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ASSESSMENT OF SOIL POLUTION BY HEAVY METALS IN THE AREA OF OPEN MINING WORKS

Abstract. This article discusses the assessment of the level of soil pollution of heavy metals by their content in the conditions to mining and processing production associations. According to the results of laboratory analysis of the studied soils, the predominant types of HM soil contamination were identified. We have studied 8 heavy metals, the determination of the content on the territory of mining plants showed a quantitative increase in the content of heavy metals in the soil. According to the scale of soil contamination by heavy metals on the territory of the mining and processing production Association, it can be attributed to the average level of pollution.

In research for the first time analyzed and assessed technogenic soil pollution of heavy metals in their mobile content and on this basis the proposed activities on environmental protection designed for the mining and processing production associations, including: measures to reduce impact, protection and rational use of soil.

This article demonstrates that currently the main factors contributing to soil contamination of HM are mining plants.

Keywords: Concentration, heavy metals, soil, MAC, disturbed land, dumps, reclamation, bioremidation.

Introduction. Open-pit mining is currently one of the largest sources of land disturbance and environmental pollution. The impact on the biosphere of technogenic landscapes, the spread of pollutants formed as a result of open-pit mining and processing plants, causes unpredictable negative effects on the state of the soil, vegetation, representatives of the animal world and human health. This requires the development of a set of measures for the return of waste land in a usable form. In the Republic of Kazakhstan, the rate of reclamation is significantly slower than the rate of land disturbance during open-pit mining operations. Therefore, the problem of restoration of land disturbed by open-pit mining operations takes on special significance. As a result of economic activities of mining enterprises harmful emissions enter into the atmosphere, heavy metals enter the environment, and the hydrogeological conditions of the area change. In this regard, an integral part of the activity of any subsurface user is the artificial restoration of soil and vegetation fertility after a man-made disturbance, i.e. the combination of reclamation and mining operations in order to intensify the reclamation of destroyed land.

The development of open deposits leads to land disturbance during mining operations and storage of overburden. Timely reclamation of disturbed land in accordance with the requirements of legislation is the direct responsibility of the subsoil user. The restoration of previously extracted quarry space is an extremely important task of a mining enterprise. The use of water management in reclamation involves the use of previously extracted quarry space to create a reservoir using various rehabilitation methods [13].

Industrialization and technological progress increase the burden on the environment, releasing large amounts of hazardous waste, heavy metals (cadmium, chromium and lead) that have caused serious damage to the ecosystem. The accumulation of heavy metals and metalloids in soils and waters continues to pose serious health problems for people around the world, as these metals and metalloids cannot decompose to non-toxic forms, but remain in the ecosystem [8]. Heavy metal pollution is currently a serious environmental problem, as metal ions persist in the environment due to their non-degradable nature.

Despite the use of the most modern equipment and environmentally friendly technologies, the impact of the mining industry on the environment, on its main components (atmospheric air, soil, vegetation cover, surface and ground water) is inevitable [18]. According to the General opinion of scientists, the main sources of biosphere pollution are mining and processing industry (38 %), energy (22 %) and transport (16 %). These 3 sources together account for about three-quarters of the total pollution of the biosphere. The impact of the mining industry on the environment is manifested in two main aspects (directions). First, the integrity of the natural landscape is violated when mining ore by open pit method, as well as by waste rock dumps. Secondly, the open space of the quarry and waste rock dumps after ore processing are the main sources of pollution. Air and water pollutants (HM) enter the environment [14].

Soil, as a complex bio-organomineral complex, is the natural basis for the functioning of ecological systems of the biosphere. Most often, the soil is polluted with heavy metals such as iron, copper, zinc, lead, cadmium, etc. They are also known as trace elements, because they are needed in small amounts by plants. However, due to vehicle exhaust gases, industrial emissions, irrigation with runoff water, application of phosphorous and organic fertilizers, use of pesticides, etc., their concentration in the soil may increase. The level of soil contamination with heavy metals affects the indicators of soil biochemical activity, the species structure and the total number of microbocenoses [1].

Heavy metal toxicity affects the number, diversity, and activity of microbial populations, as well as their genetic structure. It affects the morphology, metabolism and growth of microorganisms by changing the structure of nucleic acids, destroying cell membranes, causing functional disorders, suppressing enzyme activity and oxidative phosphorylation, and causing lipid peroxidation, changes in osmotic balance and protein denaturation [26].

Metal pollution affects the fauna and microfauna of the soil. Soil invertebrates suffer too, often there is the death of earthworms. In soils contaminated with metals, the most important microbiological and chemical properties change significantly. The state of the microbocenosis deteriorates. Concentrations of heavy metals affect the biological activity of soil microorganisms. Soil contamination with heavy metals puts pressure on sensitive microorganisms, changing the diversity of soil microflora, which is a trophic group of microorganisms [1].

