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ADVANTAGES OF USING CONTINUOUS AND DISCONTINUOUS TRANSPORT MACHINES IN SHALLOW MINES

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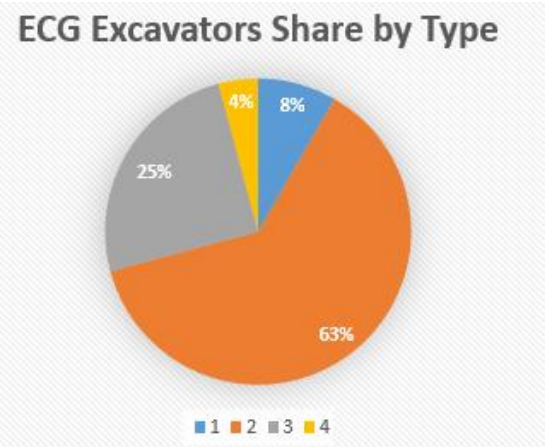
Abstract: This article analyzes the application of discontinuous and continuous transport machines in open-pit mining, their advantages and disadvantages, as well as the efficiency of integrated transport systems. The research results demonstrate the economic efficiency and technical advantages of discontinuous-continuous transport systems.

Keywords: discontinuous transport, continuous transport, conveyor, dump truck, mine transport, integrated system, efficiency.

Introduction

The "Yoshlik-1" mine belongs to the Almalyk Mining and Metallurgical Combine, and this mine is recognized as a promising mine in terms of mineral reserves. A number of modern mining machines have been brought in for the development of this mine. EKG excavators have been mainly selected for excavation and loading operations: 2 units of EKG-10 excavators, 15 units of EKG-15M excavators, 6 units of EKG-20K excavators, and 1 unit of EKG-20KM excavator (25 m³). Graph 1: Share of EKG excavators involved in the mine by bucket capacity.



Transport operations in the mining industry are one of the most important and costly parts of the production process. High-performance BelAZ dump trucks with 54 units of 130-ton and 29 units of 220-ton payload capacity have been involved in the mining operations at the Yoshlik mine. Based on the localization program, 5 units of KRANTAS NMT-240 dump trucks have been brought in to create an energy-efficient transport system for mine opening and excavation-loading operations and to use it effectively. The use of high-capacity mining machines in modern mining enterprises increases mine productivity and reduces energy consumption. According to statistical data, transport costs in open-pit mines account for 40-65 percent of the total production cost[4]. Therefore, the issue of optimizing transport systems and implementing modern technologies is of urgent importance[9,10].

Currently, two main types of transport are used in mining enterprises: discontinuous (cyclic) and continuous transport[5]. Each type has its own advantages and disadvantages, and their combined application allows achieving high efficiency[12,11]. The CPT (Cyclic-Flow

Technology) system is being used for transporting minerals to the processing plant at the Yoshlik mine, where the conveyor transport covers 4,200 meters.

Literature review and methods

In mining enterprises, the maneuverability of dump trucks is an important factor in the selection and operation of dump trucks, as well as their ability to reach the excavator. Open-pit mining operations are continuously evolving to meet efficiency and economic effectiveness requirements in material processing. Although traditional haulage systems (TS) are widespread, they face challenges such as high operating costs, operational efficiency, economic sustainability, and environmental impact. A promising solution to these problems is the In-Pit Crushing and Conveying system (IPCC), which integrates the crusher into the mining pit and uses conveyor transport for haulage. This approach not only minimizes dependence on haul trucks but also improves operational safety and efficiency, and can lead to significant financial benefits through reducing operating costs, lowering energy consumption, and increasing productivity. Nevertheless, the implementation of IPCC systems is complex and requires thorough planning of the crusher location, capacity, and its integration within the overall mine layout and planning[1].

Discontinuous (cyclic) transport machines include dump trucks, railway transport, scrapers, and other cyclically moving vehicles[4,8]. The main characteristic of this type of transport is that the haulage process is carried out according to specific cycles: loading → hauling → unloading → returning.

