

## **RESEARCHING OF MEASURES TO IMPROVE THE PERFORMANCE OF TIRES OF MINING DUMP TRUCKS IN THE MINING INDUSTRY**

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### **ABSTRACT**

*The main factors determining the development of career transport are systematically worsening mining-geological and mining-technical conditions of production. It is known that the development of an open method of development is accompanied by an increase in the concentration of production, an increase in the depth and spatial dimensions of the quarries, and the distance and complexity of transportation of the rock mass. The determining factor is the depth of the quarries. Automobile transport, as transport of the working area of the open-pit mine, is the most exposed to the effects of mining conditions that are more complex with depth. The main limitation of the use of road transport in deep quarries is still the high cost of transportation of the rock mass. In addition, career road transport is the main source of negative anthropogenic environmental impact during open pit mining.*

**Key words:** *mining, performance measurement, dump truck, environmental performance, availability, mining industry.*

### **INTRODUCTION.**

In order to expand the field of application of automotive vehicles in deep quarries, increase its efficiency, the search for new technological schemes, as well as ways of its development and improvement, continues. In recent years, the need for accelerated preparation of new horizons, as well as for new equipment that could operate at a higher rate of lowering mining operations, has opened up with access to new deep-seated reserves of raw materials. No less important is the extension of the service life of quarries that have reached their design depth, due to their deepening with a minimum separation of boards and an increase in the volume of overburden works. In recent years, there have also been intensive searches for more progressive solutions associated with the use of steeply inclined belt conveyors, which allow transporting crushed hard rocks and ores at an angle of 30–45° or more increasing the angle of inclination in comparison with the used conveyor lifts (usually no more than 16°) by two or more times.

## MATERIALS AND METHODS.

At the same time, taking into account that a very significant modernization of career vehicles has recently occurred – dump trucks began to be produced with the best traction-dynamic and ecological characteristics, this allows us to hope that the rational area of their application can be expanded. One of the ways to expand the rational field of use of mining dump trucks can be the use of inertial forces of a moving dump truck to overcome inclines. The principal differences of the process under consideration from the existing one as follows. In addition, one of the drawbacks of overcoming large inclines due to the implementation of the tangential traction force of the drive wheels is that by realizing the tangential traction force on the inclines, the drive wheels move with slipping (the more the slope, the more slip). As a result, the driving wheel tires are subject to intense wear. For comparison, the wear of the front tires is not leading (slave) wheels several times less than tires of driving wheels.

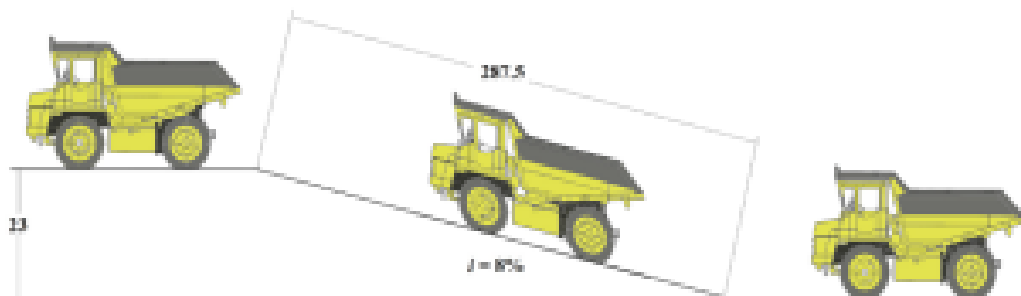


Figure 1. The existing scheme to overcome the slope by the dump truck

The analysis of the laws of physics shows that, as applied to career road transport, with proper organization of motion schemes, these inertia forces can also have a positive effect if these forces are directed at overcoming resistances to the motion of a dump truck. The magnitude of the force of inertia depends on the mass of the body and the acceleration of its movement. Considering that mining dump trucks have a large mass (tens of tons), then with an average speed of movement of 4.2 m/s, the inertial force can reach significant values (tens, and even hundreds of kN). These forces can be directed to overcome the slopes in the transport inclines. But we are talking about protracted slopes. As for the slopes of a relatively short length, a dump truck can overcome them. Above, we calculated that even with the engine completely disconnected, the dump truck run out on a 30 % slope is 6.6 meters. The overall slope of the transport incline will be 15 %, which is much higher than recommended (8–10 %). The above calculations of the length of the horizontal and inclined sections do not take into account the value of the wheelbase of the dump truck. Taking into account the wheelbase, the length of the horizontal and inclined sections should be

