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# PROSPECTS FOR THE DEVELOPMENT OF MORTGAGE WORKS IN UNDERGROUND MINES

***Annotation:*** *this article analyzes the international experience and their prospects for application in mining operations of deposits with complex geomechanical situation*

***Basic phrases:*** *mining industry, stone crushing, mixing of mixtures, deposition, mining waste, cement, granular slag.*

***Анатация:*** *в данной статье приведены анализы международного опыта применения закладочных работ и их перспективы при разработке месторождений со сложной геомеханической ситуацией*

***Ключевые слова:*** *горная промышленность, рудник, горный удар, твердеющие смеси, закладка, отходы горного производства, цемент, гранулированные шлаки.*

The constant increase in the depth of development of high-grade ore deposits, the complication of mining-geological and mining-technical conditions of their operation, an increase in mining and processing waste are a prerequisite for an ever wider spread of various options for development systems, which largely determines the efficiency of mining.

In the context of the tendency for the development of the mining industry, in order to increase the competitiveness of the enterprise in the world market, the issue of complete and high-quality extraction of ores from the subsoil and

the preservation of a safe geomechanical situation in underground mines is of great importance. When mining minerals by the underground method, this issue is solved by using the backfill of the mined-out area. At large mining enterprises developing deposits of valuable ores, the hardening backfill has become widespread. Backfilling of the worked-out space with hardening mixtures will not only allow leaving a minimum amount of ore in the pillars, but will also ensure the safe development of the remaining horizons.

The specific conditions of many fields involved in underground mining by systems with backfilling of mined-out space require an extraordinary approach to solving a complex of complex technological, organizational, technical and technical and economic problems to substantiate the optimal compositions of hardening mixtures, the technology of their preparation and the formation of artificial massifs.

When using development systems with hardening backfill, a significant share of costs (up to 15-25%) in ore mining falls on stowage works [1].

However, improving the safety of work and reducing the cost of physical labor to maintain the mined-out space justify the increased cost of mined ore [2]. Ways to achieve the standard strength of an artificial massif with minimal costs for its formation is an important production, scientific and practical task.

The hardening backfill is successfully used abroad in Russia, USA, Canada, Germany, Sweden, Finland, India, Japan, Australia in the development of ore deposits. [3-5].

This testifies to the effectiveness of the use of the bookmark, despite the additional costs, which are covered by the quality of the products obtained and the absence of costs for enrichment.

The depth of mining is the main criterion governing the strength of the filling mass of hardening mixtures. Analysis of the largest mines for the extraction of ferrous and non-ferrous metal ores by underground mining systems

with hardening backfill revealed the regularity of changes in the strength of the hardening backfill depending on the depth of development of deposi [6].

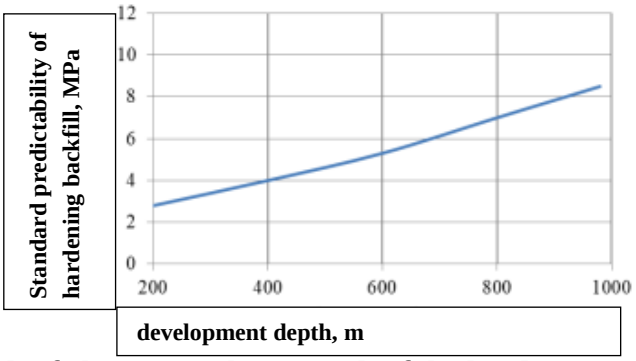



***Fig. 1. The graph of changes in the strength of the hardening insert depending on the depth of development***

Fig. 1 it follows that the depth of development significantly affects the strength characteristics of the hardening backfill, changing it in the range of 200-900 m by 2.5-3 times. Consequently, neglecting the strength of the backfill in conditions of increasing depths of development, especially deposits with difficult mining and geological conditions, hazardous by rock bursts (Fig. 2), from the standpoint of the safety of mining operations is unacceptable.

