original methodology of determination of fractional radioactive aerosol content in the air depending on climatic conditions and practical conditions of industry. The use of developed methodology of industry’s radio-ecologic control permitted to determine breach coefficient mechanism of radioactive equilibrium amongst uranium isotopes.

For checking authenticity of analysis’ results of isotope content of uranium with the use of – spectrometric analyzers “Ortec”, Analyst” and “Progress Alfa”, we compared with data of mass-spectrometric analysis. There was established permissible divergence between analysis methods.

According to accomplished perennial studies about assessment of anthropogenic influence of gold and uranium production on ecosystem, it can be concluded that around anthropogenic objects soil gets partially enriched by anthropogenic elements. At the moment in time this process practically does not exist. Concentration of detrimental and radioational-dosimetric ingredients around anthropogenic objects corresponds with established norms, and it does not exceed the value established by sanitary rules and norms.