

THE PROBLEM OF RECULTIVATION OF DISTURBED LANDS: RUSSIAN AND FOREIGN EXPERIENCE

FURMANOVA T.N., PETINA M.A.

Belgorod State National Research University, Russia

Abstract

The article provides an analysis of Russian and foreign experience of work for the recultivation of land after the anthropogenic impact - mining in the open way. The article provides the rationale for the choice of directions for the recultivation of man-made landscapes of the Lebedinsky mining complex taking into account the conditions and the factors influencing the subsequent targeted economic use of the reclaimed land.

Keywords: recultivation, man-made landscape, the disturbed land, mining complex

The research was carried out in the framework of the state order № 5.3407.2011 Rational use of subsoil resources in iron ore province of KMA: problems and ways of their solution.

The issues of rebuilding and use of disturbed lands freed up after mining, abroad started in the early 60-ies years of the twentieth century. Attention to the implementation of rehabilitation works has increased in the past 20-25 years in connection with the increase of scale open pit mining.

Here are some examples of the violation and restoration of the lands of the general mining works in the industrialized countries.

In recent years in the United States only open mining violated more than 1.5 million hectares of lands. About 40% of this territory was formed in coal mining, 25% - in mining of sand and gravel, 30% - in mining of iron and polymetallic ores.

The main attention during the recultivation of lands in the United States is paid to the forest, recreational, agricultural and water areas, in this case, must take into account the economic benefits and economic value of newly created landscapes.

Thus, in the USA, coal company in the state of Ohio turned into a recreation zone area of about 10 thousand hectares, released under the open coal mining. Rehabilitation costs, as a rule, pay off income from the sale of licenses for hunting and fishing.

For agricultural purposes in the United States primarily use the dumps with potentially fertile species, to ensure the productivity of which do not require large expenditures. In Kansas 80% of all available in the state of pastures is located on reclaimed land dumps. Newly created pastures are more productive than natural Land reclamation in the USA produce mining companies themselves or the special organizations at the expense of funds of the companies [7].

Opencast coals in Germany are concentrated, mainly, in the Rhine brown coal basin - one of the largest industrial regions of the world. Total area of the development of coal here is more than 200 km², thus, violated more than 18 thousand hectares of fertile lands.

Considerable violations of the landscape are also a career on the development of construction materials. Every year for the production of the latter is given 2 - 3 thousand hectares. In Germany most of the disturbed lands is restored under afforestation, under the cultivation of agricultural crops, for recreational purposes and for the construction of civil and industrial objects.

At mining enterprises, land reclamation is conducted for projects developed simultaneously with the projects and plans of mountain works. Reclamation is done directly after working off of stocks of deposits. All mining enterprises in the obligatory order are removed and remain fertile soil for its subsequent application to reconstruction of the surface of the affected territories. For obtaining licenses for mineral extraction it is necessary to submit the plan of restoration of the territory after the end of the development.

In Russia works on recultivation of disturbed lands in the extraction of minerals in the open way in an industrial scale were carried out also in the end of 60-ies years of the twentieth century.

First recultivation had a narrow regional character. In some areas of the country on the initiative of local authorities and heads of the mining enterprises were started experiments on growing on the slopes of overburden rocks of various agricultural and forest crops. More wide scope recultivation of work adopted in the beginning of 70-ies, when the extraction of mineral resources (80-85% of the total volume) are calculated with the use of the open method of development, the most negative impact on the environment [4].

At this time, the requirements for the implementation of rehabilitation works were formulated in the «Law on the protection of nature in the RSFSR», as well as in the Decree of the CM of the USSR of 12 July 1962 «On improvement of state registration of lands and use them in agricultural production». These legal standards have served as a stimulus for the development of wide complex researches in the field of land reclamation, as well as the beginning of the practical implementation of rehabilitation works on restoration of the disturbed land [6].

Currently, the area of disturbed lands in Russia amounts to 1.5 million hectares. The disturbed land spread over the entire territory of the country.

Significant areas of disturbed land is located in the most highly developed in the agricultural respect of areas, i.e. within an agricultural country band - in the Central, Central-Chernozem, North-West economic areas.

