Published by Empress Catherine II
Saint Petersburg Mining University

SINCE 1907

JOURNAL OF MINING INSTITUTE

DIGEST

MINE SHAFTS

№ 4 • 2023

PMI.SPMI.RU

FEDERAL STATE BUDGETARY EDUCATIONAL
INSTITUTION OF HIGHER EDUCATION

EMPRESS CATHERINE II
ST. PETERSBURG MINING UNIVERSITY

MINE SHAFTS

DIGEST

JOURNAL OF MINING INSTITUTE

№ 4 • 2023

St. Petersburg
2023

Abstract

The present digest of the Journal of Mining Institute is issued in cooperation with Giprozvetmet Ltd. and is timed to coincide with the first conference devoted to the design and construction of mine shafts.
The articles on shaft boring, the study of parameters for shaft support and rock mass, design, construction, implementation and practical use of the shaft boring system are presented in the current issue. Much attention is paid to specific cases of shaft work.
The articles are arranged in chronological order to demonstrate the dynamics of development from the basics of the field to the state of affairs.

Borisov D.F. Determination of natural draught depression by the method of counting. Proceedings of the Mining institute. 1940. Vol. 14(1), p. 83-109. https://pmi.spmi.ru/pmi/article/view/15046

Abstract. Natural draught, as it is known, is the result of the difference in the weight of the air of the air supplying and exhausting workings. In accordance with this, the natural draught depression depends on the weight, i.e. on the temperature and pressure of the air in the outgoing and incoming jet. In this case, depending on the depression developed by the suction or discharge fan, the air density of the outgoing or incoming jet can vary within significant limits, so that along with the natural draught resulting from the heating of air and changes in its composition, there is a natural draught created by the fan and "artificially created natural draught". At present, in addition to methods of calculation, a number of methods of direct measurement of the depression of the natural draught of the existing mine are known. These methods involve changing the ventilation regime of the mine. By blocking the entire air stream with a cofferdam, it is possible to directly measure the natural draft depression with a micromanometer connected to both sides of the cofferdam.

Elanchik G.M. Complex analysis of physical and mechanical processes of mine lifting. Proceedings of the Mining institute. 1948. Vol. 22, p. 251-253. https://pmi.spmi.ru/pmi/article/view/14041

Abstract. It should be noted the valuable initiative of the Leningrad Order of Lenin Mining Institute, publishing in its notes not just small articles, but extensive fundamental works, comprehensively covering the current problems of mining engineering. Volume XXI of the Notes of the Leningrad Mining Institute is entirely devoted to a major study by Prof. F.N. Shklyarsky, Dr. of Engineering, "Physical and Mechanical Basis of Electric Mine Lifting". A mine hoisting plant is a complex electromechanical complex, the physics of its operation has

long been covered in an extremely schematic and approximate way. Yet Prof. I.A. Timé was the first to begin to pay attention to the complex of mine hoisting, but only the outstanding works of Acad. A.P. German and Acad. M.M. Fedorov laid the foundation for a deep analysis of the theory of mine hoisting installations. Prof. F.N. Shklyarsky has widely deepened these analytical studies and for the first time, in addition to a comprehensive analysis of the dynamics of lifting and lowering of the load, has analyzed the physics of the electric drive of the mine hoisting machine. Published in Volume XXI of the Notes of the Leningrad Order of Lenin Mining Institute, the remarkable monograph of Prof. F.N. Shklyarsky successfully completes his many years of original research in this most complex area of transportation technology.

Shklyarsky F.N. Application of hydroelectric drive to mine hoisting. Proceedings of the Mining institute. 1950. Vol. 24, p. 57-68. https://pmi.spmi.ru/pmi/article/view/14076

Abstract. The idea of application of the hydroelectric drive to the mine hoist appeared to the author of this article in 1944. In order to implement it, at the suggestion of the author and under his scientific guidance, a research work was organized in 1945 at the Leningrad Mining Institute with the participation of Associate Professor A.E. Maximov as a responsible executor. After obtaining the theoretical and experimental results of the research by the joint efforts of researchers of the Department of Mining Electrical Engineering of the LGI and a group of engineers in 1947 was realized the first in mining practice and hydroelectric lifting machine. The principle of operation of the hydroelectric drive is as follows. Between the constantly rotating electric motor and the machine-implement, in this case – lifting machine, a hydraulic link – centrifugal hydraulic coupling is inserted, due to which, depending on the degree of filling of the hydraulic coupling with working fluid, it is possible to obtain different values of lifting speed – from zero to maximum.

Kazakovskiy D.A. To the issue of protection of structures from the harmful effect of underground mining at coal and shale deposits with unstudied character of rock displacement. Proceedings of the Mining institute. 1952. Vol. 26(1), p. 83-102. https://pmi.spmi.ru/pmi/article/view/14196

Abstract. Until now, at newly developed fields and at operating fields with unstudied character of rock displacement the calculation of safety pillars in accordance with the recommendation of the “Rules of technical operation of mines” was made by analogy with other more or less studied fields. However, there were no guidelines for the selection of analogous deposits, which could not but lead to the wrong choice of parameters for the calculation of safety pillars. At present it is possible to give some guidelines for the selection of analogue deposits on the basis of the accumulated actual data. These guidelines can be used in the calculation of pillars during the design of mines and in operating fields with unstudied character of rock shear. They can also be useful in the calculation of profile lines of observation stations.

Shklyarsky F.N. To the issue of dynamic braking in application to mine hoisting with asynchronous drive. Proceedings of the Mining institute. 1952. Vol. 26(1), p. 3-9. https://pmi.spmi.ru/pmi/article/view/14190

Abstract. In practice, it may be necessary to lower people down the shaft at a reduced speed compared to the full speed of lifting the load. This makes it necessary to apply braking operations, which in practice are often carried out with the help of mechanical brake. However, prolonged operation of the mechanical brake is accompanied by undesirable phenomena: excessive heating and wear of brake pads, which necessitates the use of cooling devices and frequent replacement of worn pads with new ones. These disadvantages are deprived of electric braking systems, of which in the considered case can be applied both brak-

ing by countercurrent (counteracting) and dynamic braking. For the possibility of realization of the countercurrent mode the lifting unit should be equipped with a load rheostat, which in comparison with the usual starting rheostat should be designed for a longer operation. In addition, this rheostat should have additional sections with correspondingly increased resistance for the possibility of obtaining small braking moments. The main disadvantage of countercurrent braking is its inefficiency, due to the significant consumption of energy from the network. As it is known, the power consumed in the countercurrent mode from the network depends on the value of the braking torque and synchronous speed and does not depend on the actual speed of descent. The power consumed in this case from the mains is in inverse dependence on the rate of descent.

Shklyarsky F.N. Electrical scheme of a hoisting installation with an asynchronous drive. Proceedings of the Mining institute. 1952. Vol. 27(1), p. 59-65. https://pmi.spmi.ru/pmi/article/view/14226

Abstract. For proper functioning of the lifting unit, it must first of all be ensured that the main bearings are properly lubricated by means of two oil pumps, one of which is a working one and the other is a spare. Control of oil pumps is made by means of oil pump switch. After closing the circuit of the 1RP coil its 1RP contact will close and thus overlap the open contact KK-0, which is open at working positions of the command-controller, providing closing of the circuit of the 1RP coil until this circuit will not be broken by the ZVK limit switch, which is opened at the end of lifting by the corresponding cage. When the circuit of the coil of the 1RP relay is closed, the contact of the 1RP relay located in the circuit of the coils of the reversing contactors B and I will be closed.