Soil is the most important element of biogeocenosis [9-13], it includes various polluting components of chemical origin, such as heavy metals that bind to the organic and mineral environment of the soil, increasing its toxicity [27]. Excess of heavy metal content in the soil cover negatively affects the agricultural products grown and plant phytosanitary indicators [2], which, in turn, is an important marker of the environmental quality of crop production in the agro-industrial complex [17].

Reclamation of technogenic lands takes place in two stages: mining and biological. Mining engineering consists in preparing land, planning the terrain surface, applying fertile soils, reclamation works, etc. the Biological stage of reclamation consists of a complex of agrotechnical and phytomeliorative measures aimed at restoring the environment of living organisms and economic productivity of land. Phyto recultivation of technogenic lands is a set of measures aimed at improving and creating the fertility of recultivated lands by growing herbaceous, shrubby and woody meliorative crops. Phyto recultivation as one of the stages of restoration of land disturbed by industry is a way not only to increase productive land for the national economy (grazing, haymaking, etc.), but also to expand the area occupied by vegetation in general.

The main indicator that characterizes the impact of pollutants on the environment is the maximum permissible concentration (MPC). From the point of view of ecology, the maximum permissible concentrations of a specific substance are the upper limits of limiting environmental factors (in particular, chemical compounds), in which their content does not exceed the permissible limits of the human ecological niche [4].

Timely technical rehabilitation of disturbed land contributes to the restoration of terrain after the completion of field development. Preparing the terrain of the minefield helps to improve the ecological qualities of the land and preserve vegetation. Restoration of abandoned quarries helps to improve the quality of the environment in the field of subsoil use and can be included in regional development planning. Providing the technical stage of development of the spent quarry reduces the cost of restoring disturbed land. These rational methods of developing the developed space in open-pit mining contribute to the preservation of the surrounding area [12].

Protection of the natural environment from technogenic impact is the most important problem of our time. Although the last decade has been actively taking measures to protect and improve nature, nevertheless, the General condition continues to deteriorate [9].

To accelerate the restoration of soil and vegetation cover, it is necessary to carry out reclamation works aimed at improving the conditions of soil formation in technogenic landscapes, thereby ensuring the long-term functioning of phytocenoses. One of the options for a rational method of soil restoration is the formation of technozems, with a mixture of dumping.

The most promising method for cleaning up pollution in industrialized countries is currently considered phytoremediation – cleaning the soil with plants. Individual plant species that grow in polluted areas can accumulate a certain amount of heavy metals in their tissues without visible signs of oppression.

Objects and methods of research. The object of research is the soil cover of disturbed lands in the territory where mining operations are carried out.

The territory of the study belongs to the black earth zone, mainly located within the West Siberian lowland, most often represented by ordinary chernozems of medium-sized medium-humus and ordinary low-power low-humus chernozems. This is the best land in the region. According to their mechanical composition, they belong to heavy and medium-loamy soils. The composition of this zone include arrays of Chernozem ordinary carbonate. The predominant soils in the study area are ordinary chernozems formed on medium and heavy loess-like carbonate loams.

Soil samples were collected using the envelope method from a ten-centimeter layer of soil in three repetitions according to the generally accepted method of soil monitoring. Soil sampling was performed as follows: a mixed sample consisting of 5 samples taken using the envelope method (at the corners of the site and in the center) was taken from the selected site. Samples were taken with a shovel at a depth of 0-10 cm and 10-20 and 20-30 cm of the horizon of 5 test objects of soil samples taken in three-fold repetition from five control points located at different distances (#1-control #2 -2 test object, # 3 -3 test object, # 4-4 test object, # 5-5 test object.

For eco-toxicological assessment of soils, the maximum permissible concentrations (MPC) of HM for their gross and mobile forms were used. The degree of soil contamination of HM was assessed by a coefficient. The critical values that characterize the total TM contamination by hazard level are as follows: for HM <contamination is considered acceptable.

The study used the method of atomic absorption spectrometry. The determination of heavy metals was carried out on the atomic absorption spectrometer "AAS IN". The temperature in the flame of the atomic absorption spectrometer is 1400°C.

Results and discussion. Soil as a biological environment serves as a primary link in the human food chain, so determining the level of toxic elements in it is important for assessing the anthropogenic impact.

It is well known that the main environmental standard for soil pollution is the maximum permissible concentration (MPC).

The degree of soil contamination with chemical elements was assessed by comparing the level of element content in the soil with the MPC. This standard is a comprehensive integral indicator of the harmless content of a chemical substance in the soil. Reflecting the objective laws of the relationship between the body and the chemical substance of the soil, MPC allows you to prevent the negative impact of toxicants on the contact environment and human health, to preserve the barrier function of the soil, to predict possible changes in connection with existing soil contamination.

Soil contamination with heavy metals (HM) in large industrial centers has become one of the most pressing environmental problems for Kazakhstan. In the industrial regions of the country, significant pockets of anthropogenic disturbances and soil contamination are common. The number of HM and the defined indicators of their normalization in the Republic of Kazakhstan are shown in table 1.

