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♦ **Гірничі машини і енергетика**

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♦ **Mining engineering**

♦ **Ecology and labor protection**

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MINING ENGINEERING

INCREASING THE EFFICIENCY OF BLASTING WORKS IN THE QUARRY OF BUILDING MATERIALS

© *S. Kozlov, O. Terentiev, M. Sergienko*

The article is devoted to the urgent problem of increasing the efficiency of blasting operations in open pits in conditions of high water saturation of minerals.

The idea of solving this problem is to use the effect of draining the local area of the water-saturated block of the mineral due to the ordinal explosion of the well charge.

The purpose of this study was to improve the efficiency of blasting operations on flooded fractured rocks in open pit mining.

Research methodology. The proposed technique makes it possible to determine the parameters of drainage of the watered mass during the explosion of borehole charges and the parameters of an ordinal explosion. This makes it possible to improve the quality of rock crushing and reduce the consumption of explosives per unit cost.

The main direction of research in this work is to reduce the energy intensity of the process of destruction of a water-saturated mineral by using the internal potential of water in the cracks of the massif destroyed by the explosion. The regularities and the role of the drainage funnel in the efficiency of destruction have been established.

The novelty and originality of the work is a developed technology for removing water from the explosion zone, which increases the efficiency of explosion and destruction of rocks using special water-resistant explosives.

The practical value of the work lies in the effectiveness of the proposed method for carrying out blasting operations, which, along with improving the quality of crushing, provides an increase in the output of blasted rock mass from one running meter of the well and reduces the cost of expensive water-resistant explosives.

Conclusions. The introduction of research results and recommendations in open pits made it possible to increase the efficiency of blasting operations in the development of water-saturated rocks. Energy consumption for the destruction of an array of water-saturated minerals is reduced by 10%. The amount of blasted rock mass per running meter of the well increased by 14.1%, and the specific consumption of explosives decreased by (12-14) %.

Keywords: quarry, minerals, well, filtration, water-saturated massif, crushing, explosive, detonation.

JUSTIFICATION OF TRANSPORT WORKS IN THE CONDITIONS OF A BLOCK QUARRY

© *N. Kyrylenko, V. Shamrai, L. Kovalevych, M. Leblya, A. Makhno*

The increase in oil prices, consumables and tools is necessitate the re–equipment of mining enterprises in Ukraine. The share of automobile transport reaches 35–50 % in the dimension blocks production costs.

The purpose of the work is to determine transportation costs (TC) of $1 \, m^3$ of blocks depending on the volume and transportation distance within the quarry; improving the transportation plan by solving transportation problems of linear programming.

Fuel consumption and dimension block TC for three models of front–end loaders (FEL) were newly calculated on the basis of a comprehensive study. A comparison of the economic feasibility of FEL and dump truck (DT) use in certain mining conditions have been made. The

rationalization plan (RP) of dimension blocks transportation within the quarry was newly proposed.

The research was performed at the dimension gabbro quarry, blocks transportation in which is performed using FEL CAT 988F (1) and DT KrAZ–256B. FELs CAT 988H (2) and CAT 986H (3) were adopted for comparison.

The average annual fuel consumption is determined: among the FELs considered in the research, the (3) consumes the least, and the (1) currently used at the enterprise consumes 22.7 % and 9.7 % more fuel compared to the (3) and the (2), respectively, in similar conditions. Trade blocks transportation using FEL is economically more expedient in comparison with the DT at transportation distance up to 300–400 m.

It is determined that the trade blocks TC using the (2) and the (3) is 5.3 % and 12.6 % lower, respectively, compared to the (1).

This paper also considers the transportation problem for FELs, in which blocks from several banks must be distributed between several storage areas, provided to minimize TC. According to the proposed RP of transportation, the savings will be up to 13 % compared to the initial conditions, which in monetary terms is 41538–48639 UAH/year depending on the FEL model. The replacement of the (1) for the (3) will reduce block TC by 12.6 % (47000 UAH/year) in the current conditions. The TC using the (3) will be 285303.5 UAH according to the proposed RP, which is 23.7 % (88476 UAH/year) less than the (1) application before the rationalization.