Borisov A.A. To determination of the load on the support of horizontal excavations during the development of coal deposits. Proceedings of the Mining institute. 1955. Vol. 30(1), p. 85-103. https://pmi.spmi.ru/pmi/article/view/15002

Abstract. The task of determining the strength dimensions of horizontal excavation support elements constantly arises both in the course of field operation and during design. Its correct solution largely determines the safety, efficiency and continuity of operations. The variety of conditions, in which the mine workings pass, does not allow to determine the load on the support in a general case. Let's consider the issue of roof pressure on the support of a horizontal excavation made in hard layered rocks, secured by a frame support with a straight top. The layered medium, each layer of which is a plate with terminated edges, is a multiple statically indeterminable system, and the solution of the problem of the pressure of this medium on the support by conventional methods has long been considered unfeasible. The method of solving this problem was first proposed by V.D. Slesarev in 1939 and named by him the sliding excavation method [9, 10]. Later, the sliding excavation method was applied by A.P. German [2], G. N. Kuznetsov [5] and others. The proposed work is devoted to further development and specification of the considered processes. The following description of the deformation and fracture processes of the roof rocks, of course, does not exhaust the issue and is somewhat schematic.

Fig. 1. Model of a man engine or mobile ladder is a mechanism of reciprocating ladders and stationary platforms installed in mines to assist the miners. 1830-s. Scale 1:16. Item belongs to the Mining Museum.

Ponomareva V.A. On the dynamic coefficient in the calculation of rigid reinforcement of mine shafts. Proceedings of the Mining institute. 1958. Vol. 36(1), p. 213-222. https://pmi.spmi.ru/pmi/article/view/13063

Abstract. In the practice of mine shaft reinforcement design until the present time, the calculation of reinforcement elements is carried out according to the standards based on the “Prussian rules of ascent and descent of people” from 6/1V 1925, despite the fact that the shortcomings of this methodology has been repeatedly noted in our literature. Thus, in 1934, P.L. Lazovsky drew attention to the fact that due to the elasticity of conductors the load is distributed unevenly between the dividers and gave a solution to the problem of load distribution between the dividers taking into account the elasticity of conductors.

Zimina E.A. New direction in drilling and blasting operations during sinking of vertical shafts of mines. Proceedings of the Mining institute. 1960. Vol. 43(1), p. 81-86. https://pmi.spmi.ru/pmi/article/view/12818

Abstract. A large amount of work in the construction of mines, as is known, falls on mining operations, and the greatest complexity and labor intensity is the conduct of vertical shafts. In recent years, a lot of new machines, mechanisms and different types of equipment have been created, which allowed to significantly increase the rate of mining excavations, in particular vertical shafts. So, according to D.I. Maliovanov, in the coal industry with an increase in the volume of sinking vertical shafts from 5,958 meters in 1946 to 20,724 meters in 1956, the level of mechanization of rock loading increased from 2.3 % in 1948 to 87.4 % in 1956. Maximum rates of sinking vertical shafts increased from 69.4 m in 1946 to 202.1 m in 1955, 241.1 m in 1957 and 264.6 m in 1959.

Borisov D.F. On the choice of the optimal position of the trunk on transportation. Proceedings of the Mining institute. 1960. Vol. 42(1), p. 3-14. https://pmi.spmi.ru/pmi/article/view/12823

Abstract. In the theory of designing coal mines, more than 30 works, mainly performed during the last 30-35 years, are devoted to determining the location of shafts under the conditions of cargo transportation. A large number of engineering, technical and scientific workers were engaged in solving this problem. Some researchers considerably extended the problem of shaft location determination, including underground and surface coal transportation, delivery of rock, people, equipment, as well as ventilation, driving of overhangs (in case of shafts position outside the suite), losses in pillars, and thus turned it into a typical method of variants, solved by graphical or tabular comparison. During the famous discussion on the application of the analytical method in mining, held by the Mining Journal in 1949, this issue also attracted attention. At the same time, some participants of the discussion questioned the correctness of the existing methodology for determining the location of the shaft according to the conditions of transportation.

Ivanov A.I. High-frequency communication from a moving mine lifting vessel. Proceedings of the Mining institute. 1961. Vol. 45(1), p. 84-88. https://pmi.spmi.ru/pmi/article/view/12690

Abstract. Operational work of a modern coal mine depends to a large extent on properly and quickly functioning production communication. The existing at the mine mechanical and electrical systems; shaft signaling between the receiving platforms and machine room, although reliable in operation, but can not fully meet all the requirements for the operation of the lift. So, for example, at any accident connected with jamming of the cage in the shaft, when it is necessary to signal directly from the cage, it is necessary to use imperfect and inconvenient traction signal. It is even less convenient to use such signalization during works in the shaft (inspection and repair of guides, shaft fixing, cable laying, etc.) associated with frequent stops and movements of the lifting vessel (cage or skip) for short distances.

Khokhlov N.A., Ushakov K.Z. Influence of cage movement on aerodynamic resistance of mine shafts. Proceedings of the Mining institute. 1965. Vol. 50(1), p. 3-12. https://pmi.spmi.ru/pmi/article/view/12457

Abstract. It is known that the movement of vessels (cages and skips) in mine shafts increases the resistance. According to the observations of A.M. Karpov, the resistance increases up to 10 % at average intensity of work and up to 25 % at intensive work, when increased turbulization of the flow is maintained during short pauses. In narrow boreholes the resistance can increase up to 50 %.

Proskuryakov E.M. Asynchronous valve cascade for mine hoist drive. Proceedings of the Mining institute. 1966. Vol. 53(1), p. 3-10. https://pmi.spmi.ru/pmi/article/view/12160

Abstract. The asynchronous drive for mine hoisting systems is widely used due to the simplicity of the system and low capital costs. However, its regulating qualities and economic indicators are low. Application of asynchronous valve cascade for mine hoisting drive can improve the regulating qualities of the drive.

Factorovich A.M. Conveyor transportation along vertical mine shafts. Proceedings of the Mining institute. 1967. Vol. 54(1), p. 13-17. https://pmi.spmi.ru/pmi/article/view/12002

Abstract. One of the progressive directions in the development of mechanization and automation of mine transport is the complete conveyorization of transport from the loading face to the bunkers on the surface. However, it is difficult to carry out complete conveyorization, because for one link of the transport scheme – along vertical shafts – there has not yet been developed a sufficiently economical and reliable method of conveyor transport.

Putikov O.F. Accumulation of radioactive emanation in a cylindrical mine workings. Proceedings of the Mining institute. 1969. Vol. 56(2), p. 113-121. https://pmi.spmi.ru/pmi/article/view/12238

Abstract. The calculation of the concentration of emanation in a mine workings traversed in radioactive rocks is of interest for mining and radiometric work. For example, let there be two environments – an active space A and a cylindrical mine workings B of diameter 2a. Space A is characterized by apparent diffusion coefficient D1 and porosity coefficient n1, space B – by apparent diffusion coefficient D and porosity coefficient n.

Burstein L.P. Impact bending tests of rocks. Proceedings of the Mining institute. 1969. Vol. 57(1), p. 35-45. https://pmi.spmi.ru/pmi/article/view/12207

Abstract. In all real bodies deformation processes occur in time. Mechanical characteristics, which do not take into account time, are approximate and in many cases are insufficient. Such factors as the rate and duration of loading, the energy accumulated by the system have a great influence on the value of the destructive stress. A great deal of work has been done in LMI to establish the physical features of the process of rock fracture by shock loading and to find out the comparative efficiency of static and dynamic methods of fracture. As a result, it was found that the fracture energy, other things being equal, is a function of impact energy, impact load application rate, and mass of the striking body. As for the comparison of energy expenditure in static and impact tests, it is permissible only at a comparable degree of fractionation, i.e. at some minimum impact work.

Klich A. New directions in the design and research of lifting vessel parachutes in Poland. Proceedings of the Mining institute. 1970. Vol. 60(1), p. 146-158. https://pmi.spmi.ru/pmi/article/view/11939

Abstract. Mine regulations of many countries contain requirements, according to which single-channel hoists, designed for the descent of workers, must be equipped with parachutes of lifting vessels. Unfortunately, the existing parachutes do not fulfill their main task, which is to brake or stop the falling stand (skip) without fail in case of rope breakage or unhooking.

Denegin V.V., Sipiagina V.G. Self-propelled cage for Koelga quarry. Proceedings of the Mining institute. 1970. Vol. 60(1), p. 200. https://pmi.spmi.ru/pmi/article/view/11946

Abstract. The basic scheme (figure) was developed and the working project of the experimental sample of self-propelled stand for Koyelgine marble quarry was made at the LMI.

