

SCIENTIFIC SUBSTANTIATION OF RATIONAL TECHNOLOGICAL INDICATORS OF AUTO-COVEYOR-RAIL TRANSPORT IN QUARRIES

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ABSTRACT

Transportation of the rock mass is one of the main and most labor-intensive processes of open pit mining. It accounts for up to 50-55% of the total cost of mining. In this regard, the effectiveness of open pit mining is largely determined by the solution of scientific and technical problems of using various types of open pit transport.

Keywords: *technical problems, mining, automobile-conveyor-railway transport, development system, backfill, treatment space, preparation of chambers, hardening mixture, goaf, economic efficiency*

НАУЧНОЕ ОБОСНОВАНИЕ РАЦИОНАЛЬНЫХ ТЕХНОЛОГИЧЕСКИХ ПОКАЗАТЕЛЕЙ АВТО-КОНВЕЙЕРНО- ЖЕЛЕЗНОДОРОЖНОГО ТРАНСПОРТА В КАРЬЕРАХ

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АННОТАЦИЯ

Транспортировка горной массы является одним из основных и наиболее трудоемких процессов открытых горных работ. На его долю приходится до 50-55% от общей стоимости майнинга. В связи с этим эффективность открытых горных работ во многом определяется решением научно-технических проблем использования различных видов карьерного транспорта.

Ключевые слова: *технические проблемы, горные работы, автомобильно-конвейерно-железнодорожный транспорт, система разработки, закладка, очистное пространство, подготовка камер, твердеющая смесь, выработанное пространство, экономическая эффективность.*

INTRODUCTION

Transportation of the rock mass is one of the main and most labor-intensive processes of open pit mining. It accounts for up to 50-55% of the total cost of mining. In this regard, the effectiveness of open pit mining is largely determined by the

solution of scientific and technical problems of using various types of open pit transport. A special place is occupied by research on the problems of using combined, in particular, automobile-conveyor-rail (a-to-railway) transport. Expansion of application practice, specificity and insufficient knowledge determine the relevance of the issues of substantiating the technological parameters of this type of transport. At the same time, the use of traditional methods for the analytical description and study of multi-link transport systems and, in particular, a-k-zh.d. transport is significantly difficult and inefficient due to the following: structural and functional complexity of systems; the need to take into account the stochastic nature of open-pit mining processes; the complexity, and in some cases, the impossibility of conducting full-scale experiments; the need for a comprehensive accounting of quantitative and qualitative changes in the elements of the system; difference in the nature of functioning (cyclic and continuous), reliability and mode of operation of individual links. The use of the simulation method, which is characterized by relative simplicity, flexibility and versatility, makes it possible to take into account these features, provide a greater degree of reliability and high efficiency of research in mining.

DISCUSSION AND RESULTS

Thus, the substantiation of technological parameters, rational management of cargo flows based on simulation modeling of the operation of multi-link transport systems to improve their efficiency is an urgent scientific task.

The purpose of the work is to establish rational technological parameters of the a-to-railway system. quarry transport, providing an increase in the efficiency of its application.

The object of the study is the system of automobile-conveyor-railway transport of a quarry.

The main idea is to use a probabilistic approach to substantiate rational technological parameters a-k-zh.d. transport in quarries.

Scientific provisions defended in the dissertation:

1. Effective application of a-k-zh.d. transport with reloading of rock mass into dump cars on a non-working side of a quarry is limited by the depth of placement of reloading complexes (KP) up to 120 - 150 m.
2. Stable operation of the a-k-railway system. transport with a specific scheme of track development and storage capacity, the KP is achieved at certain critical levels of the stock of rock mass in the warehouse.

3. The coefficient of the reserve capacity of the schemes of track development of open pit railway transport is determined for sections of at least the objective function, taking into account the average time of train service, the indicator of uneven flow, the average length of the queue in front of the elements of the scheme, operating costs for maintenance of railway tracks, as well as damage from train demurrage .

The scientific novelty of the work is as follows:

1. Analytical dependences have been established to determine the volume of separation of the side and pillars in the intrapit placement of the CP, as well as the preferred depths of their placement on the non-working side of the quarry.