Keywords: dimension stone; front–end loader; commercial blocks transportation costs; transportation problem; cargo traffic rationalization; fuel consumption; haul road gradient.

MINING MACHINES and ENERGY

INVESTIGATION OF COMPRESSOR START-UP OF CONE DRILLING RIG WITH CURRENT LIMITING FUNCTION

© *A. Toropov, L. Toropova*

The article considers the problem of research of the system "soft start device - induction motor" for compressor equipment of cone drilling complex. A refined mathematical model of the system has also been developed, taking into account the nature of the compressor load, as well as the existing algorithms for operating the stator current control unit.

Problems of a choice of a mode of start of compressor installation are considered, necessity of full research of system of the electric drive by methods of digital modeling is defined. The main parameters that must be clarified and corrected by the designer of the electromechanical system of the compressor during commissioning are determined. Next, the model implements an algorithm for controlling the unlocking angle of power thyristors used in modern soft-start devices manufactured by WEG. To do this, a software unit is formed to limit the RMS value of the stator current when starting the induction motor. After that, the simulation of the procedure of starting the induction motor of the compressor from the thyristor device of soft start with the activated function of limiting the stator current is performed.

As a result of simulation in the application Simulink software environment MATLAB obtained graphs of transients for the most important operating parameters, such as current in the stator windings, shaft speed, load torque and the value of the opening angle.

The analysis of the obtained results is carried out, as a result of which conclusions concerning the possibility of application of devices of smooth start-up for compressors of

cone machines are formulated. It is determined that at a close to linear nature of the compressor load, the motor starts with a smooth change of speed without significant jumps in the stator current of the motor. The use of a current limiting function for light starting modes and a current control function with an initial increase in torque is proposed.

Keywords: roller cone drilling machine; asynchronous compressor motor; current limiting function; soft start device; mathematical modeling.

METHOD OF MAXIMUM–AVERAGE REDISTRIBUTION OF A HOMOGENEOUS RESOURCE

© *A. Khomiak, V. Rozen, H. Starozhilova*

The article considers the method of decision-making based on the distribution of homogeneous resources between objects with different quantitative indicators of impact, in case of shortage of resources involved. The method can be used in decision-making systems in the case of distribution of such homogeneous resources as: funds, electricity and heat, water, etc.

Purpose. Improving the adequacy of the results of the allocation of scarce resources by developing a method of resource allocation in intelligent decision-making systems in the event of a shortage or excess of a homogeneous resource.

Methodology. Let the studied complex system contain a finite set of subsystems that have a common homogeneous resource: the means used to implement energy saving measures. In the conditions of deficit of a homogeneous resource there is a necessity of distribution according to the established criterion. Therefore, there is a need to develop new methods of decision-making that would significantly enhance the ability to solve such problems.

Let the system under study create i_n from a finite set of objects. Each object characterizes: S_i-requested resource, A_i-effect from the implementation of energy saving measures S_i. In the conditions of deficit of a homogeneous resource which falls under distribution, necessity of definition of a resource for each of objects is defined. As a result of application of a method of the maximum-average redistribution of a homogeneous resource for the decision of problems we receive the following parameters: y'- quantity of losses which managed to be reduced, y - the real losses received underfunding, x - the received quantity of resources in it.

Findings. The method of maximum-average redistribution of a homogeneous resource is developed, the example of application of a method is considered. The method allows you to allocate all available homogeneous resources, to gain an advantage in the effect of implementation over other existing methods, under certain conditions and initial data. Due to the new algorithm of homogeneous resource allocation and simplicity of calculations, this method can be widely used in the allocation of scarce resources. The method has comparable results to the method of proportional division in cases where objects with large requested resources have significant impact indicators, and conversely, the indicators deteriorate when objects with small requested resources have a significant impact on the system.

Originality. A new method of calculating the redistribution of a homogeneous resource according to the established criterion is proposed. For the first time the problem was solved using the method of maximum-average redistribution of a homogeneous resource.