Table 1. Maximum permissible concentrations (hereinafter-MPC) of chemicals in the soil

№ п/п	Name of the substance	The value of the MPC MK / kg of soil, taking into account the background (Clark)
1	2	3
1	cobalt	5,0
2	Iron	55000
3	Copper (movable form)	2,8
4	Lead	32,0
5	Manganese (gross form)	1500
6	Nickel (movable form)	4,0
7	Zinc (movable form)	23,0
8	Cadmium (gross form)	5,0

The results of research in the test objects of the production Association showed that heavy metal contamination of agrocenoses, in particular, reduces the productivity of plants, changes the phytocenoses, as well as the environment of this region. Therefore, the content of heavy metals in the soil at different points of the industrial zone was studied for the environmental assessment of ordinary chernozems in this zone. The data analysis is presented below.

The content of heavy metals (Fe, Cu, Zn, PB, MN). The content of cadmium, which practically does not exceed the MPC for soil horizons and varies as in chernozems: 0.12 ÷ 0.5 mg/kg. Table1. The concentration of lead in the soil ranges from 2.80 to 25.20 mg/kg. It was found that the lead content does not exceed the MPC for agrocenosis soils (MPC = 30 mg/kg).

A similar decrease in some points of the lower soil horizons was found for copper, the concentration of which is 1.08 - 10.44 mg / kg with a range of gross content of 2 - 100 mg/kg and the MPC level = 60 mg/kg. The concentration of zinc in the range of 28.0 - 126 mg / kg, where in soil samples exceeded the permissible norms by 1.4-2.2 times with a range of gross content in soils of 10 - 300 mg/kg and a Clarke content of 50 mg/kg (according to Vinogradov) [10] and MPC = 70 mg/kg. The level of iron accumulation is 8000,0 ÷ 35200 mg / kg, which corresponds to the range of gross metal content of 7000 ÷ 550000 mg/kg.

The concentration of manganese was in the range of 185.60-1055.60 MPC. The content of heavy metals (Co, NI) in the studied soils exceeds their Clarke values and the available MPC, Nickel in the soil samples exceeded the permissible norms-3.12-44.20 MPC-8 times, the highest content of cobalt was observed-2.90-18.08. mg/kg.

The level of Nickel concentration in the upper layer of soils may depend on the degree of technogenic contamination. In areas with a developed Metalworking industry, there is a very high accumulation of Nickel in the soil, and the content of Nickel in the soil largely depends on the availability of this element of soil-forming rocks. The highest concentrations of Nickel are usually observed in clay and loam soils, in soils formed on basic and volcanic rocks and rich with organic matter.

The main sources of cobalt entering the environment are non-ferrous metallurgy enterprises. Polluted soil loses its structure and its overall porosity decreases. The destruction of the structure leads to a violation of water permeability, deterioration of the air and water regime of the soil. The flow of cobalt in the food chain, biotransformation, microbial decay and chemical transformation.

Table 1. The results of the analysis of soil samples on content of heavy metals mg / kg

Points	The Depth Of The Incision	Pb	Cd	Zn	Cu	Fe	Ni	Co	Mn
PSP control	10	5,60	0,12	49,00	6,48	24640,0	19,24	5,80	638,00
	20	8,40	0,12	32,20	3,24	11200,0	14,04	2,90	336,40
	30	9,50	0,54	84,00	10,44	29760,0	21,84	23,20	2668,0
Test Object1	10	11,20	0,36	70,00	6,48	14080,0	26,00	8,12	736,60
	20	4,20	0,30	42,00	1,08	8000,0	16,64	3,48	667,00
	30	2,80	0,24	37,80	1,26	5120,0	17,68	3,48	562,60
Test Object2	10	11,20	0,12	43,40	3,96	16000,0	13,00	6,96	1392,0
	20	2,80	0,18	28,00	2,16	9600,0	4,16	2,90	551,00
	30	8,40	0,30	64,40	5,40	35200,0	3,12	13,34	2204,0
Test Object3	10	14,00	0,12	67,20	6,48	21760,0	16,64	6,96	185,60
	20	14,00	0,24	60,20	9,00	15040,0	28,60	9,28	812,00
	30	14,00	0,18	51,80	6,12	18240,0	22,36	6,38	765,60
Test Object4	10	25,20	0,18	126,00	14,40	30060,0	44,20	15,08	1055,60
	20	16,/80	0,36	98,00	10,44	25600,0	39,00	11,60	539,40
	30	16,00	0,34	98,05	9,98	14890,0	33,67	10,76	289,98

