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PROSPECTS FOR ORE FLOW QUALITY MANAGEMENT IN DEEP PITS

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Annotation. The article discusses the relevance of the use of ACS in the process of managing the quality of ore flow in deep open pit mines. Their application will allow at all stages of the development of the deposit to assess the qualitative characteristics of the mineral in the bowels, to replenish and correct information on the quality of ore, taking into account the current mining and geological conditions, and, therefore, to effectively manage the quality of the ore.
Keywords: Mining and technical, mining and geological, quality management, ore flow, mining equipment, forecasting, satellite navigation.

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Annotatsiya: Maqolada chuqur karyerlardagi ruda oqimini sifat bo’yicha boshqarish jarayonida ATB qo’llashning dolzarbligi ko’rilgan. Ularni qo'llash konni qazib olishning barcha bosqichlarida yer qari qatlamlaridagi minerallarning sifat ko'rsatkichlarini baholashga, rudaning sifati to'g'risidagi ma'lumotlarni hozirgi kon-geologik sharoitlarni hisobga olgan holda to'ldirishga va aniqlik kiritish orqali ruda sifatini samarali boshqarishga imkon beradi.
Kalit so’zlar: Kon-texnik, kon-geologik, sifat menejmenti, ruda oqimi, kon uskunalari, prognozlash, sun'iy yo'ldosh navigatsiyasi.

ПЕРСПЕКТИВЫ УПРАВЛЕНИЯ КАЧЕСТВОМ РУДНОГО ПОТОКА НА ГЛУБОКИХ КАРЬЕРАХ

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Аннотация. В статье рассмотрена актуальность применения АСУ в процессе управления качеством рудного потока на глубоких карьерах. Применение их позволит на всех этапах освоения месторождения производить оценку качественных характеристик полезного ископаемого в недрах, пополнять и корректировать информацию о качестве руды с

учетом действующих горно-геологических условий, и, следовательно, эффективно управлять качеством руды.

Ключевые слова: Горно-технические, горно-геологические, управление качеством, рудный поток, горнотранспортное оборудование, прогнозирование, спутниковая навигация.

One of the main problems of quality management is the stabilization of the content of useful components in the ore stream to the processing plant. The solution of the main issues of stabilizing the quality of the ore flow requires the creation of highly efficient control systems for the processes of extraction and movement of ores, ensuring the achievement of optimal performance and high productivity of mining and processing production [1-2]. Effective management of the quality of ore during mining is possible only if there is a sufficient amount of reliable and reliable information on the content of the useful component in the subsoil. To obtain accurate information, it is necessary to assess the qualitative characteristics of the mineral in the bowels at all stages of the development of the deposit. At each subsequent stage, the information on the quality of the ore should be supplemented and corrected taking into account the current mining and geological conditions.

In order to increase the efficiency and completeness of the development of reserves of deposits, a number of enterprises use information systems, software and hardware systems, aimed, first of all, at solving particular problems: forecasting the content of useful components in a specific area; real-time accounting of performance indicators of loading and transport equipment; monitoring changes in the volume and quality of prepared, harvested and recovered reserves.

The simplest from a technical point of view is the management of the quality characteristics of ore streams in the open pit mining. The introduction and operation of positioning systems for mining and transport equipment is achieved by using satellite navigation and wireless data transmission systems, the basic elements of which are usually installed on the territory of mining operations, mining equipment and in the control room. At the same time, a high accuracy of determining the spatial position of mobile objects is achieved with a minimum probability of their failure. It should be noted that most open pit mining enterprises is already equipped with systems of automatic control, management and accounting of the operation of mining equipment in open pits. It is known that the natural state, characterized by the content of useful and harmful components throughout the ore body, has a decisive influence on the quality of the extracted mineral. At the same time, the spatial position of each controlled volume within the quarry field and the number of ore grades that imply separate mining are important. On the operating ore quarries, the qualitative characteristics of minerals in geological contours and large blocks vary within wide limits; the degree of variability of the content of useful components in the ore during the mining process also depends on the direction of development of mining operations. The nature of the variability of the quality of ores is so complex that it is not possible to describe it with a universal mathematical function. Therefore, at present, at most enterprises, the only effective way to ensure stable indicators of ore flows is the use of blending warehouses.

The difficulty in stabilizing the quality of the ore mass during the mining of irregular ore bodies is that the thickness and the angle of inclination of the deposits vary within significant limits. This, in turn, leads to an increase in the area of contacts between the mineral resource and the host rocks, as well as between various types of ores.

Therefore, the traditional approach and methods for stabilizing the qualitative characteristics of the ore flow, based on averaging the values of the thickness and the angle of incidence of the ore deposit, are very approximate, and often invalid, since these methods do not at all reflect the entire complexity of the conditions of occurrence of ore bodies in the space of the opencast field or individual its sites.

The further effective development of opencast mining largely depends not only on the use of various new types of mining and transport equipment, but also on the accelerated development and widespread introduction of modern automated control systems for mining transport complexes using satellite navigation in open pits. The main goal of introducing such technologies is to increase the efficiency of a mining enterprise by improving the organization of production, optimizing mining operations, minimizing costs and losses at all stages of the mining cycle and thus reducing the cost of the final product.

The mining industry has become one of the first industries to effectively use navigation technologies for monitoring and dispatching mobile equipment in quarries. The introduction of a dispatching system allowed mining companies to increase the overall productivity of the enterprise by 10-15% and thereby somewhat mitigate the consequences of the economic downturn in the extractive industries.