At the present time only by KMA under the mountain objects employs more than 30 thousand hectares, of which 50% is arable land. The scale of violations of the lands of the open mountain works is explained by the fact that a part of the objects of violation of land (career, dumps, tailing dumps) are in the development within the project boundaries, the period of service which is measured in tens of years, in connection with that, there are no waste square, to the recultivation.

Restoration of lands violated by mining operations, in present in Russia is conducted in the following directions: agriculture, forestry, recreational and construction. The most frequently used the first two directions of biological recultivation. Use of the restored land for agricultural production in Russia is carried out in areas with fertile soils and favorable for the cultivation of agricultural crops climate.

Only in the basin of the KMA under agricultural production are recultivated 2.8 thousand hectares of disturbed lands.

In the Russian practice of recultivation are known examples of successful architectural-planning decisions on the establishment of recreational areas, parks, nurseries, sport facilities at the disturbed mining of the region's territory of Kuzbas, Central Chernozem Area [5].

Neolandscapes of KMA are a good standard of technogenic landscapes in the South of the Russian plain. In the North of the Belgorod region is located the Lebedinsko-Stoylenskaya group of the career-dumping complexes, formed under the open method of extraction of iron ores.

In the production of open-out mining is a violation of the land, the natural terrain and for this reason on the territory of the Lebedinsky industrial complex appears an artificial man-made landscape, adversely affecting the various components of the natural environment.

Typical elements of a newly formed technogenic landscape within the borders of the land allotment of the Lebedinsky industrial complex are: the Lebedinsky open pit with external outbound trenches; the external dump loose Stripping №2; external dump rock Stripping №1, tailing hydro dump for waste disposal, enrichment and loose breeds that are delivered from career by hydro transportation; surface industrial complexes of the plant.

The Lebedinsky open pit at the present time is an artificial terraced funnel, continuously developing in space and time as the development of the fields. The total area of the Lebedinsky pit as at 1.01.2013, is equal to 1485 ha, depth - 386 m [8].

Disturbed lands occupied by the Lebedinsky open pit fully withdrawn from agricultural turnover, because the internal formation of the dumps in the next 40-50 years is practically excluded because of the mining and geological conditions – steeply fall of deposit of ferriferous quartzites.

In connection with this, the area of disturbed lands of this pit in the short-and long-term remediation is not subject to, because the open pit will be one of the permanent sources of negative influence on the natural environment.

The acres also are excluded under the industrial complex of this enterprise in the long term. The restoration of the disturbed land will be performed in the long term after a full development of the reserves of ferrous quartzite, in the period of the operation will be carried out only improvement of vacant territories.

Spoil rock Stripping №1 and a heap of loose Stripping №2 must be recultivated. Moreover, the restoration of the shipment in the process of formation of the dumps with the purpose of reduction of terms of return of recovered lands into economic use and reduction of negative impact of technogenic landscapes on the environment.

As dumps are the main objects on the recultivation of disturbed lands for the period until 2016, explain the choice of directions of remediation with regard to the conditions and factors contributing to the economic use of the restored land:

- natural physico-geographical conditions of the territory of the plant;
- soil-ground characteristics of disturbed lands;
- the suitability of the mined rock for biological development;
- the state of environmental conditions on the territory of the complex;
- the social importance of land reclamation works.

Natural conditions of the region. The area of KMA (Lebedinsky GOK) is located in the South-Western slope of the Central Russian upland. The main forms of relief are watersheds, between the river plateau, the river valleys, and beams ravines.

Climate of the region is moderate-continental, with hot summer and cold in winter. Depth of soil freezing - 120 sm [1]. In the course of the year falls 80-520 mm of precipitation. Percentage of forest land plot is low of 4.7% (on the region - 9.2%). There are no large forests in the vicinity of Lebedinsky open pit.

Climatic conditions of the region are favorable for the growth of the basic kinds of cultures: linden, maple, birch, pine, larch, oak, sea-buckthorn and other forest and shrub crops. Field and industrial band formed of white acacia, ash, poplar, etc.

Characteristics of the land within the territory of Lebedinsky industrial complex. The territory of the complex is within the chernozem earth zone. Chernozems typical occupy a dominant area. They are dated to the plateau and light flat slopes of the terrain. They formed in the Quaternary loess-like loams, clays and chalks. The mechanical composition of soils across the territory is a light argillic. The total capacity of the humus horizon of chernozem is equal to 5.3 percent, at a depth of 50-60 cm - up to 2.9 %.