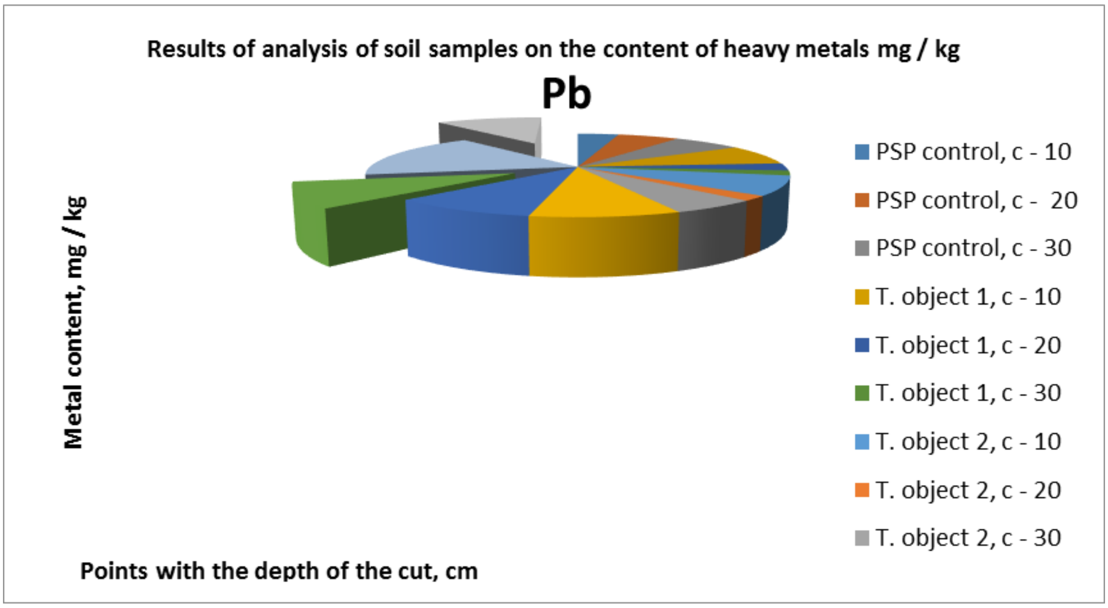

Fig. 1. TM content in the studied soils

The degree of soil contamination in the territory by heavy metals is estimated based on the results of laboratory analyses.

Figure 1 shows an increase in heavy metal concentrations at some points, with the exception of Cu,Fe, Pb, and Mn. Analysis of soil contamination shows that the spread of contamination occurs to a greater extent in the fourth and third test object.

Lead and cadmium, at almost any content, both in soil and plants, have a toxic effect on the soil fauna, as well as on the growth and development of plants. Lead has a clear ability to accumulate in the soil, since its ions are sedentary even at low pH values. In soils rich with phosphates, lead can be deposited as poorly soluble lead phosphates, in calcareous soils-as Pb(NO3) 2.

Plants are more resistant to lead than humans and animals, so it is necessary to carefully monitor the lead content in plant-based foods and in furage.

From the results of the obtained analyses, it shows that at all points in the study, the concentration of lead is within the normal range, ranging from 2.80 to 26.80 mg/kg. It was found that the lead content does not exceed the MPC, i.e. for soils that the background lead content for different types of CIS soils is 17-30 mg / kg (MPC = 30 mg/kg (table 1).

If we compare them with each other, at the depth of the horizons, we see that the content of heavy metals of lead is the largest at the fifth point (test object 4) on the upper horizon of the study zone, which is the concentration of lead 26.80 mg/kg of soil.

In all points (Fig1), the concentration of cadmium in the study is within the normal range, if we compare them with each other, at the depth of the horizons, we see that the content of heavy metals of cadmium is the largest amount, oddly enough, in the control variant. The lowest content of heavy metals is at the third point of 0.5 mg. Standards: the MPC of cadmium in the soils of Kazakhstan is 5 mg. / kg of soil. Unlike lead, cadmium enters the soil in much smaller quantities. Cadmium enters the soil either with combustion products or with phosphorus-containing fertilizers. In acidic soils with a pH value below 6, cadmium ions are very mobile and there is no accumulation of the element. However, there are types of soils where this element accumulates

