

Research, control and greening of mica mining processes in the regions

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Abstract. The article examines the features of mica as a strategically important mineral raw material for the industrial sector. The purpose of the study was to analyze the situation in mica mining in Russia and conduct an environmental audit of the territories. Mica is an important resource, and its extraction is fraught with difficulties, mainly due to the need to green production processes. An analysis of the situation regarding resource extraction in the region was carried out and the Irkutsk region was identified as a promising source of resources. Mica mining has a negative impact on all areas: public health, water and land resources, the formation of waste dumps and waste heaps, and air pollution due to dust. Thus, mica is a strategically important resource for the economy of the Russian Federation and several of its regions.

1 Introduction

Currently mineral resources are an important component of the natural resource potential of any country. Russia has a significant resource base. One of the country's strategic resources is mica. Mica is a major industrial raw material for the semiconductor industry. The most used stones are muscovite and phlogopite. Phlogopite mica is mined at the Kovdor deposit. Mica is a common mineral located in the earth's crust. Its content ranges from 2-4% of the total volume of rocks. The most important properties of muscovite and phlogopite are its mechanical strength and electrical and dielectric properties, which determined its industrial use.

According to expert forecasts, the global consumption of leaf media in 2024 will be 6 thousand tons per year. The average cost is \$30 per kg. India is a leader in the extraction and production of leaf media. The cost of muscovite in India ranges from 5 to 10 rupees [1].

The main mica deposits include the following: Mamsko-Chuiskoye, Gutaro-Biryusinskoye, located in the Irkutsk region. Their forecast volume of mica production is about 16 45 million tons. There are also such deposits as: Lugovskoye, Slyudyanskoye, Vitimskoye, Kolotovskoye, Bolshesevernoye, the production volumes in them are significantly lower than those discussed earlier. Currently, the volume of phlogopite production in the mica region is projected at 350 thousand tons.

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Phlogopite and muscovite are sought-after high-quality electrical insulating materials that are indispensable in areas related to electrical engineering. Another use of mica is its use as a thermal insulation material. Fine mica fractions and scrap are used in the construction and cement industries and to produce plastics and composite materials [2].

2 Materials and methods

T.I. Shishelova and her scholars developed thermally stable mica-containing materials consisting of effective heating elements, which allows for more rational and complete use of resources. Scientists created a mica-ceramic panel [2].

The Irkutsk region continues to develop high-tech production in the field of mica mining and subsequent processing. It is also necessary to develop new science-intensive approaches to the use of mica, especially since in the Irkutsk region there are promising areas for the use, extraction, and development of mica material [3].

Pennsylvania scientists have developed and proposed for use technologies for cleaning rivers and lakes using a cleaning element - mica pulp. Mica allows radium ions to be removed from water. Belarusian scientists were the first to use mica powder to clean a reservoir of oil products. Mica was used in specialized filters. The mica was mixed into a double layered membrane, and the cleaning efficiency was 99%. mica has a high adsorption capacity [4].

Mica and its derivatives are widely used in the production of composite materials: micanites, micalexes and other mica-ceramic materials. New technologies in this direction are technologies to produce composite materials from polymer matrices.

3 Results and discussion

3.1 Disturbance of the ecological balance due to mica mining

Mining has a negative impact on the natural environment. Minerals are mined using technologies that disrupt the natural balance, so we will assess the environmental impact of mica mining technology.

3.1.1 Destruction of soil covers

Any methods of extracting minerals destroy soil covers, first, the integrity is violated, which is why land is alienated when it is impossible to use it for agricultural and other purposes. This also contributes to landslides and landslides, as well as the formation of voids in the soil. The fertile layer of soil is discarded during mica mining, making the soil resource unsuitable for economic use. For example, in the Belgorod region, because of the industrial activities of the Lebedinsky mining and processing plant, about 6 million hectares of fertile soil were destroyed. There are no measures taken to restore land resources. During the transportation of minerals, soil pollution also occurs. Due to vehicles, the concentration of iron and zinc in the soil becomes 2-3 times higher due to dust in the area.

