RESEARCH OF TECHNOLOGICAL FEATURES OF THE DEVELOPMENT OF UPLAND DEPOSITS IN THE KYZYLKUM REGION

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Abstract: *In this article, the basis of the analysis of sources revealed the technological features of the open-underground development of upland deposits. The main factors for the effectiveness of open-underground development, which will need to be taken into account when making project decisions to determine the boundaries of open-underground work.*

Keywords: *Upland quarries, technological schemes, open-underground mining, costs, ore bodies, profitability of the enterprise.*

Introduction

Upland deposits of precious metals, incl. a gold are mined with the using of the underground method, but there are prerequisites for the using of the surface mining for the development of the upper parts of the deposit with a relatively large thickness of ore bodies and ore zones using the surface method. Such deposits include the following mining sites:

- ore bodies 7 and 51 of the Ziaetdinsky ore field in Pakhtachi district of Samarkand region;
- ore bodies 1, 14, 15 and 17 of the Charmitan deposit in Kushrabad district of Samarkand region;
- ore zones 1, 2 and 3 of the Urtalik deposit in Kushrabad district of Samarkand region.

At the same time, there are currently no specific methods and requirements for determining the rational boundaries of the use of surface and underground mining

methods in certain conditions. The main criterion for determining the applied mining method is the technical and economic indicators of the mining area under consideration. And the design of the mining facility should be carried out taking into account the specifics of the further and even parallel operations of the open pit and the underground mine at the same time.

Methodology

The starting point of traditional approaches to the projecting of open-pit mining is currently the definition of the concept of "open-underground mining". The essence of this definition in all its variants of the present time is as follows: open-pit development is the development of reserves of one deposit by surface and underground methods according to mutually influencing technological schemes. At the same time, the development of a deposit by these methods may or may not coincide in time [1].

Results and Discussion

Combined development of a field can have various options for the spatial-temporal relationship of open-pit and underground operations with the division of field reserves into separate categories:

- the upper part of the deposit is initially extracted by a quarry, after the termination of work in which further extraction of reserves to depth is carried out only by the underground method;

- transition to the open pit mining method from the previously used underground method, while the cleaning work at the underground mine is terminated;

- joint development of the deposit by open-pit and underground methods.

The research results show that the use of the open-pit method is most effective at dip angles of deposits of 50-55^{o} and more, thickness of 150-200 m and a length of about 4-5 km and more [2,3,4].

If we take into account only the mutual influence of technological schemes of the two methods, then such conditions may be created under conditions in which technological schemes of open or underground methods in their normal form will become impossible. They will become impossible either for economic reasons or for safety reasons.

Therefore, the essence of open-underground mining can be more accurately expressed by the following definition of its concept: open-underground mining is a method of developing one deposit according to a single technological scheme, which is a combination of elements of open and underground methods of conducting work, taking into account the mutual compensation for reducing the technical and economic indicators of limiting processes.

According to this definition, the best option for open-pit mining is a unified technological scheme, regardless of the time of development of individual parts of the

field, which compensates the decrease in the technical and economic indicators of surface and underground methods that occur when they are mutually (unfavorable) influenced [7].

In accordance with this approach, when designing an upland field with open-pit mining, mining and economic problems are solved taking into account the decrease of the indicators of open and underground methods when they are used separately in this field. To compensate this decrease, the technological scheme of open-pit mining, when solving mining and economic problems, must take into account changes of the design parameters and of the calculation methods.

If a significant compensation is required, these parameters can be changed so much that they require new methods for establishing the initial data for calculations. That is, in this case, open-pit mining will manifest itself as a new way. The magnitude of the change in the parameters of technological schemes in open-pit mining is associated with the degree of compensation for technical and economic indicators. Therefore, when evaluating the options for technological schemes of open-pit mining, this connection can be used to select the optimal option out of the possible. Taking into account the above provisions, we will further use the concepts of “degree (share) of compensation” and “effect of compensation (or the effect of measures)”.