Protosenya A.G. Determination of the dimensions of the inelastic deformation area around a fixed excavation subjected to support pressure. Proceedings of the Mining institute. 1972. Vol. 61(1), p. 69-75. https://pmi.spmi.ru/pmi/article/view/11788

Abstract. The magnitude of rock outcrops, the load on the support of mine workings, and the displacement of their contours are determined mainly by the size of the inelastic deformation area formed in the rock mass surrounding the workings. In the practice of maintenance, the majority of preparatory mine workings are influenced by the support pressure, and there are no calculation methods for assessing this influence on the size of the inelastic deformation area.

Bogacheva A.F. On the nomenclature of rock mass reserves in a quarry. Proceedings of the Mining institute. 1972. Vol. 63(1), p. 36-38. https://pmi.spmi.ru/pmi/article/view/11732

Abstract. In the existing classifications there is a large number of categories of mineral reserves by preparedness (opened, prepared, ready for excavation, in clean-up, in pillars, flooded, etc.) and absolutely no division into categories by preparedness for excavation of waste rock. To eliminate uncertainty in the interpretation of the role of reserves in the operation of the quarry and justify the number and nomenclature of categories of reserves, consider the quarry as a system with all its interacting links.

Zimina E.A., Tarasenko E.N. Photoelastic study of the influence of irregularities in the rock contour of horizontal excavations on the stress state of the contour zone of the rock massif. Proceedings of the Mining institute. 1974. Vol. 64(1), p. 46-54. https://pmi.spmi.ru/pmi/article/view/11584

Abstract. Currently, there is a considerable experience of experimental and theoretical studies on the distribution of stresses around excavations of different cross-sectional shape. Most of these studies have been conducted in relation to workings with a smooth contour, however, it is known that the drilling and blasting method of tunneling produces an uneven contour of the excavation. Formed in this technological irregularities, and such occurring in some cases rock dumps cause redistribution of stresses with the formation of zones of increased concentration. In full-scale conditions to determine the magnitude of stress concentration in these zones is difficult. Therefore, studies are usually carried out on models.

Bersenev V.S., Morozov V.I. Raking work. Proceedings of the Mining institute. 1975. Vol. 69(1), p. 43-46. https://pmi.spmi.ru/pmi/article/view/11344

Abstract. As the initial position of the rowing-rotor actuator operation we assume the scheme of its operation without lifting the rotor axis. We consider that the work of the rotor gravity force is fully used for the work of introduction of combs into the stack. The trajectory of a tooth of a comb in this case is a circle.

Kersky E.K. Strain-measuring shoes for dynamic control of reinforcement of vertical mine shafts. Proceedings of the Mining institute. 1975. Vol. 68(1), p. 45-48. https://pmi.spmi.ru/pmi/article/view/11390

Abstract. With the increase in the mining industry specific weight of deep vertical mine shafts and the corresponding increase in the speed of movement of lifting vessels and their lifting capacity conductors became subject to dangerous shock loads associated with the interaction of the lifting vessel with the reinforcement of the shaft.

Kersky E.K. Automatic control of measuring equipment at dynamic control of reinforcement of vertical mine shafts. Proceedings of the Mining institute. 1975. Vol. 68(1), p. 81-83. https://pmi.spmi.ru/pmi/article/view/11398

Abstract. The presence of people on the cargo lifting vessel moving at high speed, especially on the skip, is prohibited by safety regulations.

Suglobov P.N. Calculation of inter-chamber pillar cuts using the beam-slab method on an elastic base. Proceedings of the Mining institute. 1980. Vol. 82, p. 16-22. https://pmi.spmi.ru/pmi/article/view/11000

Abstract. The technology of field development with hardened backfill systems involves replacing the natural support of the overlying rock strata with an artificially constructed backfill mass in the excavated space. Since the stiffness of the backfill in most cases is much lower than the stiffness of the extracted rocks, the deformations of the supported rock strata will constantly increase as the mining operations progress.

Tolstunov P.A. Calculation of near-track pillars. Proceedings of the Mining institute. 1980. Vol. 82, p. 60-66. https://pmi.spmi.ru/pmi/article/view/11008

Abstract. Mine and laboratory studies by the method of volumetric models have established that the operation of the main roof is to some extent similar to the operation of thin slabs. In general, the main roof in the mode of its steady-state motion is a cantilever plate on an elastic base, which rests on the coal massif in front of the face and near-shot pillars.

Skrypka V.P. Calculation of the stress-strain state of virgin rock – roof – soil systems by the finite element method. Proceedings of the Mining institute. 1980. Vol. 82, p. 91-95. https://pmi.spmi.ru/pmi/article/view/11013

Abstract. During the development of deposits by chamber and chamber-pillar systems one of the urgent tasks is to determine the stability of the elements of the pillar-roof-soil (PRS) systems taking into account their external outlines, real structure and properties of the rocks composing them.

Lomakin E.A. Hydrogeological studies in connection with the protection of mined aquifers. Proceedings of the Mining institute. 1980. Vol. 80, p. 82-88. https://pmi.spmi.ru/pmi/article/view/11034

Abstract. At present, significant mineral reserves in the subsurface are preserved in safety pillars under water bodies – surface water bodies and watercourses, and thick aquifers.

Greenberg Ya.P. Study on the electrodynamic model of optimal parameters of asynchronous motors of mining harvesters. Proceedings of the Mining institute. 1982. Vol. 94, p. 108-113. https://pmi.spmi.ru/pmi/article/view/10768

Abstract. Asynchronous electric motors of mining combines work under conditions of sharply variable loads, the parameters of which can be written off only by methods of random functions.

Dmitriev P.H. Peculiarities of pillarless development of convergent formations. Proceedings of the Mining institute. 1990. Vol. 123, p. 37-40. https://pmi.spmi.ru/pmi/article/view/10202

Abstract. Coal seam mining at Raspadskaya mine is characterized by a number of essential features that should be taken into account when planning and conducting cleaning works: simultaneous mining of a suite of six converging seams with a thickness from 1.8 to 4.5 m, relatively shallow depth of cleaning works, regular order of cutting of mining pillars.

Dolgiy I.V. Maintaining formation horizontal mine workings during pillarless mining of formations. Proceedings of the Mining institute. 1990. Vol. 123, p. 61-65. https://pmi.spmi.ru/pmi/article/view/10207

Abstract. With increasing depth of work, the stresses in the intact massif increase in proportion to the depth of development, while the strength of the host rocks grows insignificantly. When a certain limiting depth is reached, the ratio of the mass of the covering column to the uniaxial compression strength of the rocks becomes greater than unity, i.e. the stresses exceed the rock strength limit. In this regard, large areas in the vicinity of the excavation pass into the limit state and plastic deformation of rocks begins to appear.

Emelyanov A.P., Sleptsova Z.B., Nefedova N.V., Agamirzov P.S. Experimental studies of adjustable asynchronous electric drive for exploration drilling machines. Proceedings of the Mining institute. 1991. Vol. 128, p. 114-120. https://pmi.spmi.ru/pmi/article/view/10146

Abstract. The development of theory and practice of adjustable AC electric drives on the basis of valve frequency converters contributes in recent years to the widespread introduction of such drives in various industries. The application of the regulated asynchronous electric drive on the system of IF-AD for machines of geological exploration drilling is progressive in all technically developed countries at the stage of research, experiments and creation of pilot samples.

Fig. 2. Model of a lifting facility in mines equipped with a water wheel. Freiberg mines. Germany. 1830-s. Scale 1:20. Item belongs to the Mining Museum.

