

ANNOTATION

for the dissertation for the degree of Doctor of Philosophy (PhD)
6D070700 - "MINING ENGINEERING"

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SCIENTIFIC AND METHODOLOGICAL SUPPORT OF TECHNICAL AND TECHNOLOGICAL ANALYSIS OF THE EFFICIENCY OF MINING PRODUCTION MANAGEMENT

The relevance of the work. At mining enterprises, the issue of energy saving is traditionally one of the key ones, however, a set of organizational measures, as a rule, concerns ensuring energy saving issues, appropriate technical readiness of the main mining and transport equipment, control and accounting of fuel consumption, planning and rationing of energy consumption based on the estimated volumes of extracted rock mass in the planned period. The information and methodological base traditionally used at enterprises does not allow realizing the existing potential for improving the energy efficiency of the operation of the main mining and transport equipment, which makes it necessary and expedient to create a universal methodological base for operational monitoring and analysis of the current and prospective functioning of geotechnological complexes, the operation of mining transport systems of open pits on a single information - methodological base at all stages of the development of mineral deposits - design, operation and reconstruction. At the same time, adequate consideration of the conditions of their functioning should be provided - mining and geological, mining engineering, mining geometric, organizational and economic. Under these conditions, information systems for the management of mining and transport operations in open pits should be adaptive to such factors as:

- unstable mining and geological situation in the quarry space and a low degree of technical readiness of the automobile and excavator fleet of modern enterprises;
 - the interaction of equipment for the delivery of mined ore between the quarry and the factory, taking into account the allowable range of fluctuations;
 - ensuring operational adjustment and regulation of the efficiency of interaction between the mining enterprise fleet.
- reducing the risk of human factor influence during the operation of the complex.

The purpose of the dissertation work is to develop methods for technical and technological analysis of mining management processes to ensure an increase in the efficiency of the functioning of geotechnological complexes in open pits.

The main idea of the work is to consider the mining-geological, mining-technical, mining-geometric, organizational and economic conditions for the functioning of the automobile-excavator complex based on the process approach.

Research objectives:

1. Conduct an analysis of modern methods and approaches for assessing the efficiency of mining in open pits and establishing directions for their improvement on a new information basis.

2. Develop a digital twin of the processes for designing geotechnological complexes in open pits;

3. Based on the established dependencies, create a classification of automated control systems for geotechnological complexes and develop a methodology for technical and technological analysis of the effectiveness of mining management.

The object of the study is a system for the development of deposits of solid minerals in an open way.

The subject of the study is the functioning of the excavator-automobile complex.

Research methods. The main research method is simulation logic-statistical and operational modeling of mining and transport processes, applied on the basis of a process approach to the management of geotechnological complexes, implemented within the framework of complex feasibility studies, technical and technological and energy audits of their functioning. Methods of mathematical-statistical and comparative analysis, as well as object programming were used.

Scientific provisions and results submitted for defense (methodological base submitted for defense):

1. Digitalization of the interaction of mining and geological, mining engineering, mining and geometric, organizational and economic factors contributes to increasing the efficiency of mining a deposit already at the stage of designing geotechnological complexes of open pits.

2. A classification of automated control systems for geotechnological complexes in open pits has been developed depending on the totality of the implemented functionality (accounting and control, regulation, stimulation, planning, organization) and the degree of reliability of accounting for the main technical and economic parameters.

3. Scientific and methodological support for the technical and technological audit of the effectiveness of the functioning of geotechnological complexes in open-pit mining of deposits of solid minerals has been developed, which makes it possible to determine the overall potential, directions and specific measures to increase efficiency through integrated modeling of the main production processes. (a new set of known provisions).

Scientific novelty is:

- in the systematization of automated methods for managing geotechnological complexes in conjunction with methods for adequately taking into account the fundamental factors and parameters of their functioning.

- in the digitalization of the processes of designing geotechnological complexes of quarries with the use of cyclic development of the deposit.

The practical value lies in:

- a systematic description of the existing production or basic design solutions (if the project of a new production is being audited), which makes it possible to develop recommendations on organizational and technical solutions that provide the

required production parameters; (productivity, quality, etc.), in the assessment (aggregated) of the required investments and the timing of the investment of funds, the assessment of the payback period of investments;

- substantiation of a long-term program of functioning aimed at reducing the cost of mining and transport operations;

- a program for the development of infrastructure, "joining" of "bottlenecks";

- versatility of the applied approach and methodological base when conducting a technical and economic analysis of the efficiency of mining production, establishing the facts of a significant - up to 20-30% error when using traditional stationary or simplified dynamic accounting methods.

Approbation and publication of research results. The results of the dissertation work were published in 13 papers, of which 6 were published in Scopus editions with percentiles 2-4. 5 in the publications recommended by the KKSON MNVO RK. In addition, as part of the work, patent research was carried out and 2 certificates of state registration of rights to the copyright object were obtained (Appendix A). They were tested at a number of round tables and seminars.

CONCLUSION

At open pits, there is a significant, up to 15% or more, potential for improving the efficiency of the operation of geotechnological complexes, which can be implemented by applying a process approach to management in mining practice, which, in addition to performing the main functions, takes into account the interconnections of all subsystems and elements of the object, such as large-scale, complex and probabilistic system.

The developed unified methodological base for calculating the main technical and economic indicators at the stages of their design, operation and reconstruction based on the process approach makes it possible to increase the efficiency of geotechnological complexes in open pits.

The proposed information and technical platform for geotechnological complexes provides an adequate flow of operational, reliable and objective information about the effectiveness of their functioning at the operational stage.

The application of the developed methodology for technical and technological analysis of the efficiency of mining management, implemented as part of complex technical and economic analyses, technical and technological and energy audits of the functioning of geotechnological complexes of solid mineral deposits, ensures a reduction in the cost of mining and transport operations.

The implementation of the main methodological provisions of the process approach in the framework of specific studies of field development projects, as well as in a number of existing mining operations as part of the conducted comprehensive technical, technological and energy audits, made it possible to establish that the existing base for designing geotechnological complexes requires significant improvement on a fundamentally different information a methodological basis that ensures adequate consideration of mining technical, mining-geological, mining-geometric, organizational and economic conditions specific in each individual case.

A general algorithm has been developed for the methodology for conducting a comprehensive technical and technological audit of a geotechnological complex, which reveals a significant reserve for increasing the energy efficiency of mining and transport operations.