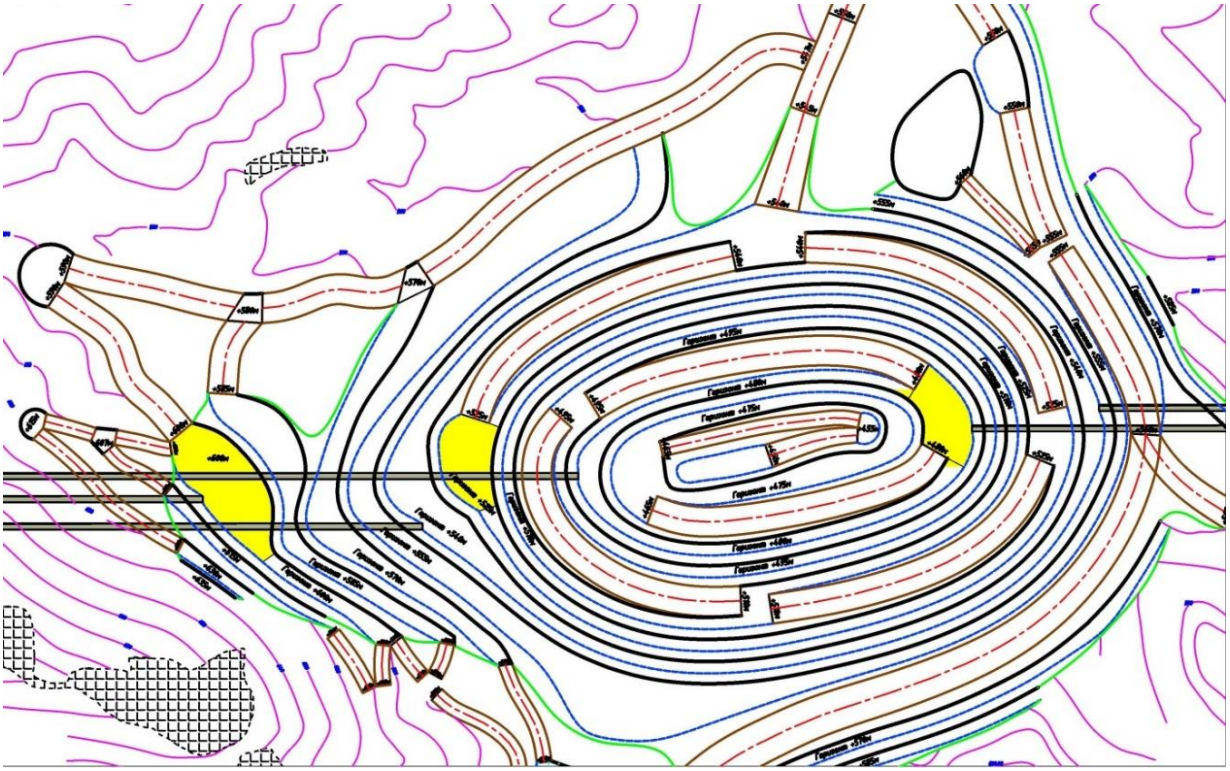

Fig. 1. The final form of the open pit for the development of ore body No. 51 of the Ziaetdinsky ore field, taking into account the placement of special areas on the sides of the open pit for the industrial site of promising adit horizons.

Compensation effect refers to the monetary value of compensation, measured in fractions of a unit. The degree of compensation expresses the share of a possible improvement in the economic indicators of the open-pit mining option in comparison with the separate mining of the deposit by open-pit and underground methods in the transition zone (adjacent zone).

It is the most convenient to represent this share through a possible increase in the depth of field development by open pit mining under the influence of combination elements. This approach is due to the fact that open-pit mining presupposes the predominant use of the open-cut method (priority) by expanding its area into the depth of the field. In this case, the priority is provided by the degree of increase in the depth of development depending on the magnitude of the economic effect, which compensates the decrease of the technical and economic indicators of a purely open method at a given depth. Thus, the share of compensation and the economic effect of this share are interrelated here [5].