Abramovich B.N., Kozyaruk A.E., Proskuryakov R.M., Rudakov V.V., Shonin O.B. Problems of creating electrical complexes for the mining and oil and gas industry. Journal of Mining Institute. 2001. Vol. 147, p. 112-127. https://pmi.spmi.ru/pmi/article/view/9771

Abstract. In the article, the main directions of the 2000 research in the field of creating electrical complexes for mining oil gas industries are considered. They are: the application of non-contact regulated power drive with control algorithms for mining machines and mechanisms; ensuring higher productivity and energy saving development of electrical technologies and special technical means for mining operations development of automated electrical complexes and systems based on the introduction of microprocessor technology; design, development and implementation of computer technology and automated control of energy consumption and adaptation of new types of electrical equipment, ensuring increased reliability and efficiency of electrical complexes; development and implementation of the concept and algorithms of usage management in oil production complexes; development of automatic control system of multifunctional resonant angle transducers with motion of different frequency and amplitude; application of methods of direct electrotechnology, based on electromechanical transfer of electric field energy in the rock proper to obtain technological effect development of electrical complexes of automatic and automated systems, which can be designed and developed as autonomous systems of different purposes.

Vakhrameev Y.S., Tverdokhlebov P.Y., Linnik A.V., Skorkin N.A. On numerical simulation of stationary and non-stationary processes in fractured rocks. Journal of Mining Institute. 2001. Vol. 148(1), p. 90-93. https://pmi.spmi.ru/pmi/article/view/9721

Abstract. The problems of numerical modeling of the behavior of fractured (non-cohesive) continuous media are related to the development of mining technologies (mainly, explosions on discharge), the study of landslide processes, as well as the phenomena established in seismically hazardous zones. The energy of deformation of unbound media is spent on overcoming internal friction and loosening. The description of irreversible deformations in non-cohesive media on the basis of physical models with constants included in them is possible if these constants are determined in laboratory or field experiments. In laboratory tests of specimens, it is not always possible to establish these constants directly, therefore, it is necessary to carry out additional calculations simulating test conditions.

Kolosova O.V. Selection of rational schemes for opening deep horizons of mines JSC Sevuralboksitruda in conditions of shock hazard. Journal of Mining Institute. 2002. Vol. 150(1), p. 68-71. https://pmi.spmi.ru/pmi/article/view/9531

Abstract. The development of the mining industry is associated with the development of deposits at great depths in difficult mining and geological conditions. A number of large Russian mining companies have already reached deposit development depths of 1000-1500 m, the depth of the projected Severouralsk mines is 1500-2500 m. For deep mines, an important problem is the choice of the optimal option for the penetration and transportation of minerals to the surface. In work three variants of opening of deep horizons of mine “Red Riding Hood” of JSC “Sevuralboksitruda” are considered: opening of deep horizons with deepening of existing vertical shafts, the stage scheme of opening

by slopes with a base horizon -860 m, the stage scheme of opening by blind vertical shafts with base horizon -860 m and a device of underground head frames. Technical and economic evaluation of the most rational options was carried out. Analysis of results showed that the volume of capital mining works on a variant with opening by blind gradients is more on 17120 m^3 at cost of excavation on a surface of 1 m^3 rock, including general expenses of a mine, 2350 rubles. The second variant in the approximate cost expression will exceed the third in the sum 40232000 rubles. The received sum is approximately one third of annual financing of mining-capital works for "Sevuralboksitruda". Consequently, according to technical and economic indicators it is expedient to open deep horizons according to the step-by-step scheme by blind vertical shafts with the base horizon -860 m and the device of underground headframes.

Anisimov I.Y. A method for calculating the parameters of anchorage on the basis of solutions of spatial problems of the theory of elasticity. Journal of Mining Institute. 2002. Vol. 152, p. 118-120. https://pmi.spmi.ru/pmi/article/view/9345

Abstract. A three-dimensional model of the rock mass, secured by anchor support, was created. The analysis of changes in the volumetric stress-strain state of the rock mass due to the installation of anchoring was carried out. On the basis of the spatial model, a method for calculating the parameters of bolting has been developed. Volumetric stress-strain state components were found from solving spatial problems of the theory of elasticity. The results of the study of stress distribution in the rock mass allowed us to identify areas with different degrees of hardening, to establish the boundaries of the unstrengthened zone and the area of softening. The following parameters are sequentially determined in the calculation: the stress state around a single anchor and the area of its influence; the number of mutually affecting anchors; the stress state caused by the tension of a system of mutually affecting anchors; the initial stress state around an unanchored work; the resulting stress field; hardening ratios in the anchored area; distribution of the hardening ratio; the hardening degree and effectiveness of the anchor support. Optimization of the parameters of bolting may result in a significant economic effect due to the increase of the lifetime of the workings and reduction of the costs of installing anchors.

Kononova N. S., Demenkov P. A. Development of methods for calculating average loads on cylindrical shaft support. Journal of Mining Institute. 2002. Vol. 150(1), p. 72-74. https://pmi.spmi.ru/pmi/article/view/9532

Abstract. Field observations show that the distribution of stresses around mine workings is uneven both in transverse and longitudinal directions. To take into account this distribution of stresses, we consider the interaction of the mine support with the surrounding rock massif. The roof support is considered as an elastic long closed cylindrical shell. The load acting on the shoring changes irregularly both along the shell and in the transverse direction: $P = P(x, \Theta)$, where x is the distance along the generatrix expressed in fractions of the radius; Θ is the central angle expressed in radians. Then, two cases can be considered:

- the support is under the action of axisymmetric radial load depending only on one variable x,
- the support is subjected to load depending only on the angle Θ.

The solution of the problem for the load of the form $P = P(x, \Theta)$, is obtained by summing up these two solutions.

Let's estimate average loads on a roof support for typical conditions of shaft construction in the elastic mode of interaction: $R_0 = 3.0$; $R_1 = 3.5$ m; $R = 3.25$ m; $h = 0.5$ m; $v_1 = 0.25$; $l = 0$; $v = 0.25$; $E_1 = 2 \times 104$ MPa; $E = 2 \times 10^4$ MPa. Thus, when modeling vertical shaft support by a closed cylindrical shell the calculated average load is three times less than the corresponding value for a flat problem.

Bochkarev V.A. Improvement of prospecting and exploration methods and prerequisites for hydrocarbon reservoirs in organogenic structures of the Upper Devonian of the Umitov-Lenevskaya depression and adjacent areas. 2002. Journal of Mining Institute. Vol. 151, p. 6-9. https://pmi.spmi.ru/pmi/article/view/9406

Abstract. A justification is given for the most effective direction of geological exploration work – search and exploration of new oil deposits in Upper Devonian reefs, which will allow to fill the raw material base in the old oil-producing area in the north of the Volgograd region. Prognostication, search and exploration of oil and gas deposits in carbonate sediments are determined by the specificity of lithologic-facial composition and physical properties of reservoir rocks and coverings, paleogeographic setting of their accumulation, conditions of realization of oil-gas-maternal potential of Devonian deposits, structural conditions of their occurrence and specific features of formation in them hydrocarbon (HC) deposits. The three-member structure of hydrocarbon deposits in fossil reefs has been established and the role of the false cover (Umetovsko-Linevskaya strata) in the formation and destruction of hydrocarbon deposits in the Evlanovsko-Livensky carbonate sediments has been determined. When predicting the location of the reef and the oil deposit in it with the calculated parameters in terms of area and height, the methodology proposed by the author, based on the analysis of the structural surface of the roof of the Umentov-Linevskaya formation (false cap), was used. On the basis of the studies conducted, the areas of the Dobrinsky-Suvodsky barrier riffogenic system of the Upper Devonian complex of carbonate rocks and the inner zones of the Umetovsko-Linevskaya depression are referred to highly promising lands.

Reznikov E.P. Improvement of deep vertical shaft reinforcement. Journal of Mining Institute. 2003. Vol. 155(1), p. 132-134. https://pmi.spmi.ru/pmi/article/view/9087

Abstract. The advantages and disadvantages of rigid reinforcements are discussed, the main parameters of rope reinforcements and an example of the use of cage shaft rope reinforcement are given. In addition, the design and materials of reinforcements used for sinking deep vertical shafts are listed. The areas of application of reinforcements, conditions of their expedient use in specific conditions and ways of their improvement are determined. The schemes of mutual arrangement of conductors and lifting vessels of rigid reinforcement are given.