All the existing works aimed at improving the methods for assessing and describing the spatial position and configuration of ore bodies are reduced to attempts to increase the accuracy of providing geological information by justifying various kinds of coefficients that allow to move away from the use of linear parameters of the ore deposit. To stabilize the quality indicators of ore flows during the development of ore bodies of complex irregular shapes, it is necessary to improve the methods of spatial description of the ore deposit within the open pit field. It should be noted that all of today's techniques make it possible, at best, to quantify indicators of the complexity of the shape and conditions of occurrence of ore bodies. These shortcomings in the practice of open pit mining can be compensated for by using satellite navigation tools in conjunction with an automated control system for the quality characteristics of ore flows.

Such a system has been created and implemented at the Vorontsov gold mine of ZAO Gold of the Northern Urals [3-4]. It was based on software and hardware adapted to the specific mining-geological and mining-technical conditions of the enterprise within the framework of a unified information system aimed at stabilizing the quality characteristics of the combined ore flows entering for processing from various production faces.

The idea of ensuring the required quality indicators of the ore mass is based on the formation of ore flows, based on a set of ore quality in single extraction volumes, determined as a result of forecasting on a constantly updated block model of the deposit and control during the drilling of the massif, extraction of ore from the production block, loading into vehicles , the number and mode of movement of which is regulated depending on the characteristics and locations of the faces, the number, volumes and points of unloading in the open pit.

To increase the objectivity of the control system for the quality characteristics of ore streams, it is necessary to have and use a block geological model as initial information on the quality of the ore mass. All operatively detected actual deviations in quality are recorded by the geological service of the enterprise with the introduction of appropriate changes into the software database of the geological model. Ore mass quality control devices in the stream installed on the receiving conveyors of the concentration plant can also be used as controls. The data recorded by the instrument parameters are taken into account in the ore mass quality control system at the factory blending warehouses.

As part of the development of automated management tools for the operation of mining transport complexes, the VIST Group company tested and designed a positioning system for mining equipment in the conditions of the mines of the Olenegorsk GOK and the Kazakhmys corporation [5-6]. Systems using Wi-Fi signal, radiating cable, or RFID tags were used. The operation of these systems in underground mining is complicated by the limitation of the wireless signal transmission zone and the need to use devices that provide stable radio coverage as mining develops. There is also a need for a multi-stage formation of ore quality indicators, taking into account the individual quality indicators of the ore mass extracted from individual elementary excavation volumes (chambers, belts),

with their sequential integration through a system of ore passes into a single network of intra-ore flows. A similar system is used in an underground chromium mine in Finland. It should be noted that, in general, the process of forecasting and monitoring the quality indicators of the ore mass is similar to that in the open pit mining.

In the deep open pit Muruntau, the GPS-system of the ACS AT, together with a set of software and hardware, interacts with the CAD GP, as well as with the automated control system for controlling the quality of the ore flow. Information about the location and movement of mining and transport equipment and the amount of rock mass recovered is transmitted to the central server in a form suitable for use with CAD software. In turn, information on the results of the operation of individual CAD subsystems of the GP (grade plan, surveying data, drilling project, etc.) is transmitted to the GPS system for managing the quality of the ore flow and then to the GPS system of the ACS AT. The list of tasks of the GPS-system of the automated control system of the AT of the Muruntau quarry for current, regular and long-term planning is presented in table 1.

Table 1

The list of tasks of the GPS-system of ACS AT quarry

Current: **Control** **technological transport in the quarry**	- automatic determination of the coordinates of dump trucks and tracking movements in real time; - display on monitors the position of the trajectories of movement of mining and transport equipment; - automatic solution of problems of distribution and routing of dump trucks between loading points; control of optimal distribution and routing of dump trucks; - automatic accounting of the volume of transported rock mass, as well as archiving the movement of dump trucks; - automatic generation of reports at the user's request concerning the efficiency of the use of mining and transport equipment and the volume of rock mass; - visualization of the state of excavation and transportation of rock mass; - speed control of dump trucks
Regular: **Control stream quality**	- quality control of selective mining; - determination of the content and volumes of ore shipped to the plant in real time; - optimization of shipping and ore mining; - automation of mine surveying
Promising	- control over the technical condition of dump trucks; - accounting of personnel work in a polluted atmosphere.

Thus, the ACS AT is a structural element of the overall management system for open pit mining.

Thus, at the present stage of the development of mining production, the development of deposits by deep quarries is becoming more and more important, while their depth is calculated in hundreds of meters. As the size of the quarries increases, the volumes of the moved rock mass also increase.

On the basis of the tested positioning systems of mobile mining transport facilities, a system for managing the quality characteristics of ore flows is being formed, which provides a significant increase in the efficiency and completeness of the development of the deposit. Stabilization of the quality of ore mass makes it possible to significantly reduce the costs of the enterprise in the enrichment process, reduce ore losses, predict the quality of raw materials in the man-made formations formed from mining and processing waste.

At the same time, a number of enterprises have already created technical and informational components that make it possible to increase the efficiency and completeness of the development of deposits at the expense of creating an operational system for stabilizing the quality of the ore mass. An automated control system of a mining transport complex using satellite navigation acts as a link between geographic information systems, a block model of field reserves and technical means of production. Therefore, the substantiation of the conditions for stabilizing the quality of the ore mass in the open-pit mining of ore deposits using satellite navigation is a very urgent scientific and practical problem.

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