To evaluate the option of open-pit mining, all these can be expressed by the following formula:

$$R = P \cdot 100/Z_{\Delta}(F_{\text{OCH}} + F_{OB}) = max$$

where R is the level of profitability of the enterprise, %; P is the amount of the enterprise's profit, rubles; Z_{Δ}- fraction of interference compensation, fraction of units;

F_{OCH}, F_{OB} - fixed assets and working capital of the enterprise, respectively, rubles;

$$Z_{\Delta} = \text{H}_0/\text{H}_\text{K}$$

where H_0 is the depth of development with an open-pit method (determined by a well-known formula), m; H_K - depth of development, taking into account open-pit mining, m.

$$H_K = H_O(1 + n_{KOM}/n_E)$$

where n_{KOM}, n_E are the boundary overburden coefficients for the depth, respectively, by the combined and open methods, which are estimated at reduced costs

$$Z_{\text{п}} = Z_{\Delta}(\frac{\sum_{i=t_n}^{\text{T}} C_i K_{P.Z}^{i-t_n}}{T - n_f} + E_H \frac{n_f}{n_H} \sum_{i=1}^{n_f} K_i K_{P.Z}^{t_{\text{п}}-i}) = min,$$

where C_i, K_i - current costs (cost) and capital investments for each option, respectively; $C_i K_{P.Z}^{i-t_n}$, $K_{P.Z}^{t_{\text{п}}-i}$ - coefficients of bringing the costs of future and past years, respectively; E_H - standard coefficient of efficiency of capital investments, E_H = 0.12; T is the duration of the estimated period from the beginning of the construction of the facility, years; n_f, n_H - actual and standard construction time of the facility, respectively, year; t_n - year of cost reduction; i - the considered year of costs [6].

The expression in parentheses represents the adjusted costs of production, taking into account the factor of time, for the open-pit development method in a given field.

The given evaluation formulas assume the availability of development options. Knowing the development options, you can roughly (tentatively) calculate the coefficients of their effectiveness. Then you can set the main technical and economic parameters according to technological schemes and evaluate the option more accurately [8].

These signs will allow you to find the elements by which the development options are formed. Knowing the development options, you can roughly (tentatively) calculate the coefficients of their effectiveness [9]. The efficiency factor allows attributing this deposit to a certain group according to the classification. Then you can set the main technical and economical parameters according to the technological schemes and evaluate the option more accurately.

When designing open pits using traditional methods, when 2-3 options for the development of mining operations are compared, the best option can be skipped. Therefore, with the advent of modern computer-aided design technologies, there is a real opportunity to search for the optimal career development option, which provides:

- minimum development volumes with maximum recovery of field reserves;
- uniform distribution of development volumes over time.

It should be borne in mind that an integral part of this option is the construction of a non-working pit wall with parameters that ensure the minimum amount of overburden while maintaining the safety of mining operations.

Conclusions

So, it should be noted that the conditions that determine the effectiveness of open-pit mining are expressed by the interaction of the following factors:

1. Approach to the concept of a combined method. The interaction of indicators that determine the effectiveness of the method depends on the concept of the essence of the method itself.

2. The novelty of the applied technological solutions. During the operation of the transition zone of the field, where, according to economic results, the two methods (surface and underground) are equalized, the degree of difference between the combined method and traditional methods (novelty) will express its effectiveness.

3. Depth of development. The degree of perfection of the combined method depends on the depth of development, since with an increasing in depth, technological solutions will include more and more elements of the underground (less productive) method which will need to be taken into account.

4. The ratio of the boundary stripping coefficients of the combined and open methods. This ratio, on the one hand, affects the depth of development, and on the other hand, it determines the proportion of interference compensation (unfavourable actions of factors).

5. Method for evaluating the combined method. A preliminary assessment can be used, which does not require detailed calculations for all indicators, or a final assessment with a detailed calculation of many indicators.

With such definition of the development efficiency, the patterns of qualitative and quantitative changes in the indicators of options are traced; the choice of the development option is made by a more simplified, consistent method, and the technical and economic indicators are determined with a minimum amount of calculations.

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