Advantages of discontinuous transport: High flexibility - the ability to operate in any direction and in various geological conditions. The possibility of quick commissioning and relocation. Relatively low initial investment is required. The ability to transport various types of loads.
Disadvantages of discontinuous transport: High fuel consumption - high operating costs. Negative environmental impact - dust and exhaust gases. Road maintenance costs.

The necessity of training driver personnel.
Continuous transport machines Continuous transport machines include belt conveyors, chain conveyors, screw conveyors, and pneumatic transport systems[5,7]. This type of transport provides the transportation of cargo in a continuous flow.

Advantages of continuous transport: High productivity - the ability to transport thousands of tons of cargo per hour. Low energy consumption - less energy consumed per ton of cargo. High level of automation - fewer human resources required. Minimal environmental impact. Reliability and long-term service.
Disadvantages of continuous transport: High initial investment. Operation only in a fixed direction. Complexity of installation and dismantling.

RESULTS Integrated discontinuous-continuous transport systems The most effective solution in modern mining enterprises is the combined application of discontinuous and continuous transport machines[8]. In this system, dump trucks or excavators deliver the cargo from the extraction site to the crusher or loading point, then conveyor systems transfer the cargo to the processing plant.

Comparative analysis of transport types

Table 1.

Indicator	Discontinuous transport	Continuous transport

Productivity (t/h)	500-2000	3000-15000
Energy consumption (kWh/t·km)	0.8-1.5	0.1-0.3
Initial investment	Low	High
Operating costs	High	Low
Flexibility	High	Low
Environmental impact	Negative	Minimum

Research shows that the application of integrated discontinuous-continuous transport systems provides the following economic efficiency[7,8]: Reduction of transport costs by 25-40%. Reduction of fuel consumption by 30-50%. Reduction of labor costs by 20-35%. Increase of overall productivity by 15-25%.

Discussion

In open-pit mining enterprises, excavation and loading operations cause a number of problems in transporting the extracted rock mass to the processing plant or dump as the mine deepens. Transporting rock mass leads to an increase in transport costs, as a result, it is necessary to carry out design work for the transport system and excavation-loading operations depending on the mining conditions[11,12]. Several scientists have conducted practical work in solving the problems of improving cyclic-flow technology in excavation depending on mining conditions related to the mining conditions of open-pit mines. Taking into account the specific mining-geological conditions of the open-pit mine, it determines the necessity of developing new technological and technical solutions for the use of conveyor transport using mobile complexes.

The mobile crushing complex in combination with continuously operating conveyors allows abandoning the alternative excavator-truck haulage scheme and the fleet of heavy-duty haul trucks. In addition to reducing excavation costs, the development technology based on the new fully mobile crushing system significantly reduces the emission of exhaust gases into the atmosphere. Thus, it has been determined that the recommended technological scheme for overburden excavation using mobile crushing-transfer-conveyor complexes ensures rapid development of mining operations along the depth together with high technical and economic indicators of open-pit mining[2].

In haulage operations, after analyzing several factors in transporting cargo with discontinuous transport machines (dump trucks) and transporting cargo with continuously operating conveyor transport, the analysis results determined that conveyor transport uses 81% of its consumed energy for cargo transportation. Haul trucks use only 39% for cargo transportation.

It has been determined that the cost of conveyor transportation can be equal to one-third of the haul truck system[3].

Conclusion

The combined use of discontinuous and continuous transport machines in mining enterprises allows achieving high economic efficiency. Integrated transport systems combine the advantages of both types of transport and minimize their disadvantages.

In the future, with the development of automated control systems, artificial intelligence, and IoT technologies, the efficiency of discontinuous-continuous transport systems will further increase[10]. When selecting the optimal transport system for mining enterprises, the geological conditions of the mine, production volume, and the demand for energy efficiency should be taken into account. Such a modern transport system is being used at the Yoshlik mine, and the implementation of the truck-conveyor system is proving that it is possible to achieve economic efficiency by reducing transportation costs, and furthermore, it leads to a reduction in the amount of harmful gases emitted from vehicles.

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