



COMPREHENSIVE ANALYSIS OF TECHNOLOGICAL AND OPERATIONAL FACTORS CONTRIBUTING TO ELEVATED DIESEL FUEL CONSUMPTION IN BELAZ DUMP TRUCKS OPERATING IN OPEN-PIT MINING CONDITIONS

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Abstract. The purpose of this article is to analyse the problems affecting the increase in fuel consumption of mine dump trucks, as well as the efficiency of BelAZ dump trucks. Various methods of determining fuel consumption rates for dump trucks have also been analysed. As a result of the study, data on the operation of dump trucks from the road transport department of the Central Mining Department of Navoi Mining Division of Navoi Mining and Metallurgical Combine were collected, and the factors affecting the consumption of diesel fuel were analysed. As a result of researches the estimation of operational indicators of dump trucks is given, and also the indicators influencing fuel consumption during transportation of rock mass are revealed. In addition, several methods of calculation of fuel consumption are proposed and additional parameters affecting this indicator are determined. As a result of the research, recommendations were developed to improve efficiency by reducing fuel consumption during the operation of dump trucks.

Keywords: dump truck, fuel, internal combustion engine, diesel fuel, consumption rates, road surface, load capacity, turning radius, performance indicators, tire pressure.



Introduction

The pace of development of the mining industry is sharply increasing. This encourages improvements to mining equipment as well as vehicles used in it to improve the efficiency of mining enterprises. As a result of this, special attention is paid to the auto industry, which is considered the largest share of the transport of minerals in the world.

Today, the Department of Road Transport is a multifaceted and multidisciplinary unit of the Central Mining Department of the NKMC, which performs the following functions:

In the careers" Muruntog", Tashkura "and" Amantaytog " are engaged in the transportation of mass of rocks and ores in technological car transport;

The transfer of gold ore into a heap solution provides loading into the grinding and sorting complex at the workshop.

The technological park of the traffic structure of the Department of Road Transport consists of modern motor vehicles with a carrying capacity of Caterpillar and BelAZ, from 55 to 220 tons, road-building cars Caterpillar, Komatsu, Dressta, Kirovets, as well as an auxiliary park of motor vehicles with mainly different BelAZ models.

One of the main indicators for analyzing the performance of dump trucks is fuel consumption, which represents the amount of fuel required to cover a certain distance or perform a certain amount of work (Sadudin Hodzic et. al., 2008; V. Kecojevic et. al., 2010).

One of the operational problems of dump trucks in quarries is excessive consumption of diesel fuel, which leads to material losses for mining enterprises. This indicator has a significant impact on planning the operation of dump trucks and assessing their efficiency (S. Masic et. al., 2005; Kurganov V.M. et. al., 2020; Kuznetsov I.S. et. al., 2021).

Fuel consumption is usually expressed in tons and grams per ton kilometer. To solve this problem, we will use the following scheme to evaluate the factors affecting diesel fuel consumption.

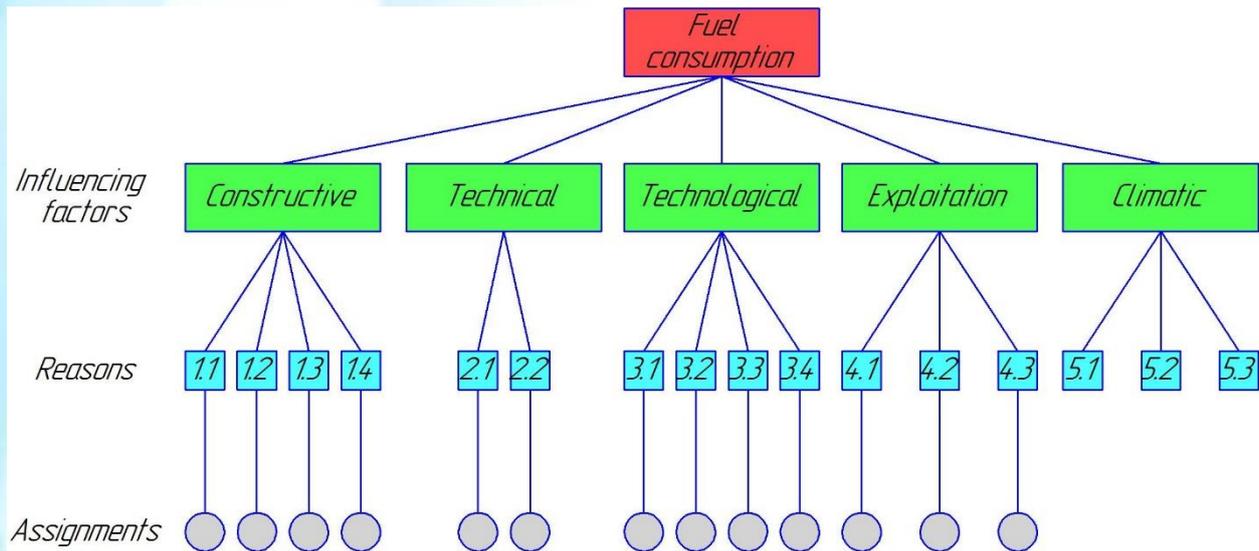


Figure 1. Factors affecting diesel fuel consumption.

A detailed analysis and calculation of fuel consumption is carried out for each dump truck, taking into account its individual technical indicators and performance characteristics. Therefore, we can calculate the standard fuel consumption using the following formula.

$$Q_n = 0.01 \cdot H_n \cdot S \cdot (1 + 0.01 \cdot D) + H_{q.n} \cdot Z$$

This is Q_n – a complex indicator of the soft standard fuel consumption in liters;
 H_n – an indicator expressing the fuel consumption of a dump truck for cargo operations;

S – a dynamic indicator of the total distance traveled by dump trucks, measured in kilometers.