Nuss S.V. Analysis of electromechanical coupling in electric drive by asynchronous valve cascade system of mine hoisting unit. Journal of Mining Institute. 2003. Vol. 155(2), p. 116-119. https://pmi.spmi.ru/pmi/article/view/9025

Abstract. The paper focuses on the research methodology of electromechanical system with elastic coupling of the mine hoisting unit and electric drive according to the asynchronous valve cascade system. An analysis of dynamic properties and electromechanical coupling as applied to the skip hoisting unit equipped with an electric drive based on the asynchronous valve cascade system is carried out. An expression for determining the electromechanical coupling coefficient is obtained and the results are given for a particular installation.

Karasev M.A. Stress-strain state of the pillar-mass system around the RAW chambers. Journal of Mining Institute. 2004. Vol. 156, p. 60-62. https://pmi.spmi.ru/pmi/article/view/8925

Abstract. The distribution of temperature and rock pressure stresses with regard to the temperature factor around underground radioactive waste (RAW) repositories in the underground space is considered. The geological formations taken are blue clays deposited in the Northwest region of Russia. The problem is solved by the finite element method. Influence of a temperature factor on the stress-strain state of the support-mass system was found out. The surface elevation from the temperature in the RAW chambers has been established. The analysis of the influence of the RAW chambers on each other has been made. The patterns of horizontal and vertical stresses distribution along the chamber axis were found.

Ushakov L.S., Kotylev Y.E., Kravchenko V.A., Yurev D.A. Dynamic rock destruction machine systems. Journal of Mining Institute. 2004. Vol. 157, p. 73-75. https://pmi.spmi.ru/pmi/article/view/8879

Abstract. The percussive method of rock destruction makes it possible to expand the field of application of machine technologies when carrying out mine workings over strong rocks. The designs of high-capacity manipulator percussion devices have been developed, bench and mine tests have been carried out. Currently, work is underway to create a clearing machine for extracting construction materials and minerals in quarries.

Reznikov E.P. Improvement of deep borehole construction technology by drilling and blasting. Journal of Mining Institute. 2004. Vol. 159(1), p. 86-88. https://pmi.spmi.ru/pmi/article/view/8724

Abstract. The analysis of the current state of construction of deep vertical shafts and the technology of their equipment is presented. The issues of improving the drilling and blasting complex on the example of smooth contour blasting and the calculation of the effectiveness of this method compared with conventional. The carried out researches allowed to make suggestions on improvement of the technology of shaft construction by means of drilling and blasting.

Volkov D.V. Asynchronous frequency-controlled drive of a mine electric locomotive. Journal of Mining Institute. 2004. Vol. 159(2), p. 78-81. https://pmi.spmi.ru/pmi/article/view/8674

Abstract. The results of asynchronous drive development for mine electric locomotive are presented: selection and construction of traction motors characteristics, a variant of electric drive power part and control system structure. Application of individual frequency converters for each motor is justified. Drive control system forms mechanical characteristic, soft in the area of medium and increased loads with limitation of maximum traction force and hard at low and negative loads with automatic speed limitation and load equalization between traction motors. Circuit diagrams of power converters and the control system using a programmable microcontroller have been developed. Mathematical modeling of the drive using MATLAB system was performed, the results of which confirm the performance of the proposed control system structure.

Gendler P.G. Thermophysical aspects of safety and efficiency in mining and operation of underground facilities in harsh climatic conditions. Proceedings of the Mining institute. 2006. Vol. 168(3), p. 64-67. https://pmi.spmi.ru/pmi/article/view/7910

Abstract. Severe climate and the permafrost rocks characterize almost 2/3 terrains of Russia. Considerable temperature of atmospheric air amplitude oscillation equal 70-100 °C determines alternating-sign nature of the heat and mass-transfer in workings. These processes influence on many aspects of the safety and efficiency of mining and underground operations. In the paper, characteristics of mine air and rock massif thermodynamic parameters influence human health and labor productivity, dustiness of air, stability of ricks, formation of ice coatings, ventilation and etc. are given. The difference in the principles of regulation of the thermal working regime in permafrost rocks and at high rock temperature heating is marked. The analysis of the control of the thermal regime of railway tunnels is described. The contribution of the mining faculty scientists and graduates to elaboration of thermal basis of both safety and efficiency of mining and the operation of underground structures is marked.

Martemyanov G.A., Ochkurov V.I., Maksimov A.B., Petrov D.N. Deformation of ore massif around mine workings. Proceedings of the Mining institute. 2006. Vol. 168(3), p. 196-202. https://pmi.spmi.ru/pmi/article/view/7934

Abstract. The nature of deformations around the excavation supported by KMP-A3 in weak and dense martite ore with iron and mica inclusions is different. The displacements of the dense strata are characterized by time-dependent oscillating deformations. The majority of displacements occur in 10-80 days. The size of the deformed zone in the strata in the ledge wall is (1.2-1.3)R_{up}, in the roof it is (1.0-1.1)R_{up}, in the top wall it is (1.3-1.4)R_{up}. The edge zone (0.8-1.5 m) is inclined to break. Stabilization of displacements in the weak and dense are strata was not observed.

Potemkin D.A., Plaschinsky V.F. Parameters of the stress field in the ore-crystalline massif before the start of mining operations. Proceedings of the Mining institute. 2006. Vol. 168(3), p. 123-126. https://pmi.spmi.ru/pmi/article/view/7922

Abstract. Numerical modeling of a stress-strain state of the ore-crystalline mass prior to the beginning of mining operations is carried out. The calculated values of regularities of formation of stress field of a virgin ground are given. The stress distribution in the ore-crystalline mass is established, that, including ore and rocks with different physical and mechanical properties (the difference is up to two orders of magnitude), essentially differs from the distribution according to Dinnic.

Fig 3. Model of a self-supporting dome. Rubble protection for roadway of soft rocks. Freiberg, Germany, 1820-s. Item belongs to the Mining Museum.

Urmazov A.A. Computer modeling and determination of rational parameters of non-shooting reinforcement of vertical shafts. Journal of Mining Institute. 2006. Vol. 167(2), p. 261-264. https://pmi.spmi.ru/pmi/article/view/8019

Abstract. The article deals with computer modeling of rigid reinforcement in vertical shafts of various structures. Finite element models of typical multilink reinforcement (on the example of typical scheme K-2 of the design institute Yuzhgiproshakht), cantilever, cantilever-joint and block reinforcement schemes are constructed. As a result of the conducted research it has been established that slope-free reinforcement schemes with a significant reduction in the number of metal components provide the same and even higher hardness than typical structures. The areas of application and rational parameters of non-braced schemes of reinforcement used in cage and skip shafts with different intensity of hoisting are determined.

Egorov D.G. Advantages of drilling out cylindrical stone products at quarries and methods of their separation from the rock massif. Journal of Mining Institute. 2006. Vol. 167(1), p. 10-12. https://pmi.spmi.ru/pmi/article/view/8048

Abstract. Manufacturing of large-sized cylindrical blanks from stone slabs with the use of drilling equipment and tools is currently used in the production of a number of technical products. Further improvement of technical and technical means of drilling is the need to use them directly at stone quarries with the possibility of separation from the rock massif, extraction from the borehole, stacking and transportation on specially equipped vehicles.

Chumak V.K., Naumenko A.I. Sonic location method of mine shaft sinking control by drilling. Journal of Mining Institute. 2007. Vol. 172, p. 175-177. https://pmi.spmi.ru/pmi/article/view/7643

Abstract. The paper deals with the development of sounders for surveying vertical shafts filled with drilling mud. The experience of implementation of sonic borescope surveying is given.

Mugalimova A.R. Energy saving compensated asynchronous motors and electric drives on their basis. Journal of Mining Institute. 2008. Vol. 174, p. 129-131. https://pmi.spmi.ru/pmi/article/view/7505

Abstract. Conventional induction motors have the electric efficiency of $\eta = 0.85 \div 0.94$, $\cos\varphi = 0.7 \div 0.85$ and the energy efficiency of $\eta_{en} = \eta \times \cos\varphi = 0.6 \div 0.8$. The proposed power saving compensated induction motors is characterized with higher energy indices of $\eta_n = 0.85 \div 0/94$, $\cos\varphi_n = 1.0$, $\eta_{en} = \eta_n \cos\varphi_n = 0.85 \div 0.94$.

