



International Conference on Industrial Engineering, ICIE 2017

## Selection of Open-Pit Dump Trucks during Quarry Reconstruction

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### Abstract

Nowadays and in the near foreseeable future the quarry road transport will be the most common in the open-cut mining method. This is due to a range of advantages of open-pit dump trucks usage as compared with other types of quarry transport, i.e. autonomy, the possibility of using in any mining engineering and climatic conditions etc. At the same time, this type of quarry transport is the most expensive and the questions related to operational cost reduction are relevant. The market of open-pit dump trucks in Russia features a large number of different producers. Many of them offer open-pit dump truck in almost all loading capacity classes. At the same time, open-pit dump trucks of different producers are characterized not only by the price but also by the design features, including overall dimensions. The mining enterprises could incur significantly greater quarry reconstruction costs to create the necessary transport communication with security conditions if they are guided by the initial cost of open-pit dump trucks and costs on their consequent service by selecting open-pit dump trucks in the same class of loading capacity.

The actual problem of selecting the ground mining and conveyor equipment for open-pit mining is considered in the present paper. The dependencies of changing the volumes of recovered minded rock from the width of haulage berm for open-pit dump trucks from different classes of loading capacity were established.

The application of the suggested approach and the developed Program of automated parameters calculation of quarry transport communications for different types of open-pit dump trucks will allow selecting the open-pit dump trucks during the quarries reconstruction with minimal volumes of through quarry of open pit side and costs over the planning period of the deposit development.

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Peer-review under responsibility of the scientific committee of the International Conference on Industrial Engineering

*Keywords:* open-pit transport; dump truck; haulage berm; open-pit sides; costs; volumes of mined rock.

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## 1. Introduction

The market of mineral resources production at mining enterprises is the strategically important for the Russian Federation. The main method of mineral development is open-pit mining that accounted for more than 80 per cent of iron ore, more than 70 percent of nonferrous metal ores, and almost 100 percent nonmetallic minerals deposits and construction materials [1].

The intensive development of the open-pit mining in Russia in the first half of the 20th century has worsened mining-and-geological conditions of mining and the increase in the number of deep and ultra-deep quarries [2]. The volume of transport work significantly increases and costs for transportation of mined rock reached up to 40-60 per cent of prime cost of mining activities [3].

Nowadays, about 70 percent of all mined rock's volume from quarries in Russia transported with application road transport that is most expensive. Despite the high operating costs, the application of open-pit dump trucks at quarries compared to other has the range of advantages [4,5]: high manoeuvrability and mobility; large slopes and small radii of rounding the road alignments etc. In the near foreseeable future, the share of transportation of mined rocks at the quarries by open-pit dump trucks will remain at a high level.

The analysis of practical experience of selecting the models of dump trucks for work in quarry showed [6,7] that people are applied by the following main factors when they are selecting dump trucks: the combination of parameters of mining and loading, transport; the unit cost of the vehicle; operating costs; availability of centres to provide maintenance service or to train own personnel etc.

That factor as overall dimensions of dump trucks, usually, does not take into account [8]. However, this is precisely the overall width of dump truck defines parameters of haulage berm. This factor has an impact on design of open pit side, the volumes of recovered mined rock, and consequently the costs of deposit's development. Therefore, the questions of optimal selecting the dump trucks models at the development of deposit are relevant and their solution will define the projects' effectiveness of opening the deposits.

Here introduce the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 10 pt. Here follows further instructions for authors.

## 2. Dependence research of changing the volumes of recovered mined rock from the width of haulage berm

The open-pit dump trucks are the basis of automobile park used at open-pit mining [9]. Nowadays, the major producers are the following companies: BelAZ, MoAZ, Ashok-Leyland, Bharat, Case, Caterpillar, Caterpillar-Elphinston, Hindustan, Hitachi (Euclid), Komatsu, Kyomsungsang (Kumsusan), Kress, Liebherr, NHL, Perlini, Randon, Rimpull, Shaofeng, Tamrock (Toro Supra), Terex (Unit Rig и Payhauler), Terberg и Zhonghuan. The schemes' variety of dump trucks applied in the long history of development has led to the most appropriate that is with rear-wheel drive and back unload dumper skip. Other schemes, for example, front-wheel drive vehicle, middle-wheel drive vehicle, turning dumper skip and dumper skip with side dumping, dumpers didn't take root [10].

Nowadays, the Russian market of open-pit dump trucks has over 9 thousand of vehicles with capacity of between 30 and 360 tonnes [11]. The market's analysis of demand for open-pit dump trucks in Russian Federation showed that the largest share is the production of automobile factory «BelAZ» – 94 per cent of the total quantity. The Caterpillar (3 per cent) and Komatsu (2 per cent) are the leaders among foreign manufacturers. At the same time, the share of mining equipment of producers from distant foreign countries have recently been on the rise. The analysis of proposed open-pit dump trucks showed that trucks of each capacity's class are differed in their overall dimensions. The authors have been conducted the studies to assess the impact of the width of dump trucks on design of open pit side through the width of haulage berm.

The characteristics of dump trucks Caterpillar, Komatsu, BelAZ, Hitachi have been applied as database for research in the present paper: 40-45 tonnes; 90-100 tonnes; 135-140 tonnes; 180-220 tonnes. In studies, the most attention is devoted to dump trucks with capacity up to 45 tons because of their prevalence in Russian market (their share is about 70 percent of the total number of dump trucks) and dump trucks with capacity of between 180-220 tonnes, as a result of perceptiveness of that models caused by general market's tendency – increase in unit size of dump trucks. This tendency has economic justification, the transportation costs reduced by 25 per cent with

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