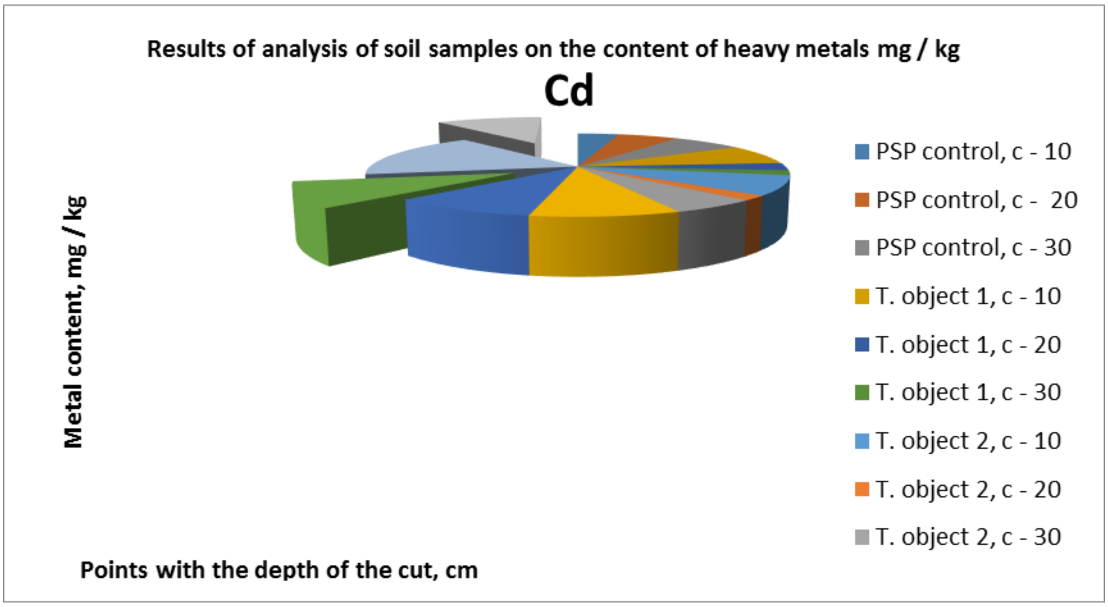

Fig. 2. Cd Content in the studied soils

In figure 1, we can see that at the fourth points of the study, the concentration of zinc exceeds the permissible MPC, at the fifth point, the content of heavy metal zinc is high, 126 mg/kg on the upper horizon of the soil, i.e. this indicator is much higher than the MPC Low content of heavy metals, at the third point it is 0.22.

Analyzing the data, we see that the content of mobile forms of zinc in the soils of the region is in the range of 28-126 mg/kg, which in any form is much higher than the MPC. The solubility of zinc begins to increase when the pH of the soil is less than 6, for plants, the toxic effect is created when the content of zinc is about 200 mg per kg of dry matter. The human body is quite resistant to zinc and the risk of poisoning when using agricultural products containing zinc is low. However, zinc contamination of the soil is a serious environmental problem.

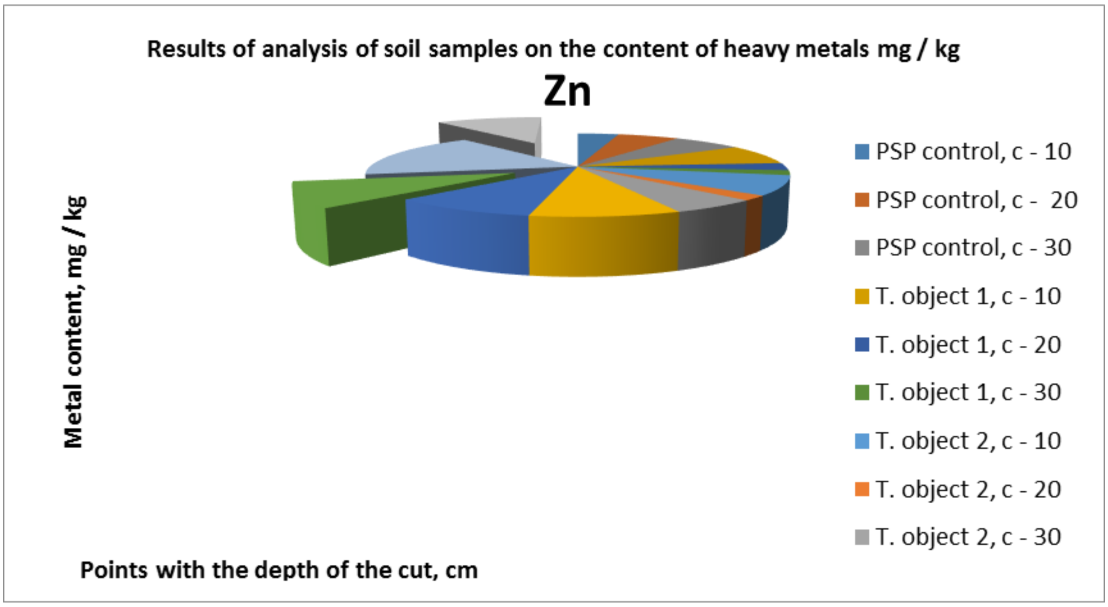

Fig. 3. Content of Zn, Ni in the studied soils

The average copper content in soils is 30 mg/kg (table 1). The mobility of copper ions is even higher than the mobility of cadmium ions. This creates favorable conditions for the assimilation of copper by plants. The solubility of copper compounds in the soil increases significantly at pH values at less than 5. Although copper in trace concentrations is considered necessary for life, plants have toxic effects at a content of 20 mg per kg of dry matter.

Changes in the copper content by points can be analyzed in figure 1, how these indicators have changed, as well as by horizons. It can be seen that the content of heavy metal Cu has significantly increased. The highest level of Cu was found, as everywhere else at the fifth point in the upper horizon, whose concentration is 14.4 mg / kg of soil. This exceeds the permissible norm almost 3 times. The MPC of copper in the soils of Kazakhstan is 4 mg / kg of soil (table 1).