At development depths over 600 m, the consumption of binders is 300 kg / m3 and more. The current situation requires the search for economical ways to increase the strength of the filling mass. Analysis of the component compositions of the hardening fill of world and domestic mines showed that today the most common type of binder is cement (in 70% of mines), as an inert filler - sand, crushed stone (28 and 26%, respectively).

Modern mining practice and recent research have shown that although cement is one of the best binders, it can be successfully replaced with other cheaper cementitious agents, including materials that are production waste.

The most difficult moment associated with the use of a hardening plug is the correct choice of its composition, as applied to specific conditions and materials. In the production of innovative hardening materials, a general concept of targeted synthesis of neoplasms is required, for which it is necessary to develop a methodology for their study and statistical processing of the results of work. In the production of innovative hardening materials, a general concept of targeted synthesis of neoplasms is required, for which it is necessary to develop a methodology for their study and statistical processing of the results of work. The physical and mechanical properties of industrial waste are associated with a complex set of factors, the most important of which are the mineral composition, density, water demand, and others. For full-scale tests, the authors of [8] prepared samples of a hardening mixture based on the tailings of an enrichment plant (OP).

It was determined that the strength of the mixture (aggregate) depends on the amount of the binder [9] and changes exponentially according to the expression:

$$\delta_3 = \delta 0 e^{0,058q},$$

where δ0 is the strength of the aggregate without the addition of cement, kgf / $cm^2$; q - specific consumption of cement (M-400), kg / $m^3$.

After 30 and 90 days, samples of experimental filling mixtures were tested using a PSU-100 hydraulic press for uniaxial compression (Fig. 3).

On the basis of the studies carried out, laboratory and industrial tests, it was found that the rate of increase in the strength of the hardening mixture with an increase in the consumption of filler and the holding time increases.

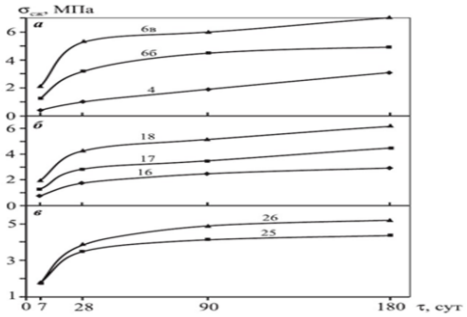
Thus, the following composition of the hardening mixture was recommended:

Sandy part of the tailings of the processing plant, kg / $m^3$ -1350 – 1500

Ground granulated slag, kg / $m^3$ -50 – 70

Mixing water, l / $m^3$ -350

Based on the results of the studies, the optimal composition of the filling mixtures was determined, which ensures the achievement of the standard strength with the minimum consumption of the binder, which serves as cement, and the filler is acidic or neutralized tailings and crushed rock (Fig. 3).




With a significant variation in the composition of the filling mixtures used in the mining industry, not enough attention is paid to the study of the chemical processes of the formation of structural connections and the factors influencing the formation of a monolithic stone have not been identified.

A promising direction can be the creation of a filling complex serving several nearby mines.

Based on the analysis, the following can be noted.

- With an increase in the depth of field development with backfill systems, there is a natural tendency to increase the strength of the backfill massifs.

-Starting from a depth of 500-600 m, the consumption of binders is over 300-350 kg / $m^3$, with the transition to depths over 1000 m, the cost of stowing work will increase significantly. The current situation requires a scientific search for economical ways to increase the strength of the filling mass.

- Prospects for the resumption of stowing operations at the mines of Uzbekistan have been disclosed, suggesting the use of a simplified stowing complex and local industrial waste (slags, tailings, etc.).

- In the conditions of a decrease in the depth of development of rich ores by mining systems with a hardening backfill, scientific research should be developed in the direction of improving the schemes for preparing a backfill mixture, achieving an optimum between the consumption of binders and their dispersion.

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