longer. In turn, an increase in the length of sections by the size of the wheelbase will lead to a slight increase in the magnitude of the total gradient. For example, considering that the base of the BelAZ-7547 dump truck is 4.2 meters, the length of the slope to be overcome will increase to 11.95 meters (Fig. 4), and the height of the slope will be 3.59 meters respectively. Performance measurement systems (PMS) in today's business environment are different from the 1970s and 1980s. The nature of today's business is unique and dynamic, and as an effect of globalization, the organization's PMS requires a different dimensional approach. To provide managers with useful information and to sustain competitiveness in the global market, the organization must measure all aspects of organizational functions.

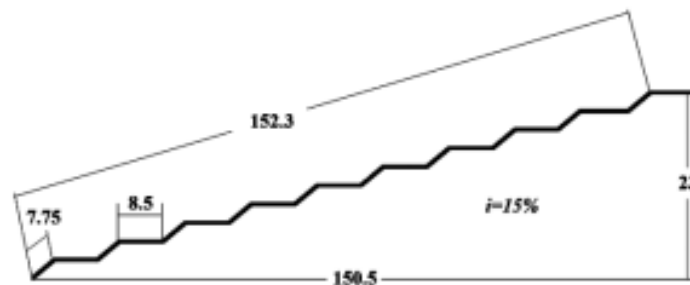


Figure 2. Scheme of slopes for transport incline

Mining activities specially the surface mining has substantial environmental impacts at local, regional and global scales. Dump trucks are popularly used to transport material in surface mines. These off-road mammoth trucks are loading the environment with tons of diesel every day in their operating cycle which includes following events:

- positioning near loading shovel;
- loading by shovel;
- travelling of loaded dump truck to the dumping point;
- positioning at dump point;
- unloading at the dump point;
- travelling back to the loading shovel.

This research redefines the PM for dump trucks including the environmental impact aspect of dump truck operation. Both the internal and external losses occurring in the system and beyond the system are duly accounted in the modified PM and are useful for comparing, monitoring, and managing of equipment and system performance. However, the system's operational effect on environment plays an important role to determine its performance in today's business. It considers the external losses occurring beyond the system boundary like environmental losses due to the operation of mining equipment. Environmental issues have become one of the

major concerns to all industries. The ever-increasing public awareness and stringent government regulations have forced mining entrepreneurs to take the environmental aspect very seriously. Today, every corner of the world is worried about environmental pollution because of its consequences faced by people every day. To have a check on environmental degradation, regulatory bodies of different countries imposing stringent regulations time to time on various environmental issues. Many mining projects have not been materialized, or running projects have been shut down on environmental issues. All these show that environmental issues have become very important for mining projects. Therefore, it will not be wise to ignore it while measuring the performance of a dump truck and other machinery.