Sergeyev R.V. Engineering and geological support of vertical shaft sinking operations. Proceedings of the Mining institute. 2008. Vol. 176, p. 187-190. https://pmi.spmi.ru/pmi/article/view/7312

Abstract. The results of geotechnical support of vertical shaft construction are described. The study was performed in regional zones of tectonic dislocation at a depth of 1200 m, in saline rocks at a depth of 540 m and in sedimentary frozen rocks with a thickness of 620 m. The method has been tested for 30 years. It ensures greater safety of vertical shaft construction and operation.

Gavrilov S.V. Development of technology for construction of sidetracks with horizontal sections under the condition of preservation of the old wellbore and existing production from it. Justification of economic feasibility of drilling of sidetracks with horizontal sect. Journal of Mining Institute. 2008. Vol. 174, p. 60-62. https://pmi.spmi.ru/pmi/article/view/7483

Abstract. The practice of new oil and gas field development often shows that the real oil-drainage boundary is larger than supposed one. On account of this the special zones are fixed in the area of oil field that are not in the area of drainage usually. The similar situation is considered by the example of oil field in Western Siberia. It was suggested to develop the area of field that was not covered with well spacing by means of construction of two lateral branches with horizontal sections instead of four deviated wells to solve this problem. The drilling technology of lateral branches and technology of tailing-in are considered by stages. A review of equipment that is used in drilling of lateral branches and in completion of wells with branch holes is given. The economical expediency of project realization of lateral branches construction.

Kotikov D.A. Justification of reliability of cantilever-channel reinforcement of deep shafts. Proceedings of the Mining institute. 2009. Vol. 181, p. 89-92. https://pmi.spmi.ru/pmi/article/view/7037

Abstract. A possibility of combined operation of the rope and cantilever armor of shaft is studied. A device is offered to secure their combined operation. Calculation dependences are given to assess stresses in the device elements, as well as graphical dependences to select the sizes of these elements.

Zhurov D.E. Skip shaft reconstruction at the Uzelginsky Ore Mine. Journal of Mining Institute. 2009. Vol. 181, p. 86-88. https://pmi.spmi.ru/pmi/article/view/7036

Abstract. The paper discusses the details of the draft plan for skip shaft reconstruction at the Uzelginsky Ore Mine. The methods of loading chamber construction at –340 m horizon and improvement of the shaft lining at the construction level are described in detail.

Protosenya A.G., Petrov D.N., Popov M.G. Modeling of the volumetric stress-strain condition of the rock massive in the near mine which are crossing zone of weakening. Journal of Mining Institute. 2010. Vol. 188, p. 127-132. https://pmi.spmi.ru/pmi/article/view/6596

Abstract. According to geological data which was received at the Yakovlevsky deposit, the volumetric model was developed. This model taking into consideration the driving of the mine through zone of weakening. During the analysis of the stress-strain condition near the mine the character of distribution and numerical results of tangential and longitudinal stresses have been revealed. The zone of weakening affects to the distribution of stresses and displacements around the mine. To select the parameters of the lining support it is necessary to take into consideration weakenings and contacts in the ore massive and the distance for these zones.

Dolgii I.E., Kotikov D.A. Estimation of stresses in system 'massive – support – shaft drift' at dynamic loadings. Journal of Mining Institute. 2010. Vol. 186, p. 104-106. https://pmi.spmi.ru/pmi/article/view/6720

Abstract. In the article the question of dynamic influence on shaft drift a moving vessel is considered. Dependences of pressure in system 'massive – support – shaft drift' from various in a direction and value of the loadings received by means of a method of final elements are resulted.

Levit V.V., Borshchevskii S.V. Geologo-geomechanical developments of structures of deep vertical shafts at coal mines in Donbass. Journal of Mining Institute. 2010. Vol. 188, p. 74-78. https://pmi.spmi.ru/pmi/article/view/6584

Abstract. The litho-geomechanical trend of conditions for strengthening the vertical shafts of collieries which coordinates and unites the litho-geomechanical and mining factors into a system has been developed.

Zvezdkin V.A., Karenin V.N., Anokhin A.G. Providing of safe conditions for mining of shaftbottom protective pillars in deep ore mines at Talnakh. Journal of Mining Institute, 2011. Vol. 190, p. 101-104. https://pmi.spmi.ru/pmi/article/view/6432

Abstract. Consideration is given to the causes complicating the mining of shaftbottom pillar and protection of shaft lining. The analysis is given of the formation of stress-strain state of the protective pillar and its enclosing rocks. Practical recommendations are given for control of deformationand stresses in the shaftbottom mass during extraction of protective pillars in deep ore mines at Talnakh.

Protosenya A.G., Sinyakin K.G. Stress-strain condition of the ore massive within the second working modeling. Journal of Mining Institute. 2011. Vol. 189, p. 240-243. https://pmi.spmi.ru/pmi/article/view/6531

Abstract. According to geological data received on the Jakovlevsky deposit, a the spatial geomechanical model has been developed. During the analysis of the stress-strain state the distribution of horizontal pressure and vertical displacements on the border of the ore roof and carbonic strata have been received. It is established that the zone of clearing works essentially influences the distribution of pressure and displacements to the border of the ore roof and carbonic strata. By the results of modeling, it is possible to estimate the possibility of formation of vertical water conduction cracks in the ore roof.

Ochkurov V.I., Ogorodnikov Y.N., Antonov Y.N. Metal pliable support developments in an ore file Yakovlevsky mine. Journal of Mining Institute. 2011. Vol. 190, p. 192-196. https://pmi.spmi.ru/pmi/article/view/6447

Abstract. Loading on support is defined by geomechanical, technological and geometrical parametres. At long-wall technologies of carrying out of developments loading decreases in 1.5-1.6 times. Rigid dependence of size of loading on quality of filling contact spaces remains. Bearing ability of arches from СВП-27 and СВП-33 exceeds bearing ability of arches from СВП-22 accordingly on 33 and 76 %. Bearing ability of an arch with the account of plastic deformations of a steel increases on 32-42 % in comparison with elastic calculation.

Protosenya A.G., Belyakov N.A., Kuranov A.D. The prediction technics of tunnel sets with complex three dimensional configuration stress state with allowance for relative influence and building sequence. Journal of Mining Institute. 2012. Vol. 199, p. 17-24. https://pmi.spmi.ru/pmi/article/view/5813

Abstract. The three dimensional stress distribution in tunnel set with allowance for relative influence and building sequence is investigated. To complete the task the finite elements analysis was used. The values of stress concentration factor and conformities of stress distribution in the "lining – mass" system are estimated. The relative influence of each tunnel in tunnel set with allowance for building sequence is identified.

Yagodkin F.I., Kurnakov V.A., Pleshakov M.S. About the problem of shafts projecting and building in the conditions of modern market relations. Journal of Mining Institute. 2012. Vol. 199, p. 95-100. https://pmi.spmi.ru/index.php/pmi/article/view/5826

Abstract. Comparative analysis of home and foreign experience of shaft building is fulfilled. Conclusion about perspectiveness of unification of educational, scientific – research and building organizations is made. Concrete examples of cooperation are given.

Kurnakov V.A., Pleshakov M.S. Perspectives of further development of technics and technology of shafts building in Russia with consideration of world technologies. Journal of Mining Institute. 2012. Vol. 199, p. 101-105. https://pmi.spmi.ru/pmi/article/view/5827

Abstract. Comparative analysis of home and foreign experience of shaft building is fulfilled. Conclusion about perspectives of further development of technics and technology of shaft building in Russia is made.