Practical implications. The method of maximum-average redistribution of a homogeneous resource can be widely used in the allocation of funds for the implementation of energy saving measures, as well as in all industries, economics and other areas where there is a need for intelligent decision-making systems. The application of the method allows to solve problems with the allocation of resources in case of their shortage or excess. In case of excess resources, the algorithm for applying the method remains the same.

ECOLOGY AND LABOR PROTECTION

SPECIFICS OF FORECASTING METHODOLOGY INDUSTRIAL INJURIES AND PROFESSIONAL DISEASES

© *Y. Polukarov, O. Zemlyanska, N. Kachynska, L. Mitiuk*

Purpose. Substantiate the need for development of new scientific and methodological foundations for forecasting occupational injuries and illnesses.

Methodology. Analyze existing methods of occupational injuries and illnesses forecasting, propose a new algorithm for calculation of their levels, set scientific and methodological requirements to information analysis system used for the prevention of occupational illnesses.

Findings. Modern methods of forecasting injuries make it possible to assess the effectiveness of preventive measures. However, there is no universal method for analyzing the occupational morbidity due to the different specifics of disease causes and manifestations which do not allow to conduct a realistic assessment of labor protection in a particular area over a given period of time. Therefore, it is the reduction in the level of occupational injuries and illnesses compared to the data obtained by the forecasting method that may be indicative of preventive measures effectiveness. At the same time, development of information analysis system of personal protective equipment continues to be a pressing issue (PPE).

Originality. It has been proposed to develop a special mathematical tool for determining loss reduction and information analysis system, which will provide a forecasted estimate of occupational morbidity at an enterprise. To obtain a reliable forecast it is important to identify the average value of cases over a given period of time, which has been considered in this paper.

Conclusions and Practical Significance. There are numerous methods available for analysis of occupational injuries and illnesses. Most of them, however, are unfit for the assessment of occupational diseases. Since chronic occupational illnesses have a cumulative nature, the rate of work-related diseases is more predictable than that of injuries and accidents. This makes it possible to determine the "occupational morbidity rate" provided that the time spent by workers in the area of exposure to occupational hazards is recorded together with reference data on the conditional level of exposure to each hazard.

Keywords: forecasting, injuries, occupational morbidity, occupational safety activities, hazard, information analysis system.

DETERMINATION OF FORCES AND MEANS OF RESCUE MINING RESCUE

© *Ya. Krupka, M. Kraliuk, V. Kostenko, O. Zavyalova, T. Kostenko*

Purpose. The purpose of this article is to study the conditions for achieving high results of operational actions of rescue services and quality management, which will allow timely and correct choice of methods, forces and means of firefighting in coal mines and carry out operational maneuvers depending on the type of fire (exogenous, endogenous). places of

origin of combustion centers, its scale, gas situation, number of people captured by the accident and their places of residence, etc.

Methodology. During the research, to solve the tasks, the complex used general and special methods, in particular: methods of induction (at the stage of collecting, systematizing and processing information for research) and deduction (in the process of theoretical understanding of the problem), system-analytical , comparative analysis, method of analysis of definitions; economic analysis, possibilities of economic cybernetics and the theory of optimal management in the development of tactics for mining operations, etc.

Findings. Economic and mathematical model of rational rescue operations in firefighting differs in that for the first time their management is considered as an economic category, and the process of emergency response and their consequences is presented as an extreme (optimization) problem, which is solved using computational experiments and engineering analysis. An algorithm for solving the extreme problem of optimizing the forces and means of rescue units, based on the fact that the arguments of integral objective functions are not control parameters, but related to the latter determined mathematical model. Methods of calculations in mining, including those used to ensure optimal organization of rescue operations, need to be improved to improve accuracy and simplify their algorithmization in order to reduce the share of manual calculations in mathematical models.

Originality. For the first time, on the basis of general methodical provisions of the theory of optimal management integrated quality criteria and on their basis economic and mathematical model of rational conducting of rescue works on liquidation of difficult underground fires are developed.

Practical implications. Economic and mathematical model of rational rescue operations will allow timely and correct selection of methods, forces and means of fire fighting in coal mines, minimize economic losses, increase the efficiency and safety of emergency response.

Keywords: accident, coal mine, mining works, integrated quality criteria, fire, economic-mathematical model.

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