COPPER IN COAL MINING PRODUCTS OF VIZEYSKA LVIV-VOLYN COAL BASIN MINE: ECOLOGICAL, GEOCHEMICAL AND TOXICOLOGICAL ASPECTS

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Coal producers create special natural and man-made systems, which spread over large areas and affect all components of the biosphere: living and non living, biogenic and abiogenic matters. An important aspect of such a natural and man-made system is the distribution of individual chemical elements in concentrations much higher than background values. In the ecological sense, distribution of bioavailable forms of heavy metals, that can be determined in water-soluble and acetate-ammonia extracts, is the matter of high importance.

The authors have investigated the distribution of various forms of copper within the waste heap of the Vizeyska mine (Lviv-Volyn Coal Basin). This metal belongs to the second class of danger. The metal content was separately determined in the rocks of different lithological composition and the degree of thermal transformations: burnt and unburnt samples of argillites, siltstones, sandstones and soils at a distance of 50 and 100 m from the heap. Sampling was carried out in accordance with all-Union State Standard 17.4.4.02-84, preparation of solutions of extractors from the heap rock and soil was carried out in accordance with State Standards of Ukraine 4770.9: 2007. Copper concentration in extracts was determined by the atomic absorption method using the AAC-115-M-1 spectrometer.

The concentration of copper in acetate-ammonia extract ranges from 0.5 mg/kg in burnt siltstone to 5.49 mg/kg in unburnt argillite; in soils its amount decreases from 0.28 to 0.19 mg/kg depending on the distance from the heap. In aqueous extract, the concentration of Cu varies within the following limits: in unburnt argillite 2,7 mg/kg; in burned argillite, unburnt siltstone, burned siltstone, burned sandstone and unburnt coal <0.1 mg / kg (below detection limit); in the soil at a distance of 50 and 200 m from the foot of the heap < 0.1 mg / kg (below detection limit).

The maximum allowable concentration (MAC) of copper labile forms (in acetate-ammonium buffer extract) in soils is 3.0 mg/kg. The concentration of copper in soils at a distance of 50–100 m does not exceed the corresponding MAC. However, high concentrations of copper in unburnt argillite (up to 5.49 mg/kg) poses significant risks to the environmental safety of the research area.

Despite the general tolerance of plant species and genotypes to this element, copper is considered to be highly toxic. Among other factors the indirect toxic effect of copper on winter wheat is determined by varying the intensity of Ca^{2+}-dependent metabolic processes that determine the regulation of cell division and root growth. Copper is highly toxic to most fresh invertebrates. Therefore, the MAC of drinking water (European standard – 0.05, USA and CIS – 1.0, WHO – 2.0 mg/l) is higher than the fishing MAC – 0.01 mg/l. Using modified Allium test A. Dovgalyuk found that the effective toxic concentrations of copper are 23 times lower than the approved MAC of this metal in the soil and is 0.13 mg/liter.

In the human body prolonged absorption of copper along with disturbances of metabolic processes may cause cirrhosis of the liver. There are some reports about the influence of copper on the metabolism of artificially fed infants. Acute poisoning of people in the case of consuming copper with drinking water in doses of 0.14 mg/kg and above was reported.

Conclusions. Copper concentration in the acetate-ammonia extract from the heap rocks of the Viseyska mine (Lviv-Volyn Coal Basin) varies from 0.5 mg/kg to 5.49 mg/kg and from 0.28 to 0.19 mg/kg in acetate-ammonia extract from soils in the mine area. That may be dangerous for the state of the environment.

Key words: Lviv-Volyn Coal Basin, Copper, Waste Heap of the Vizeyska Mine, Bioavailability