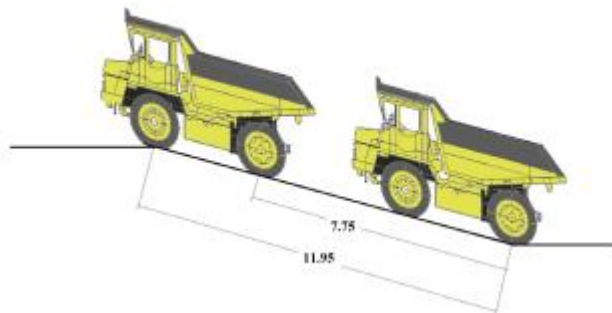


Figure 3. Overcoming the slope of 30 %

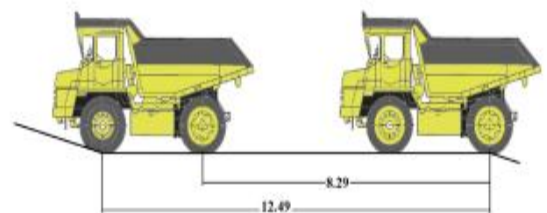


Figure 4. Movement at the horizontal part

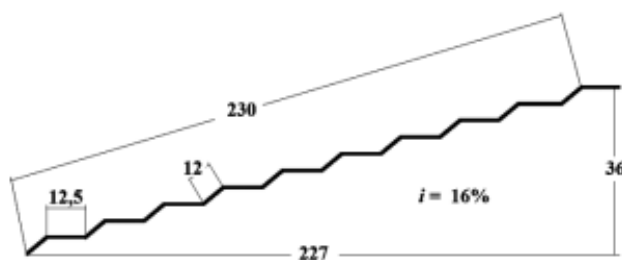


Figure 5. The proposed scheme tilt exit incline

High productivity and uninterrupted operation of the rock mass transportation is an important part of mining enterprise functioning. It is ensured by the increase in the technical readiness of the vehicle fleet while maintaining acceptable levels of safe operation. So, the significant role of large tires in ensuring continuous and safe operation of open cast mining equipment becomes apparent. The analysis of statistical data, for the typical reasons of large tires failure, showed that about 12% of failures are associated with fatigue and thermal damage caused by excess temperature of large tires during operation for various reasons, and a temperature of 120 ° C is critical for them. If the temperature exceeds the critical temperature, the tire will

collapse due to a decrease in the strength of the cord and its connection with rubber, the development of the following defects, such as delamination, bloating of the tread and delamination of the carcass. For the most operating modes, the heat generation is about 85-95 % because of the deformation and internal friction, from 5 to 15% is from external friction. The exceptions are skidding, slipping and applying to the wheel moments exceeding the maximum traction moment significantly. In these cases, the main cause of heat generation in the tire is the external friction on the road surface. However, such modes are implemented quite rarely in the actual operation of dump truck, mainly during the season of sluts and uphill movement. Solar radiation affects tire heating only in the hottest time of the year. In this case, the temperature of individual sections of the tire illuminated by the sun can increase by 10-15 ° C compared with the surface of the tire in the shade. Knowing the importance of haul truck tires in a mining operation to achieve planned productions. Tire OEMs had developed a large number of Tire Pressure Monitoring System (TPMS) to avoid or reduce failure by tire overheating. This TPMS is commonly a sensor that sits inside the tire chamber and wirelessly reports temperature and pressure regularly to the mining staff or the contractor in charge of the tires inventory. Mining companies typically maintain records of total diesel use across the mining fleet. In some cases, the fuel consumption of individual trucks is measured by recording the amount of fuel that is filled into each vehicle, while other operations simply measure total fuel dispensed to the fleet. Fortescue was able to acquire data for fuel deliveries to each haul truck from their fuel management system, and those of their contractors. Companies should determine the key performance indicators that enable an adequate analysis and management of energy use. In practice this may require a set of indicators to be developed. To effectively track energy performance, companies will need to develop a framework that adequately considers the variables affecting operations to provide a fair or normalized picture of the operation's energy use and enable potential efficiency improvements to be identified

## **CONCLUSION**

Mining Technology has listed leading suppliers of tracks, wheels and tires for mining and industrial vehicles based on its comprehensive knowledge and extensive experience in the sector. The information contained in the download document is designed for mine tire technicians, mining car operators, mine supervisors, procurement officers, maintenance specialists, and equipment operators. Vehicles fitted with rubber tracks are ideal for mine sites compared to vehicles fitted with tires or steel tracks as they provide more stability and ease of operation. Tracked vehicles also produce less vibration and do not damage the ground as they move.

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