Zuev Y.I., Zelentsov S.N., Kuznetsova E.I., Zvezdkin V.A., Karelin V.N. Optimization of protective pillars parameters of mine shafts at the ore mines of OJSC «MMK «Norilsk Nickel». Journal of Mining Institute. 2012. Vol. 198, p. 7-10. https://pmi.spmi.ru/pmi/article/view/5906

Abstract. The article presents the results of long-term investigations of the problem concerning the protection of shafts with pillars of reduced sizes under conditions of the Talnakh and Oktiabrsky deposits. The principal potentiality of partial mining of shaft-bottom pillars VS-3 and GS has been proved at the Oktiabrsky ore mine. Certain recommendations are given on optimization of parameters of shaft-bottom protective pillars.

Agafonov A.V., Ilyashov M.A., Kocherga V.N., Skipochka S.I., Krukovskaya V.V. New objective laws of methane exhalation during intensive mining of shallow coal seams. Journal of Mining Institute. 2013. Vol. 205, p. 77-85. https://pmi.spmi.ru/pmi/article/view/5497

Abstract. Natural observations and mathematical modeling of methane exhalation during increase of intensive mining in shallow coal seams have found that when excavation speed of coal area movement increases, process of methane desorption and its filter into atmosphere of working face is delayed. Discovered objective laws are subject to create scientific base to determine loading factor of highly productive working face, allowed as per gas ratio.

Protosenya A.G., Shokov A.N. The prediction of underopencast rock mass stress- strain condition during surface-underground development of Koashva deposit. Journal of Mining Institute. 2013. Vol. 204, p. 214-219. https://pmi.spmi.ru/pmi/article/view/5579

Abstract. The parameters of underopencast rock mass stress-strain condition for Koashva deposit are defined. The estimation of influence of surface development with opencast on the stress-strain distribution in the mass is revealed. Research is revealed with appliance of finite-elements method.

Protosenya A.G., Bai N.N. Method of normal load prediction on vertical shaft lining based on nonlinear behaviour of rock mass. Journal of Mining Institute. 2014. Vol. 207, p. 231-234. https://pmi.spmi.ru/index.php/pmi/article/view/5425

Abstract. Method of normal load prediction on vertical shaft lining which is constructed in nonlinear rock mass is suggested. It is supposed, that limit state zone is formed around excavation. The deformation properties of rock mass in the suggested method are determined according to nonlinear rock model. In order to predict stress and strain state around excavation the equations of deformation plasticity theory are used. The Mohr-Coulomb strength criteria is taken as a yield surface.

Kozyaruk A.E. Energy efficient electromechanical systems of mining and transport machines. Journal of Mining Institute. 2016. Vol. 218, p. 261-269. https://pmi.spmi.ru/pmi/article/view/5106

Abstract. The problems of selecting the type and the structure of mining and transport machines electromechanical control system, providing energy efficiency and performance. The conclusion about the most admissibility of variable frequency drives with induction motors and power semiconductor converters was made. The methods and technical means of improving the energy efficiency of asynchronous electric motors due to the choice of increased power characteristics motors, design of special motor control algorithms and applying of semiconductor converters with active rectifiers, providing high power factor and improving of the electricity supply quality were reviewed. To improve the operational characteristics prompted use of diagnostic systems and residual life assessment of electrical equipment. Implementation of designs tied to the excavator-transport sector. The schemes of the excavator power drive, mining truck and implemented complex picture at coal mine are shown.

Shonin O.B., Pronko V.S. Energy-efficient control of asynchronous motor drive with current refinement of the loss minimum on the basis of fuzzy logic. Journal of Mining Institute. 2016. Vol. 218, p. 270-280. https://pmi.spmi.ru/pmi/article/view/5107

Abstract. Currently, asynchronous electric drive on the basis of semiconductor frequency converters is widespread because of the relative simplicity and reliability of the design, the use of digital control systems, providing the accuracy and flexibility of process control, which allows for a significant increase in product quality, reduction in energy consumption and improvement of the enterprise profitability. In spite of these advantages, the problem of ensuring high energy efficiency of the drive in wide range of its operational modes is still not solved in full scale. The paper is devoted to the reduction of losses in the asynchronous drive on the basis of energy-saving control algorithms that aim to ensure the desired mode of the driven mechanism while minimizing losses in copper and steel of the motor. On the basis of the motor model, taking into account magnetic losses, dependences of losses in the copper and steel, as well as the total loss from the absolute slip have been derived for different operating points of the drive. The optimal values of the absolute slip for different speeds of the rotor have been obtained for use in the con-trollers ensuring operation of the drive at maximum efficiency, highest power factor and minimum of the stator current. For minimizing the losses in the drive when changing the motor parameters it has been offered the combined method based on the method of loss model and iterative method of searching the minimum of power consumption. The effectiveness of the proposed control system using fuzzy logic is confirmed by comparing the graphs of losses and efficiency, obtained at using a traditional control law and the optimal control law.

Zhautikov B.A., Aikeeva A.A. Development of the system for air gap adjustment and skip protection of electromagnetic lifting unit. Journal of Mining Institute. 2018. Vol. 229, p. 62-69. DOI: 10.25515/pmi.2018.1.62

Abstract. The efficiency of the electromagnetic lifting system is ensured by the well-coordinated work of all its parts and elements, namely those providing the strictly vertical movement of the skip. The deviation of the skip movement from the vertical axis can lead to a stop and damage of both the skip and the unit. Therefore, the air gap adjustment and skip protection system of the electromagnetic lifting system, which includes determining the size of the air gap between the electromagnet of the skip and the electromagnet of the aligning device, and the development of a stabilization system to ensure a constant air gap and regulate the current in the electromagnet winding, provide both a strictly vertical movement skip, and its protection. The article is devoted to the theoretical determination of the air gap between the electromagnets of the aligning device and the skip using the Biot – Savar – Laplace law.

Karasev M.A., Buslova M.A., Vilner M.A., Nguyen T.T. Method for predicting the stress-strain state of the vertical shaft lining at the drift landing section in saliferous rocks. Journal of Mining Institute. 2019. Vol. 240, p. 628-637. DOI: 10.31897/PMI.2019.6.628

Abstract. The article proposes a method for predicting the stress-strain state of the vertical shaft lining in saliferous rocks at the drift landing section. The paper considers the development of geomechanical processes in the saliferous rock in the landing area, the support is viewed as a two-layer medium: the inner layer is concrete, the outer layer is compensation material. With this in view, the paper solves the problem of continuum mechanics in a spatial setting, taking into account the long-term deformation of salts and the compressibility of the compensation layer. Long-term deformation of saliferous rocks is described using the viscoplastic model of salt deformation into the numerical model, and the crushable foam model to simulate the deformation of the compensation layer. This approach considers all stages of the deformation of the compensation layer material and the development of long-term deformations of saliferous rocks, which makes it possible to increase the reliability of the forecast of the stress-strain state of the vertical shaft lining.

Fig. 4. Model of a curbing support for shallow mines and pits. Freiberg, Germany. 1830-s. Scale 1:16. Item belongs to the Mining Museum

Levin L.Y., Semin M.A., Parshakov O.S. Improving methods of frozen wall state prediction for mine shafts under construction using distributed temperature measurements in test wells. Journal of Mining Institute. 2019. Vol. 237, p. 268-274. DOI: 10.31897/PMI.2019.3.268

Abstract. Development of mineral deposits under complex geological and hydrogeological conditions is often associated with the need to utilize specific approaches to mine shaft construction. The most reliable and universally applicable method of shaft sinking is artificial rock freezing – creation of a frozen wall around the designed mine shaft. Protected by this artificial construction, further mining operations take place. Notably, mining operations are permitted only after a closed-loop frozen section of specified thickness is formed. Beside that, on-line monitoring over the state of frozen rock mass must be organized. The practice of mine construction under complex hydrogeological conditions by means of artificial freezing demonstrates that modern technologies of point-by-point and distributed temperature measurements in test wells do not detect actual frozen wall parameters. Neither do current theoretical models and calculation methods of rock mass thermal behavior under artificial freezing provide an adequate forecast of frozen wall characteristics, if the input data has poor accuracy. The study proposes a monitoring system, which combines test measurements and theoretical calculations of frozen wall parameters. This approach allows to compare experimentally obtained and theoretically calculated rock mass temperatures in test wells and to assess the difference. Basing on this temperature difference, parameters of the mathematical model get adjusted by stating an inverse Stefan problem, its regularization and subsequent numerical solution.