$H_{(q.n)}$ – an indicator expressing the additional energy consumption of dump trucks, taking into account the number of trips with a load, measured in liters;

Z – a figure expressing the number of trips with a load in one shift;

D – a coefficient reflecting the total increase or decrease in energy consumption relative to this standard, expressed in percent.

Based on the above formula, we can determine the fuel consumption of a dump truck H_n for transportation operations as follows.

$$H_n = H_t + H_{q.m} \cdot (G_{a.m} + 0.5 \cdot q) \quad l/100 \text{ km}$$

Here H_t – is the standard fuel consumption indicator for transportation of dump trucks with a load coefficient of 0.5;

$H_{(q.m)}$ – is the fuel consumption indicator for transportation of dump trucks taking into account the additional mass of the dump truck;

$G_{a.m}$ – is the weight of the dump truck;

q – is the load-carrying capacity of the dump truck.

Based on the above formulas, we used data from January 2024 to February 2025 to analyze the fuel consumption of dump trucks with a full load. As a result of the calculations, a comparison diagram of the fuel consumption of dump trucks with a full and average load was drawn up in Figure 2.

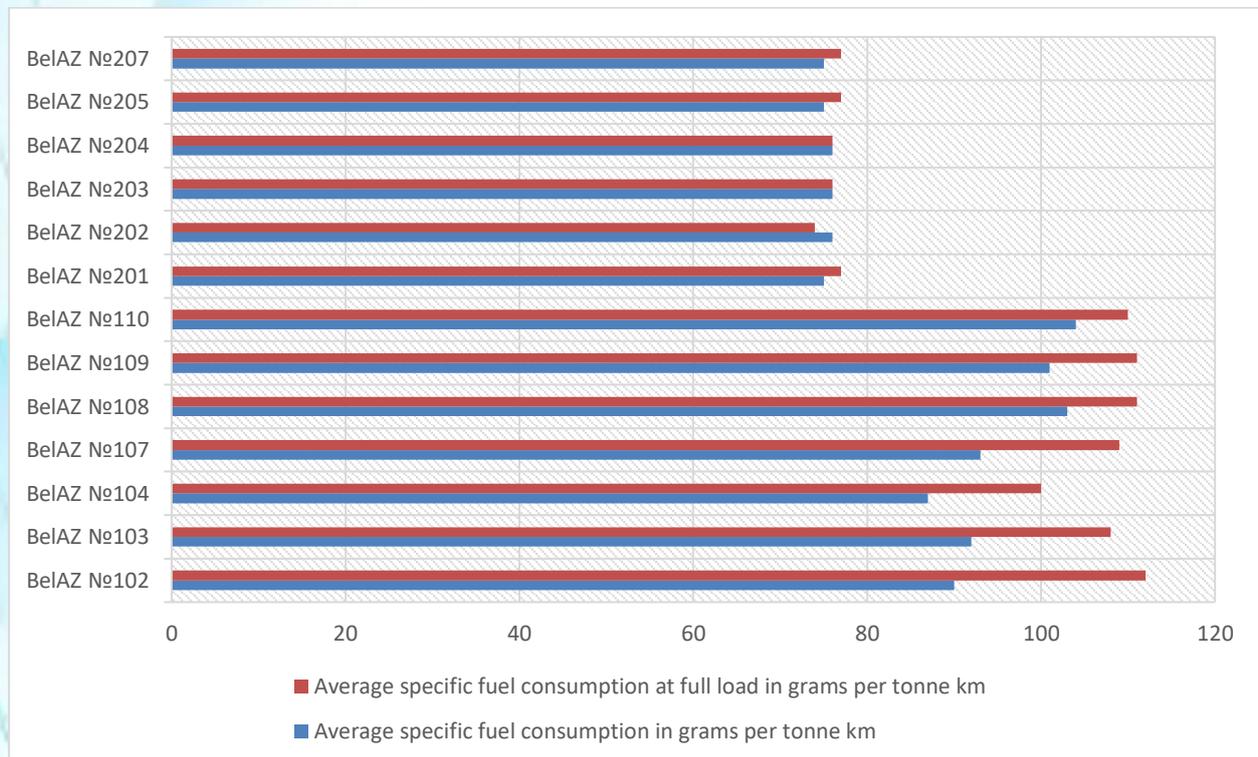


Figure 2. Comparison diagram of fuel consumption of dump trucks with full and average load capacity.

Analyzing the above diagram, we can conclude that the average diesel fuel consumption for BelAZ 7513 dump trucks exceeded the standard by 13.5%, the maximum value by 23.9%, and the minimum value by 6.3%. The best indicators of compliance with the standard for diesel fuel consumption for BelAZ 75310 dump trucks were shown by BelAZ No. 202, BelAZ No. 203, BelAZ No. 204, but we can see



that the diesel fuel consumption for BelAZ No. 201, BelAZ No. 205, BelAZ No. 207 exceeded the standard by 1%, 0.9%, and 1.03%, respectively.

Conclusions

In conclusion, following the above recommendations can significantly reduce fuel consumption in dump trucks, which in turn will lead to reduced costs and increased efficiency. Regular maintenance, tire pressure monitoring, efficient loading and distribution of loads, use of quality fuel, and driver training are some of the main factors in reducing fuel consumption.

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