A similar increase in figure 3 in the lower soil horizons is found for the gland, the concentration of which is 5120 ÷ 35200 mg / kg, which corresponds to the range of metal content of 7000 ÷ 550000 mg/kg.

The highest concentration of the gland was shown at the third point (test object 2) in the lower horizons which is 35.20 mg/kg and at the fourth point (test object 4).

Standards: the MPC of Nickel in the soils of Kazakhstan is 4 mg/kg of soil (table 1) in figure 3, a similar decrease for Nickel in the lower soil horizons, and a high content of them in the upper horizon is established and a high concentration at the fifth point of which is 35-45 mg/kg of soil. Since the concentration of Nickel exceeds the MPC 8 times, this is the most polluted area under study.

Standards: the MPC of cobalt in the soils of Kazakhstan is 5 mg / kg of soil (table 1) The content of heavy metal cobalt figure 3 (Co) in the studied soils exceeds their Clarke values and available MPC, (table 1) cobalt in soil samples exceeded the permissible norms – 3.12-24.9 MPC - 5 times. In the control variant, the concentration of cobalt increases at the lower horizon. The lowest concentration of cobalt was found at the second point of the study zone, which showed a concentration of cobalt of 4-8 mg / kg of soil.

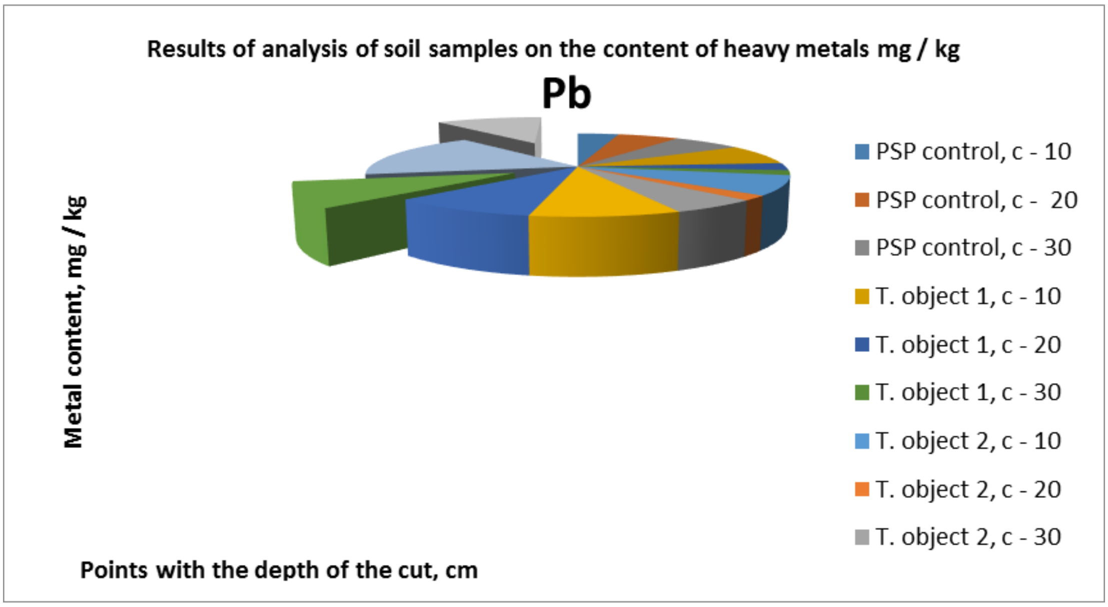

Fig. 4. Content of Pb,Cu,Co in the studied soils

As a result of our research, it was found that the level of cobalt content in the soil exceeds the MPC in all five points of the area.

The results of the analysis show that the content of manganese (Fig. 5) was within the normal range, but nevertheless in some points of the soil samples significantly increased. In the control variant in the lower soil horizons, it was found for manganese, the concentration of which is-2668 mg / kg of soil. This significantly exceeds the MPC. The MPC of manganese in the soils of Kazakhstan is 1500 mg / kg of soil (table 1). In General, the concentration of manganese in the soil ranges from 185-2668 mg/kg.