2. A technique for simulation modeling of the functioning of a-to-railway has been developed. transport, which is distinguished by the operational reproduction of the operation of the crushing and conveyor complex and railway transport, taking into account the reliability of the equipment and sections of the track development scheme.

3. The dependencies of the system performance a-k-zh.d. of transport on the depth of the CP location, the capacity of bunkers and storage, the number of trains in operation, the dependence of the share of bunker transshipment in the cargo flow through the combined CP on the performance of the system, the capacity of bunkers and storage.

4. A methodology has been developed for determining rational regimes for controlling the intensity of shipment of rock mass, depending on its stock in the KP warehouse.

5. A methodology has been developed for determining the rational coefficients of the throughput capacity reserve of the elements of the track development scheme for open-pit railway transport.

Research methods: analysis and generalization of theoretical and experimental studies, probabilistic-statistical processing of experimental materials, simulation-statistical modeling, optimal experiment planning, technical and economic analysis.

The practical significance of the work lies in the use of the developed information, mathematical and software for the selection of technological parameters and modes of transport, methods for determining the rational coefficients of the throughput reserve of the elements of the scheme for the track development of open-pit railway transport and control modes for the intensity of shipment of rock mass depending on its stock in the KP warehouse in the design, reconstruction and operation of complex transport systems.

CONCLUSION

This paper proposes a solution to the actual scientific problem of substantiating the rational technological parameters of automobile-conveyor-railway transport in open pits. The analysis of scientific and technical literature made it possible to identify the main objectives of the research. The improved and adapted methodological apparatus for solving these problems ensures the achievement of the above goal based on a comprehensive account of the features of the interaction of the crushing and conveyor complex with railway transport, increasing the scientific validity and quality of the choice of technological parameters in specific mining conditions.

The main scientific and practical results of the work are as follows:

1. Analytical dependences of the volumes of separation of the side and rear pillars on the depth of placement of transshipment complexes from conveyor to rail transport are obtained. It is established that a-k-zh.d. transport with the placement of reloading in dump cars on the non-working side of the quarry has a field of effective application. At the same time, the placement of reloading complexes at a depth of more than 120-150 m is not advisable. The rational values of the placement depth of various types of reloading complexes on the non-working board are determined.
2. A simulation-statistical model of the functioning of a-k-railway has been developed. transport, which allows, taking into account the stochastic nature of the mining and transport process, the reliability of equipment and the interaction of individual systems of the system, to solve a wide range of tasks for assessing and choosing the technological parameters of the open pit transport system.
3. On the basis of the implementation of experimental plans with the use of a simulation model for the conditions of the Dzhetygarinsky open pit, multifactorial dependences of productivity a-k-railway were established. transport from the depth of placement of CG1, the capacity of the warehouse and bunkers, the number of trains in operation. The dependences of the share of bunker loading in the total cargo flow through the combined gearbox on the performance of the system, the capacity of bunkers and the warehouse are revealed. Rational technological parameters a-k-zh.d. transport for a promising transport system of a quarry.
4. In order to ensure the stable operation of the a-k-zh.d. transport through the organization of rational interaction between DCC and rail transport, a simulation model was developed for managing shipment modes depending on the stock of rock mass at the KP warehouse.

5. On the basis of simulation modeling of the operation of mining and transport systems of a number of large deep quarries, it has been established that the main limiting factor in regulating the intensity of the arrival of locomotive trains at the KP warehouse in the implementation of promising design volumes of rock mass transportation is the throughput capacity of railway transport track development schemes.

6. A methodology has been developed that allows, taking into account the stochastic nature of the mining and transport process, the structure and dynamics of cargo flows, to determine rational coefficients of the throughput reserve differentially for sections of the railway transport track development scheme.

7. Using a simulation model for controlling the modes of shipment of rock mass from the KP warehouse in the variant using a-to-railway. transport of ore at the Dzhetygarinsky open pit, rational values of critical levels of stock and intensity of receipt of locomotive trains for loading are determined.

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