Soils have a neutral reaction (pH 6.4 to 6.9). These soils correspond to GOST 17.5.3.06-85 «Requirements to the definition of the norms of the removal of the fertile layer of soil in the production of excavation works» and are suitable for agricultural, forestry development and to the earthing of marginal lands [3].

The suitability of the developed rocks in the biological development of disturbed land. In sedimentary thicker developed the Lebedinsky deposit of ferriferous quartzites prevail suitable for biological recultivation of waste rock: the fertile soil (0.5-1% of the total volume of soft overburden); potentially suitable breed - loess-like loams - about 10%. The soil-mixture obtained as a result of the development and transporting them to the dumps, a mixture of clay loams with other breeds. All these breeds have favorable agrophysical properties, chemical composition and are suitable for cultivation of perennial grasses, shrubs and tree crops. Moreover, Quaternary clays, Callovian clays and their mixtures can be used in agriculture and forestry without covering their soil fertile layer (pastures, hay fields, plantations).

The state of the environmental conditions at the JSC «Lebedinsky GOK» and the adjacent territory. The territory of the «Lebedinsky GOK» at the present time is characterized by a high concentration of disturbed lands: the open pit (one of the largest in Russia) acting heap of loose Stripping №2, dump rock Stripping №1, the tailings of the hydro dump, industrial objects.

Because of the neighboring provisions the Stoylensky and Lebedinsky iron ore deposits, as well as its location and the territory of the complex of other mines, a high concentration of disturbed lands, all of these sources have a negative and multi-faceted impact on the environment. In the future, for the period up to 2016, the further concentration of mining production in the territory will be provided.

The expansion of morphological parameters of the pit, waste dumps, tailing would lead to the additional withdrawal of acres. In the connection with this, the company is characterized by high and increasing the extent of development of mountain works of technogenic load on the environment, and the protection of the environment at the plant is one of its priorities.

The social importance of the recultivation of lands of the JSC «Lebedinsky GOK». The region of the JSC «Lebedinsky GOK» is characterized by high population density, the proximity of the source of land for human settlements and the industrial enterprises.

Recultivation should be directed at the establishment of a waste of wood plantings various purposes, as well as the establishment of recreational areas, parks, sports facilities on the territory of the allotment of land of the plant with the purpose of prevention of the harmful impact of mining operations on the environment, improvement of sanitary-and-hygienic situation territory of the plant.

With the purpose of substantiation of the most appropriate, as from the point of view of economic value, and taking into account ecological safety, select the type of subsequent development of disturbed land, we considered the following directions:

- natural overgrowing of surfaces and slopes dumps, tailing dumps;
- agricultural recultivation;

-forest recultivation

Natural overgrowing of external dumps and tailings dam of the plant is the most economic direction of the disturbed lands.

For the natural formation of vegetation cover on the slopes of great importance have the properties of soil, forming the dumps, the degree of suitability for the normal growth and development of plants, climatic conditions of the regions of location of the dump, the presence or proximity of sources of infestation of the surface of the dumps.

So, to dump rock waste rock tailings from the unsuitability of the pouring and wash soils, the process of self overgrown on the surface of these objects is practically impossible.

The process of natural recovery of vegetation communities at the dumpsite №1 is possible, but the process is slow and may not be effective and efficient, so as violations of the earth do not disappear, they become sustainable technological formation, not to be carried to a safe condition.

Agricultural recultivation of disturbed lands includes the restoration of fertility of soils for the cultivation of agricultural crops with a sufficient degree of productivity, the creation of the disturbed lands areas of arable land, meadows and pastures.

In a densely populated area with a favorable climate and fertile soils, which is an area of the Lebedinsky GOK, recultivation should be predominantly in agricultural direction.

One of the main factors restricting the use of disturbed lands dumps №1, №2 for agricultural purposes is the height of the dumps. For the agricultural development of the height of the tips №1 and №2 should be not more than 50 m, and the number of tiers in the dumpsite 3-4. At the present time existing dumps №1, №2 surpassed the height, but in the short term until 2016 height dumps reaches 100 m and more.