Semin M.A., Levin L.Y., Bogomyagkov A.V. Theoretical analysis of frozen wall dynamics during transition to ice holding stage. Journal of Mining Institute. 2020. Vol. 243. P. 319-328. DOI: 10.31897/PMI.2020.3.319

Abstract. Series of calculations for the artificial freezing of the rock mass during construction of mineshafts for the conditions of a potash mine in development was carried out. Numerical solution was obtained through the finite element method using ANSYS software package. Numerical dependencies of frozen wall thickness on time in the ice growing stage and ice holding stage are obtained for two layers of the rock mass with different thermophysical properties. External and internal ice wall boundaries were calculated in two ways: by the actual freezing temperature of pore water and by the temperature of –8 °C, at which laboratory measurements of frozen rocks› strength were carried out. Normal operation mode of the freezing station, as well as the emergency mode, associated with the failure of one of the freezing columns, are considered. Dependence of a decrease in frozen wall thickness in the ice holding stage on the duration of the ice growing stage was studied. It was determined that in emergency operation mode of the freezing system, frozen wall thickness by the –8 °C isotherm can decrease by more than 1.5 m. In this case frozen wall thickness by the isotherm of actual freezing of water almost always maintains positive dynamics. It is shown that when analyzing frozen wall thickness using the isotherm of actual freezing of pore water, it is not possible to assess the danger of emergency situations associated with the failure of freezing columns.

Zaitsev A.V., Semin M.A., Parshakov O.S. Features of the thermal regime formation in the downcast shafts in the cold period of the year. Journal of Mining Institute. 2021. Vol. 250, p. 562-568. DOI: 10.31897/PMI.2021.4.9

Abstract. In the cold period of the year, to ensure the required thermal regime in underground mine workings, the air supplied to the mine is heated using air handling systems. In future, the thermodynamic state of the prepared air flow when it is lowered along the mine shaft changes due to the influence of a number of factors. At the same time, the processes of heat and mass exchange between the incoming air and its environment are of particular interest. These processes directly depend on the initial parameters of the heated air, the downcast shaft depth and the presence of water flows into the mine shaft. Based on the obtained experimental data and theoretical studies, the analysis of the influence of various heat and mass transfer factors on the formation of microclimatic parameters of air in the downcast shafts of the Norilsk industrial district mines is carried out. It is shown that in the presence of external water flows from the flooded rocks behind the shaft lining, the microclimatic parameters of the air in the shaft are determined by the heat transfer from the incoming air flow to the underground water flowing down the downcast shaft lining. The research results made it possible to describe and explain the effect of lowering the air temperature entering the underground workings of deep mines.

Semin M.A., Grishin E.L., Levin L.Y., Zaitsev A.V. Automated ventilation control in mines. Challenges, state of the art, areas for improvement. Journal of Mining Institute. 2020. Vol. 246, p. 623-632. DOI: 10.31897/PMI.2020.6.4

Abstract. The article is divided into three main parts. The first part provides an overview of the existing literature on theoretical methods for calculating the optimal air distribution in mines according to the criteria of energy efficiency and providing all sections of mines with the required amount of air. It is shown that by the current moment there are many different formulations of the problem of searching the optimal air distribution, many different approaches and methods for optimizing air distribution have been developed. The case of a single (main) fan is most fully investigated, while for many fans a number of issues still remain unresolved. The second part is devoted to the review of existing methods and examples of the automated mine ventilation control systems implementation in Russia and abroad. Two of the most well-known concepts for the development of such systems are automated ventilation control systems (AVCS) in Russia and the CIS countries and Ventilation on demand (VOD) abroad. The main strategies of ventilation management in the framework of the AVCS and VOD concepts are described and also the key differences between them are shown. One of the key differences between AVCS and VOD today is the automatic determination of the operation parameters of fan units and ventilation doors using the optimal control algorithm, which is an integral part of the AVCS. The third part of the article describes the optimal control algorithm developed by the team of the Mining Institute of the Ural Branch of the Russian Academy of Sciences with the participation of the authors of the article. In this algorithm, the search for optimal air distribution is carried out by the system in a fully automated mode in real time using algorithms programmed into the microcontrollers of fans and ventilation doors. Minimization of energy consumption is achieved due to the most efficient selection of the fan speed and the rate of ventilation doors opening and also due to the air distribution shift control and the partial air recirculation systems introduction. It is noted that currently the available literature poorly covers the issue related to emergency operation modes ventilation systems of mines and also with the adaptation of automated control systems to different mining methods. According to the authors, further development of automated ventilation control systems should be carried out, in particular, in these two areas.

Baryakh A.A., Devyatkov S.Y., Denkevich E.T. Mathematical modelling of displacement during the potash ores mining by longwall faces. Journal of Mining Institute. 2023. Vol. 259, p. 13-20. DOI: 10.31897/PMI.2023.11

Abstract. In favourable mining conditions, in particular at the Starobinskoye potash deposit (Belarus), longwall mining systems are used. They cause a high human-induced load on the subsoil, including intense deformation of the ground surface. The presented investigations are aimed at studying the dynamics of the ground surface displacement during the longwall face advance. Mathematical modelling was carried out in an elastic-plastic formulation with numerical implementation by the finite element method. The condition for the roof rocks collapse was opening of the contact between the seams when its boundaries were reached by shear fractures or formation of the tensile stresses area at the outcrop. With the working front advance, an increase in subsidence is observed, followed by its stabilization to a value determined by the process parameters of mining operations and the physical and mechanical properties of collapsed rocks. In this case, each point of the ground surface experiences sign-alternating horizontal deformations: when the front approaches, it causes tension, and when it moves away, compression. The obtained results of mathematical modelling are in good agreement with the data of instrumental measurements of the ground surface displacements, which indicates the adequate description of the rock mass deformation during the slice excavation of sylvinite seams by longwall faces.

Ershov M.S., Komkov A.N., Feoktistov E.A. A complex model of a drilling rig rotor with adjustable electric drive. Journal of Mining Institute. 2023. Vol. 261, p. 339-348. DOI: 10.31897/PMI.2023.20

Abstract. A modified mathematical model of an asynchronous electric drive of the rotor – a drill string – a bit – a rock is considered and implemented, which develops and generalizes the results of previously performed studies. The model includes the following subsystems: a model of an asynchronous drive with vector control; a model of formation of the resistance moment at the bottom of the bit, taking into account the peculiarities of the interaction between the bit and the rock; a model of a multi-mass mechanical part that takes into account the deformation of the drill string; subsystem for the drilling rig energy-technological parameters formation. The integrated model makes it possible to calculate and evaluate the selected drilling modes, taking into account their electro-mechanical, energy and technological efficiency and the dynamics of drilling processes. The performed computer simulation of drilling modes confirmed the possibility of a stick-slip effect accompanied by high-frequency vibrations during bit stops, which may change the direction of rotation of the bit, its accelerated wear and unscrewing of the drilling tool. Long bit stops lead to a significant decrease in the average bit rotation speed, which can explain the decrease in the ROP and increase in energy consumption when drilling in the zone of unstable bit rotation. The model can be used as a base for further improvement of rotary drilling control systems.

Scientific edition

MINE SHAFTS

Digest

JOURNAL OF MINING INSTITUTE

№ 4 • 2023

Editor *S.V. Sinyavina*

Digester *P.V. Kotova*

DTP specialist *S.A. Lysenko*

Photos are submissed by the Mining Museum
(photographer *P.V. Dolganov*)

Publishing House
of Saint Petersburg Mining University
https://pmi.spmi.ru

The Mining Museum
https://museum.spmi.ru

Anyone wishing to issue a scientific digest is welcome
to Publishing House of Saint Petersburg Mining University
(email: pmi@spmi.ru)