

Substantiation of the Parameters of Regenerative Devices for Mining Dump Trucks

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Annotation: At mining enterprises with an open pit, a special role belongs to quarry transport. It is not only the most complex and laborious link in the technological process of developing mineral deposits, but to a large extent determines the conditions and performance of other links and the enterprise as a whole. In the cost of mining, the share of transport costs reaches 50-70%.

Keywords: quarry transport, cars and light trucks, use of recuperative devices, quarry dump trucks.

Relevance of the topic: Currently, interest in the creation of hybrid power plants has increased significantly: domestic and foreign scientists are conducting research work; the world's largest automotive companies are not only creating prototypes, but are already mass-producing cars with such units (mainly cars and light trucks). Meanwhile, the principle of recuperation of kinetic and potential energy for the purpose of further use for movement has the most favorable conditions for use specifically on mining technological vehicles, since in a quarry the operation of transport is cyclical with a significant downhill period, when potential energy can be stored in the battery and used to drive dump truck systems. The use of recuperative devices would make it possible to comprehensively improve the technical level and technological properties of mining dump trucks in the above directions and apply a more efficient technology for open-pit mining.

Thus, the need for a comprehensive increase in the technical and technological properties of mining dump trucks through the use of regenerative devices, on the one hand, and the lack of a scientific and methodological basis on this issue, on the other hand, make it a question of justifying the parameters of rock mass transportation by mining dump trucks with regenerative devices, determining technological and technical requirements for them is an urgent scientific task, which is of great practical importance for design institutes, mining enterprises and manufacturers of mining dump trucks.

The purpose of the work is to substantiate the parameters of rock mass transportation by mining dump trucks with recuperative devices and technical requirements for them.

The main idea of the work is to establish and use the dependences of the energy parameters of the transport cycle of mining dump trucks with regenerative devices on mining and technical conditions to justify their technological and technical parameters.

To achieve this goal, it is necessary to solve the following **tasks**:

- to assess the impact of mining and technical operating conditions on the energy parameters of the transport cycle of a mining dump truck;
- Select criteria and justify the preferred operating conditions for mining dump trucks with regenerative devices. Justify the areas of preferential use of dump trucks with recuperative devices in existing quarries;
- To analyze the used power plants for mining dump trucks, to develop layout solutions for dump trucks with a combined power plant. Develop technical requirements for the creation of mining dump trucks with regenerative devices;

- Justify the technological parameters of mining dump trucks with recuperative devices. Develop an algorithm for selecting parameters and determining the performance of mining dump trucks with recuperative devices for specific mining and technical operating conditions.

The object of research is the method and processes of rock mass transportation in quarries by dump trucks with recuperative devices.

The subject of the study is the relationship between the technological parameters of transportation and the technical parameters of mining dump trucks with recuperative devices, the criteria for substantiating these parameters.

Research methods:

- ✓ analysis, synthesis, analogy method;
- ✓ generalization and analysis of scientific and technical literature;
- ✓ numerical and simulation modeling on a computer;
- ✓ mathematical analysis;
- ✓ math statistics;
- ✓ technical and economic analysis;
- ✓ Elements of mining and geometric analysis.

The scientific novelty of the work lies in the fact that:

- Based on the criterion of equality of the amount of stored and consumed energy during the auxiliary operations of the transport cycle, the dependence of the limiting minimum required average weighted slope for the normal operation of a dump truck with regenerative devices has been established;
- The area of preferred conditions for the use of dump trucks with recuperative devices has been substantiated in terms of the parameters of rock mass transportation;
- Analytical dependences of the operational indicators of dump trucks with regenerative devices on mining and technical conditions have been established: productivity, average technical and average operational speed, fuel consumption for transport work, emissions of harmful substances with exhaust gases;
- An algorithm for calculating the main technical and technological parameters of dump trucks with recuperative devices for specific mining conditions of open pits has been developed.

The practical significance of the work is as follows:

- ✓ The technical requirements for the development of mining dump trucks with recuperative devices were determined;
- ✓ Layout solutions for mining dump trucks with recuperative devices of various carrying capacities are proposed;
- ✓ The economic efficiency of the use of dump trucks with recuperative devices is substantiated;
- ✓ The preferred conditions for the use of mining dump trucks with regenerative devices, as well as the areas of preferential use of dump trucks with regenerative devices for the conditions of specific quarries, are substantiated.

The introduction of dump trucks with regenerative devices will allow:

- optimize the shape of the quarry due to the possibility of using transport communications with increased longitudinal slopes;
- ensure higher productivity of quarry vehicles;
- reduce the gas contamination of the working area of the quarry;
- to reduce, under certain conditions, the fuel consumption of open-pit vehicles;
- Reduce the total and reduced costs for transporting the rock mass.

To date, significant progress has been made in the field of mechanical engineering, which can become the basis for a new stage in the development of mining and transport equipment. One of the directions of development is the use of regenerative devices in the construction of mining vehicles.

A promising direction in the development of career vehicles is the creation of specialized and special vehicles. Specialization refers to constructive changes in vehicles. Specialization requires changing a large number of components and assemblies, and especially the power plant, which in modern conditions has high requirements for environmental friendliness, efficiency, reliability, provided that the high performance of the dump truck is ensured, that is, speed and grade ability. The development and application of new types of power plants for mining vehicles is advisable if, while maintaining the achieved level of the main performance indicators, they will have a number of advantages.

Studies by a number of authors have established that it is possible to reduce the negative impact of the factors listed above by using recuperative devices. Their distinctive feature is the use of energy recovery effect.

Conclusion

The scope of recuperative devices is quite wide. In the field of quarry vehicles, rather in-depth studies were carried out, mainly in the direction of contact-battery dump trucks. A similar direction has become widespread in the field of mine railway and road transport. Recently, the most widely carried out research and development work in the field of general purpose vehicles (cars and trucks, buses).

Naturally, the achievements of such diverse studies are, on the one hand, significant, and on the other hand, lead to certain confusion in terminology. Recently, along with this concept, the term hybrid power plant has been used, meaning essentially the same thing. Its emergence is associated with the wide dissemination of the achievements of foreign scientists and designers.

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