At the height of the dumps of conditions of cultivation of agricultural crops is very difficult (increased wind and water erosion of soils, deteriorating their water regime, is complicated by the use of agricultural equipment and implementation of agro-technical measures).

According to the classification of disturbed lands for technical relief (GOST 17.5.1.02 - 85) the area of external dumps at the height of the dumps about the natural surface of 30-50 m is used for agricultural lands. Violated the area of external dumps with a height of over 50 m for agricultural development are not suitable [2].

Taking into account the limitations of the agricultural recultivation of areas outside dumps of overburden №1 and №2 is ineffective and counter-productive.

Forest reclamation of disturbed lands provides for planting tree crops, the creation of forests of various purpose and values. For the conditions of external dumps of the Lebedinsky GOK forestry development can be encouraged with a view to:

- EC development through afforestation in the dumps with the steepness of slopes of 8 - 10 degrees;
- plantings general economic purpose on the surface of the dumps and gentle slopes;
- plantings general economic plantations in the system of forest shelterbelts in the case of agricultural development of the dumps;
- natural complexes and the parkland, regardless of from the composition of the rock - when the dumps in the immediate vicinity of settlements.

Artificial forest plantations for the forest-steppe zone of the district of the Lebedinsky GOK, which is characterized by a low total woodiness 4.7%, provide favorable state of the environment (Fig. 1).



Fig. 1 Ledges recultivated dump under forest vegetation

Forest plantations contribute to the detention of dust in the amount of from 15 to 23 kg/ha, daily absorb a 23.3 tones/ha of CO₂, emit up to 18.5 tons/ha of O₂, which is especially important for the Staroosolsco-Gybkinsciy area, where the industrial enterprises emit to the atmosphere of 5 million tons CO₂ per year.

Forests and bushes protect the soil on surfaces and slopes of waste; contribute to the accumulation of moisture in the soil. Forestry development of disturbed land dumps allows you to:

- use for the recultivation of less fertile soils for the cultivation of forest cultures suitable majority of loose rocks of stripping);
- reduce costs for the recultivation of disturbed lands, since the application of the fertile soil and potentially fertile soil in the area reclamation, you can perform the main mining and transportation equipment in the process of the dumps formation;
- conditions of the cultivation of forest cultures in comparison with the agricultural development of disturbed land requires less material and labor costs;
- reduce the requirements to the preparation of surfaces and slopes dumps to forest reclamation;
- carry out forest recultivation of dumps of any height (over 100m) and forms;
- increase the percentage of forest land territory of the plant and Gubkino the area as a whole;
- reduce the negative impact on the environment;
- improve sanitary-and-hygienic conditions and aesthetic appearance of the territory of the plant and in the Gubkinsciy district.

On the basis of the listed factors, taking into account the high degree of disturbed lands territory of the plant, affecting the natural environment, the proximity of the dumps to settlements, we can conclude that the most appropriate direction of the recultivation of disturbed lands of external dumps №2 is a forestry engineering recultivation.

References

1. Agroclimatic resources of the Belgorod region. - L.: Gidrometeoizdat, 1972. - 91 p.
2. GOST 17.5.1.02-85 Nature protection of the Earth. Classification of the broken lands for a rekultivation.
3. GOST 17.5.3.06-85 Nature protection of the Earth. Requirements to the definition of the norms of the removal of fertile soil layer in the manufacture of earthworks.
4. Doronenko E.P. Land reclamation of the disturbed surface mining. M. Nedra. 1979.
5. Pankov Y.V. Recultivation of landscapes. Publishing house of the VGLTA, 2010.- 163 p.
6. Resolution of the Council of Ministers of the USSR from 12.07.1962 n 730 «On improvement of state registration of lands and use them in agricultural production»
7. Yollwork K. Violation of the land. M. «Progress» of 1979.
8. Furmanova T.N., Belousova L.I. Optimization of technogenic landscapes in the Starosolsco-Gubkinscaya mining area of KMA// Materials of the I-st International scientific and practical conference.: «Modern science - theory and practice». Volume I. Natural and engineering sector. Stavropol: Izd-vo SevKavSTU, 2010. - pp. 393 - 396.