3.1.2 Waste generation from mica mining processes

As a result of mica mining, halite waste is formed (3-4 tons are generated per 1 ton of mining). During mining, waste rock is removed, which must be reduced, since it subsequently becomes waste [5] (Figure 1) [6].

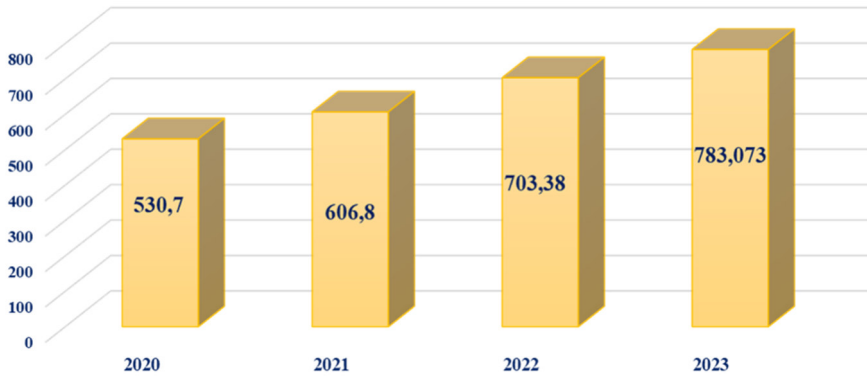


Fig. 1. Dynamics of halite waste formation, million tons per year.

Many rocks contain several types of minerals, so it is possible to combine the extraction and processing of all mineral components. This process is cost-effective. The problem with dumps has not been resolved to date.

3.1.3 Impact of mica mining on the aquatic environment

Due to mica mining technology, the risk of pollution of water resources, both surface and underground, increases significantly. Extraction technologies affect the drainage of swamps. When mining minerals, salts and heavy metals enter the water, and the water becomes alkalized and acidified.

Thus, to maintain the aquatic environment, it is necessary to carry out a number of measures [7]:

- reduction in the volume of water resources during mining;
- monitoring of wastewater treatment;
- measures to clean up contaminated groundwater;
- use of mine water for technical consumption.

3.1.4 Negative impact of emissions into the atmosphere during the extraction of mineral raw materials

During extraction and transportation, the following substances are released: dust, nitrogen oxides and dioxides, carbon monoxide; these substances significantly affect the state of atmospheric air in the region. As a result of the extraction and transportation of the environment, intense dust is generated, which significantly affects the health of the region's residents. Explosive technologies are often used in quarries, which increases dust levels [8].

Thus, mica mining has a serious negative impact and contributes to the disruption of the ecological balance, since changes affect natural environment: water, land, and atmospheric air.

3.2 Features of organizing the mica mining process in modern reality

The largest mica deposit in the Russian Federation is Kovdorskoye. The Kovdor Mining and Processing Plant produces phlogopite. The quarry is located in the city of Kovdor. Then the raw materials are delivered to the processing workshop located at the Mica Factory in St. Petersburg, where primary processing is carried out (separation of waste and large and small

inclusions), then the processed raw materials enter the production area, where additional processing of mica into sheet mica and mica plastic is carried out and produced Mica is sorted and then shipped to customers. This technology operates successfully and is gradually becoming greener: the mica factory processes waste and releases small fractions of mica, which are subsequently used in agriculture [9, 10].

4 Conclusion

Based on the results obtained, the following conclusions can be drawn.

Mica is an important and relevant mineral raw material for both Russian and foreign production, since mica is a dielectric or, on the contrary, depending on the type, has electrically conductive properties. The main mica deposits are located in the Irkutsk region and include: Mamsko-Chuiskoye, Gutaro-Biryusinskoye, the projected production volume reaches 350 thousand tons.

Pennsylvania scientists have developed a unique method for cleaning reservoirs using mica pulp. This technology has not found wide application due to its high cost, but it has shown a fairly high degree of purification of 99%.

Mica mining has a serious negative impact on the region: polluting the atmospheric air, surface and groundwater, disturbing the balance of land resources and leading to the loss of their agricultural importance. This negative impact primarily disrupts the ecological balance in the regions. Currently, the most advanced and modern technology is the Kovdor Mining and Processing Plant and the Mica Factory, which are aimed at the complete extraction of mica and the greening of technology.

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