CHANGES IN THE FERTILITY OF TECHNO-SOILS DURING LONG-TERM AGRICULTURAL USE OF RECLAIMED IRON ORE SLUDGE STORAGES IN THE STEPPES OF UKRAINE

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Abstract. Repositories of iron ore beneficiation waste in the Kryvyi Rih industrial region are ecologically dangerous man-made objects, for which more than 7.5 thousand hectares of land have been allocated. Subject to reclamation, they can be successfully used for agricultural production.

According to the results of 38 years of research, the most rational model of technozem is the three-membered edaphic construction for agricultural reclamation of iron ore: the sludge is first covered with a 50-cm layer of forest-like loam, on which a 50 cm layer of humus is laid. This option ensures the productivity of crops at the level of intact soils. During the period of use, the indicators of humus accumulation slightly increased in the arable layer, gross reserves and the content of macronutrients did not change, the quality of man-made soil did not deteriorate.

Key words: sludge storage, reclamation, technozem, humus.

Topicality. Storage of iron ore beneficiation waste requires the withdrawal of large areas of land from economic circulation. In the Kryvyi Rih iron ore basin alone, more than 7,500 hectares of land have been allocated for sludge storage. In addition, sludge dumps are environmentally hazardous objects that have a negative impact on the environment, polluting the atmosphere and groundwater, flooding the surrounding lands. Therefore, the study of rational options for their conservation and reclamation is an urgent problem for the Kryvyi Rih mining region.

Analysis of recent research and publications. Although the mining industry is considered to be the most important economic activity in the world, it has a significant negative impact on the environment. Due to its nature, opencast mining inevitably leads to a serious degradation of the ecological and aesthetic values of the landscape. [Cutter. N., 2013]. Environmental problems associated with the extraction of minerals have damaged the significant global economic value of the industry. In particular, the mining industry has a negative legacy of contaminated land. Thus, effective reclamation of contaminated soil is necessary before former mine lands can be further developed for residential and commercial purposes [Le et all., 2017]. A number of reclamation methods have been developed to return lands that have extracted minerals to a certain productive state [Kozhevnikov & Zaushintseva, 2015; Legwaila et all, 2015]. Previous studies on the reclamation of filled iron ore sludge storages [Zabaluev, 1992, 2005, 2011; Bekarevich, Zabaluev, 1996] proved the viability of their agricultural use. It was established [Zabaluev, 2011] that sludges have a slightly alkaline reaction, are characterized by a lack of humus and biophilic elements available to plants, unsatisfactory for plant growth water-physical properties, low connectivity, easy deflation. All these negative properties make it impossible to use sludge as a substrate for the formation of technosoils for growing crops.

Materials and methods of research. The study used conventional methods and techniques. Analyzes of the studied substrates were performed according to current methods: total nitrogen - according to DSTUISO 11261-2001 [3]; mobile phosphorus - according to DSTU 4114-2002 [4]; exchangeable potassium - according to DSTU 4405: 2005 [5]; humus - according to the method of Turin in the modification of CINAO (GOST 26213-84) [6].

During 1982-2019 in the experimental field were grown typical for the Steppe of Ukraine crops in 8-field crop rotation with the following alternation: alfalfa 2 years - winter wheat - corn for grain - corn for silage - winter wheat - corn for grain - barley with alfalfa. Technologies for growing crops are generally accepted for the Steppe zone. During the rotation of the crop rotation, 40 tons of cattle manure (for corn for silage) and

mineral fertilizers with the general norm N580 P640 K 420 were applied. The statistical reliability of the experimental data was determined by analysis of variance [7].

Research results. Analyzing the agrochemical parameters in the model of technozem with sludge coating with a humus layer of 50 cm of black-earth (Table 1), we can state that for 38 years of agricultural use there is a slight accumulation of mobile forms of phosphorus and exchangeable potassium in the topsoil (0-10 cm). . Below the profile there is a decrease in the content of these elements. The content of total nitrogen in the upper layer (0-10 cm) remained at the same level, and in the layer of 10-30 cm a slight increase was recorded. No changes were recorded in the lower layers of the soil mass (30-50 cm). The total nitrogen in the sludge is absent, and the content of mobile phosphorus and metabolic potassium was 25-30 times lower compared to the humus mass of the soil and during the study period has not changed.

Comparing the changes in the humus content in the two- and three-membered models of techno-soils, it can be stated that due to the loam-like layer in the three-membered model the humus accumulation processes were more intensive, as evidenced by the greater increase in humus content in the upper 30-cm layer over 38 years. This can be explained by the better edaphic conditions, which are formed in a more powerful model of the techno-soil due to the higher moisture content and larger root-containing volume of phyto-favorable substrates.

Conclusions

Studies suggest that in the process of long-term traditional for the steppe agricultural use of reclaimed sludge storage man-made soils do not worsen the humus and nutrient status.

The optimal model of agricultural reclamation of iron ore sludge is a model of techno-soil formed from a 50 cm layer of forest-like loam, on which 50 cm of fertile soil layer is applied (humus mass of humus-accumulative and the first transitional horizons of zonal black-earth). This model allows to carry out on reclaimed lands traditional for the Steppe of Ukraine intensive agriculture with the reproduction of soil fertility, significantly increase the area of productive soil resources in the industrial region, as well as radically improve the sanitary and hygienic condition of the environment.