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EFFICIENT USE OF TRANSPORT VEHICLES IN OPEN-END MINING ENTERPRISES

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Abstract: The extremely large scale of mining operations, labor and capital requirements, as well as the increasing depth of mining operations, the complexity of excavation conditions and the increasing distance of rock transportation have a negative impact on the efficiency of the mining enterprise. This thesis considers the issue of the effective use of road transport in rock transportation.

Keywords: Dump truck, step, open pit mines, transport vehicles, rock.

The complexity of technological processes in mining requires the preparation and improvement of the equipment used in it based on special requirements. Along with the main mining machines used in mining enterprises, improving the mining transport system and reducing costs is one of the problems that exist in mines today. In order to implement these requirements, the scope of application of effective new technical equipment and devices is increasing today.

In world practice, new types of production transport are used not only for transporting minerals, but also for transporting building materials, and the transportation distance is up to 200 km, and in some places even longer.

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Figure 1. Direction of movement of road transport

Today, transporting rocks in open pit mines is becoming increasingly difficult. Because in the process of extracting rock in quarries, the mine is deepening. This in itself makes it difficult to use a transport vehicle to transport rock. When using road transport in such mines (Figure 1), the distance increases, fuel consumption and the working fleet of dump trucks also increase. That is, in the case shown by the red line in Figure 1, the dump truck travels a long distance.

General information for calculation

Annual productivity of the quarry, *t/y*	6200000
Density of transported mineral, (t/m^3)	2.6
Distance from Zaboy to the unloading point, *m*	4900

The maximum amount of traction force is limited by the condition of contact of the moving wheel with the road surface, i.e.:

$$F_{yukli1}=237\ kN;\ \ F_{yukli2}=186\ kN;\ \ F_{yukli3}=210\ kN;\ \ F_{yukli4}=195\ kN;$$

The maximum value of the pulling force must comply with the condition.

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$$F_{max}=F_{yukli1}\leq 1000\cdot M_{sp}\cdot g\cdot \psi$$

$$237000\leq 1000\cdot 157{,}5\cdot 9{,}81\cdot 0{,}5;$$

$$237000\leq 772538\ N;$$

Estimated fuel consumption.

$$E_{diz}=\frac{A_{Tr}}{4187\cdot q_{T.s.}\cdot \eta_{diz.}}=\frac{8{,}8\cdot 10^8}{4187\cdot 10000\cdot 0{,}43}=48{,}3\ kg;$$

Actual fuel consumption calculation.

$$E_f=E_{diz}\cdot K_{qish}\cdot K_m\cdot K_{g.eh.}=48{,}3\cdot 1{,}05\cdot 1{,}04\cdot 1{,}04=54{,}8\ kg;$$

Dump truck productivity during a shift.

$$Q_{sm}=\frac{60\cdot T_{sm}}{T_r-t_{qush}}\cdot q\cdot K_g=\frac{60\cdot 11}{40-2{,}2}\cdot 130\cdot 0{,}75=1702\ t/smena;$$

Determining the working and inventory fleet of dump trucks.

$$Q'_{sm}=\frac{A\cdot K_{n.r.}}{n_{ish.}\cdot n_{sm}}=\frac{6200000\cdot 1{,}1}{305\cdot 2}=11180\ t;$$

$$N_{ish}=K_{n.h..}\cdot \frac{Q'_{sm}}{Q_{sm}}=1{,}2\cdot \frac{11180}{1702}=8;$$

$$N_{in.}=\frac{N_{ish}}{K_g}=\frac{8}{0{,}75}=11$$

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Figure 2. Road traffic direction at close range

In such cases, if we continue the movement from the nearest steps in the quarry, we will be able to reduce the transportation distance. That is, if the dump truck moves in the position shown by the black line in Figure 2, we will be able to save significantly on both fuel and dump truck labor.

General information for calculation

Annual productivity of the quarry , *t/yil*	6200000
Density of transported mineral, (t/m^3)	2.6
Distance from Zaboy to the unloading point, *m*	4350

The maximum amount of traction force is limited by the condition of contact of the moving wheel with the road surface, i.e.:

$$F_{yukli1}=185{,}5\ kN;\ \ F_{yukli2}=180\ kN;\ \ F_{yukli3}=210\ kN;\ \ F_{yukli4}=194{,}5\ kN;$$

The maximum value of the pulling force must comply with the condition.

$$F_{max}=F_{yukli4}\leq 1000\cdot M_{sp}\cdot g\cdot \psi$$

$$210000\leq 1000\cdot 157{,}5\cdot 9{,}81\cdot 0{,}5;$$

$$210000\leq 772538\ N;$$

Estimated fuel consumption.

$$E_{diz}=\frac{A_{Tr}}{4187\cdot q_{T.s.}\cdot \eta_{diz.}}=\frac{7{,}8\cdot 10^8}{4187\cdot 10000\cdot 0{,}43}=43\ kg;$$

Estimated fuel consumption.

$$E_f=E_{diz}\cdot K_{qish}\cdot K_m\cdot K_{g.eh.}=43\cdot 1{,}05\cdot 1{,}04\cdot 1{,}04=48\ kg;$$

Dump truck productivity during a shift.

$$Q_{sm}=\frac{60\cdot T_{sm}}{T_r-t_{qush}}\cdot q\cdot K_g=\frac{60\cdot 11}{35-2{,}2}\cdot 130\cdot 0{,}75=1961\ t/smena;$$

Determining the working and inventory fleet of dump trucks.

$$Q'_{sm}=\frac{A\cdot K_{n.r.}}{n_{ish.}\cdot n_{sm}}=\frac{6200000\cdot 1{,}1}{305\cdot 2}=11180\ t;$$

$$N_{ish}=K_{n.h..}\cdot\frac{Q'_{sm}}{Q_{sm}}=1{,}2\cdot\frac{11180}{1961}=6;$$

$$N_{in.}=\frac{N_{ish}}{K_g}=\frac{6}{0{,}75}=8$$

Conclusion

In the work we have shown above, currently 11 dump trucks are transporting rock over a distance of 4.9 km, and each dump truck consumes 54 liters of fuel. If we continue to move from the nearest steps, the dump truck will cover a distance of 4.3 km, so we will need 8 dump trucks and each dump truck will consume 48 liters of fuel. It is clear from this that we can achieve economic efficiency by using the nearest steps.

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