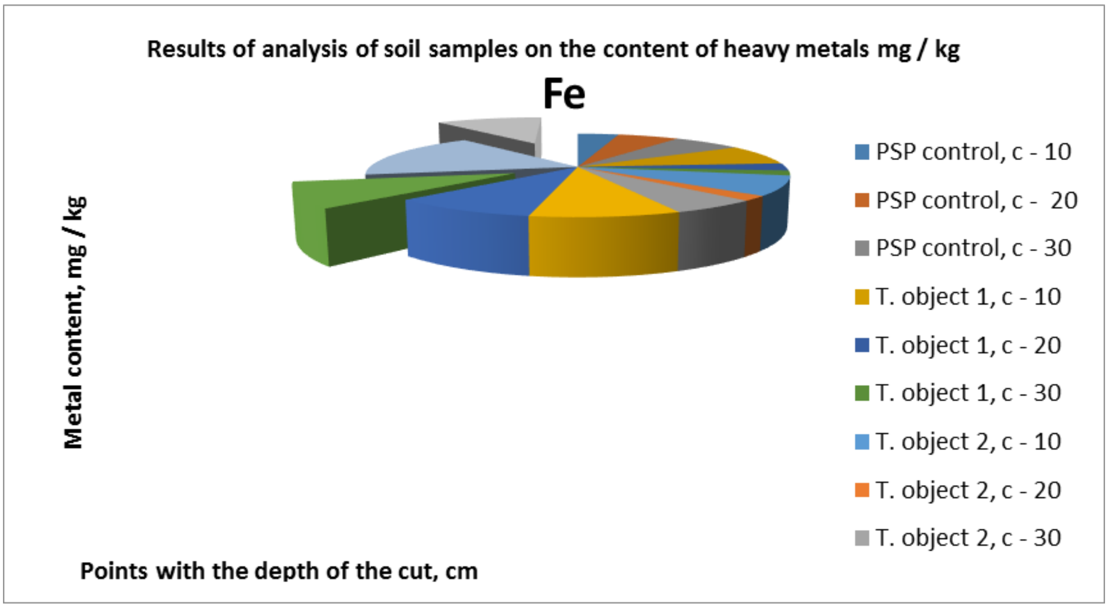

Fig. 5. Content of Fe, Mn in the studied soils

Thus, the content of manganese and Nickel has significantly increased, this is due in particular to the location of the industrial zone near the object under study. Enterprises located on the territory of the zone may be the main sources of heavy metals such as Nickel and manganese.

According to the data obtained, if the soils in the surrounding area are contaminated with non-processed ore, the most expected increase in the content of elements such as Nickel, zinc and cobalt in the soil is expected.

However, the enrichment of ore and the production of metals lead to a significant redistribution of its ore substance, which, in turn, can lead to soil contamination and those elements, whose content in the source ore is relatively small.

The source of man-made heavy metal pollution is atmospheric emissions and liquid effluents from industrial enterprises. Mining and processing of minerals and, as a result, the development of industrial production has led to the fact that the soils surrounding the production and mining areas of the landscape significantly exceed the content of heavy metals.

According to the results of analyses, the content of heavy metals in the black earth leached soil under study exceeds the maximum permissible standards for all elements. In the experimental area (0 - 20 cm) and in the section (0 - 5, 5 - 15 cm), an increased concentration of heavy metals is observed in the upper layers. Heavy metals are released from the mining plant, which negatively affects the soil and vegetation cover of the area of this plant. This area is polluted, especially the upper soil horizons. Zinc contamination exceeds the MPC by 3-4 times. This high pollution has a strong impact on the vegetation cover

According to the results of our research in the area where the enterprises are located, the content of gross lead in the upper 10 cm layer of soil does not exceed the control zonal values of 26 mg / kg; cadmium-5 mg/kg; zinc-exceeds 3-4 times

Copper-exceeds the permissible norm almost 3 times. for a gland whose concentration is 5120 ÷ 35200 mg / kg, which corresponds to the range of the gross metal content of 7000 ÷ 550000 mg / kg: the concentration of Nickel at some points exceeds the MPC 8 times the highest concentration at the fourth point of which is 35-45 mg/kg of soil.

The MPC of Nickel in the soils of Kazakhstan is 4 mg / kg of soil: The manganese content was within normal limits. Cobalt in the studied soils exceeds their Clarke values and the available MPC, cobalt in the soil samples exceeded the permissible norms-3.12-24.9 MPC-5 times.

For cleaning soils from heavy metals using battery plants, it can be used in public utilities for the reclamation of polluted soils, in the mining industry. The method includes the cultivation of battery plants on recultivated soils in compliance with agricultural techniques for the cultivated crop and using a stimulating substance-soil acidifier, collecting parts of battery plants that have accumulated heavy metal. The method allows you to reclaim the soil faster by 5-15 times, while increasing the fertility. Remediation of soils contaminated with heavy metals is also possible with the use of microorganisms. Data available on the effect of inclusion of mushroom mycelia, which is a waste production of antibiotics and biosorbent, obtained on its basis. It is shown that biosorbent and mycelium can be used even at a high level of contamination.

The results of our research in the future will allow us to conduct:

- forecast of changes in soil cover during the implementation of the planned activities (characteristics of violations of soil cover, assessment of disturbed land; soil contamination during normal operation of the facility and accidents, taking into account the amount and toxicity of waste);

specialists in the field of ecology and soil science when planning and conducting activities for integrated environmental monitoring of the environment;

- planning of measures to eliminate possible soil contamination;
- calculation of conditions and terms of restoration of the fertile soil layer;
- planning of measures for improvement of disturbed territories,
- land reclamation and prevention of negative impact on the soil cover.
- to develop a sustainable approach to choose the most suitable biosorbent, operating conditions and effective mechanism for the removal of heavy metals

Conclusion. According to the results of laboratory analysis of the studied Chernozem soils, the main factors affecting the degree of their environmental disturbance were determined, the prevailing types of HM were identified and exceeded the maximum permissible norms.

Accordingly, we studied 8 heavy metals, the determination of the content on the territory of mining plants showed that the quantitative increase in the content of heavy metals in the soil.

It was found that the scale of soil contamination by heavy metals on the territory of the mining and processing production Association can be attributed to the average level of pollution.

It was found that the violation of the ecosystem structure in the area of operation of the mining enterprise occurs due to the constant and intensive intake of pollutants as a result of extraction and processing of raw materials, migration of pollutants within the existing natural and man-made complex.

To prevent the harmful impact of waste accumulators of processing enterprises on the environment, it is essential to develop environmental protection measures that include the mining and biological stages of reclamation, improvement of the territory of mining settlements.

Based on theoretical, experimental and calculated data of the soil in the study area, which is based on the method of phytoremediation, as the most effective, as from the position of reducing heavy metals in the soil.

The obtained data can become the basis for monitoring studies and comprehensive assessment of soil cover. The results of the study can also serve as the basis for a work plan to reduce the concentration of heavy metals.

In conclusion, it should be noted that the urgent task is to implement a large-scale method of phytoremediation in the territories of open mining in order to create conditions for safe living of the population, as well as the planned return of polluted scarce arable land after their remediation with the help of plants.

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ОЦЕНКА ЗАГРЯЗНЕНИЕ ПОЧВ ТЯЖЕЛЫМИ МЕТАЛЛАМИ В РАЙОНЕ ПРОВЕДЕНИЯ ОТКРЫТЫХ ГОРНЫХ РАБОТ

Аннотация. В данной статье рассматривается оценка уровень загрязнения почвенного покрова тяжелых металлов по их содержанию в условиях на горно-обогатительные производственные объединения. По результатам лабораторного анализа исследованных почв выявлены преобладающие виды ТМ загрязнения почв. Нами были изучены 8 тяжелых металлов, определение содержания на территории горнодобывающих комбинатах показало количественное увеличение содержания тяжелых металлов в почве. По шкале степени загрязнения почвы тяжелыми металлами на территории горно-обогатительного производственного объединения можно отнести к среднему уровню загрязнения.

В исследовательской работе впервые проанализированы и оценены техногенного загрязнения почвенного покрова тяжелых металлов по их подвижному содержанию и на этой основе предложены мероприятий по охране окружающей среды, разработанный для горно-обогатительного производственного объединений, включающий: мероприятия по снижению воздействия, охраны и рациональному использованию почвенного покрова.

Эта статья демонстрирует, что в настоящее время основными факторами, способствующими загрязнению почвы ТМ, являются горнодобывающие комбинаты.

Ключевые слова: концентрация, тяжелые металлы,почва, ПДК , нарушенные земли, отвалы, рекультивация, биоремидация.

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АШЫҚ ТАУ-КЕН ЖҰМЫСТАРЫН ЖҮРГІЗУ АУДАНЫНДА ТОПЫРАҚТЫҢ АУЫР МЕТАЛДАРМЕН ЛАСТАНУЫН БАҒАЛАУ

Аңдатпа. Бұл мақалада ауыр металдардың топырақ жамылғысының ластану деңгейін олардың тау-кен байыту өндірістік бірлестіктері жағдайындағы құрамы бойынша бағалау қарастырылады. Зерттелген топырақты зертханалық талдау нәтижелері бойынша топырақтың АМ ластануының басым түрлері анықталды. 8 ауыр металдар зерттелді, тау-кен зауыттарының аумағындағы құрамды анықтау топырақтағы ауыр металдардың сандық өсуін көрсетті. Тау-кен байыту өндірістік бірлестігі аумағындағы топырақтың ауыр металдармен ластану дәрежесінің шәкілі бойынша ластанудың орташа деңгейіне жатқызуға болады.

Зерттеу жұмысында ауыр металдардың топырақ жамылғысының техногендік ластануы олардың жылжымалы құрамы бойынша алғаш рет талданып бағаланды және осы негізде тау-кен байыту өндірістік бірлестіктері үшін әзірленген қоршаған ортаны қорғау жөніндегі іс-шаралар ұсынылды, оның ішінде: топырақ жамылғысының әсерін азайту, қорғау және ұтымды пайдалану жөніндегі іс-шаралар.

Бұл мақалада қазіргі уақытта АМ топырағының ластануына ықпал ететін негізгі факторлар тау-кен зауыттары болып табылады.

Негізгі сөздер: концентрация, ауыр металдар, топырақ, ШРК, бұзылған жерлер, үйінділер, рекультивация, биоремедиация.