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Constructions Investigation of Ore Transfer Points Within Mining Limits While Developing the Deep Pit

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Abstract: The article describes the existing schemes excavation of ore transshipment points in the quarries with road- rail transport use. A method for overload ore warehouse with a hydraulic backhoe has been proposed. Transshipment point is a combination of mining and receiving trench bottom and moves following advance work.

Key words: Hydraulic excavator with backhoe · Ore warehouse · Combined transport · Mining · Quarry · Scope of work

INTRODUCTION

During the lifetime, from the beginning of construction and finish of mining operation, quarries are continuously developing. Large amounts of rock mass are extracted, working area are moved in one space to another, the size and depth of quarries are increased, schemes of transport communications are complicated, geological conditions of field development are changing.

Exploitation feature of deep pits is that the growth of complexity and the complexity of rock mass transportation outpace production volume and transportation capacity for account of integrated impact of the abovementioned factors [2, 6, 7].

Because of the specific technical and technological features it is obvious not possible to solve the transport problem using one mean of transport, so the large quarries used combined transport systems. In addition, each type of transport involved in the most convenient and favorable conditions for it, thus achieving the highest technical and economic efficiency of the transport process [1, 8].

In this case interconnection of transport means is carried out via constructions of intermediate points. The correct choice of design, location of quarry steps of transfer these points depend on performance, continuity and operation of the mining equipments [3, 5, 4].

As the transfer points stocking dolly ways and intermediate excavation warehouses are used for reloading points. Due to economic and organizational factors (simplicity of the device, the high speed construction, independence of vehicles on delivery and loading of the rock mass, the ability to sorting and averaging), overloading via direct mechanical shovel excavators is the most widely spread (Fig. 1) [4].

The object of study. It has been established [9, 10] that it is efficient for transfer points to be in the vicinity of mining face. Such scheme of work allows simultaneously or alternately loading the rock mass of ready-to-extract and warehouse stocks. The service life of the transfer points without transfer transport means as well as the utilization of warehouse equipment are increasing, automobile transportation volumes is reducing, opportunities to average quality and grading of ore are developed. Fig. 2 shows a diagram of a transfer point, which is a combination of the receiving trench (position I) and mining face (position II).

The principal difference from the existing schemes of intermediate storage is that the ore is not placed in piles but in the receiving trench standing below the excavator. This provides reducing in the volume of mining operations, compared with the bulk warehouses, reducing the width of the working area; decreasing dust emissions at the site of unloading ore.

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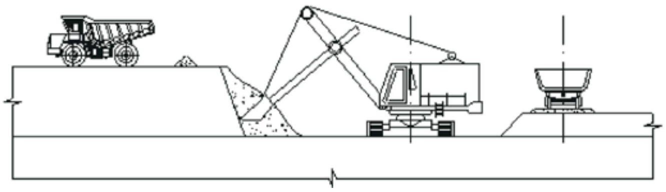
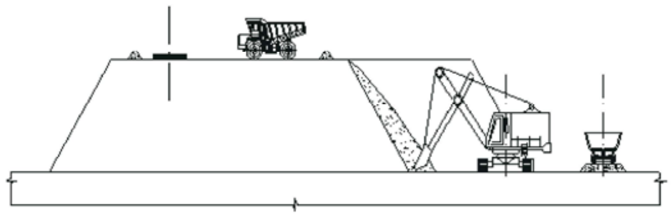


(a)



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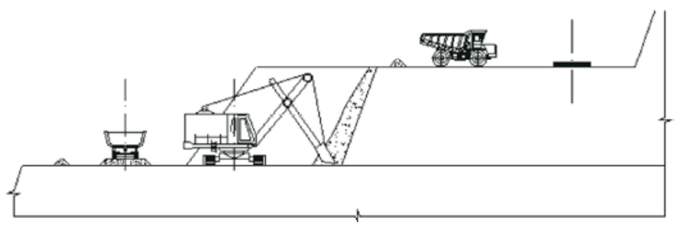

(c)

Fig. 1: Main types of excavation reloading types:
a) buried: a) front side and c) one-sided stacking

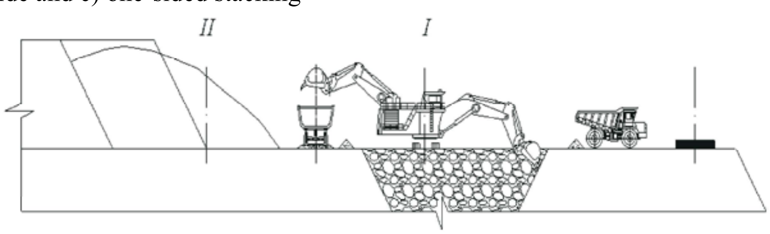

Fig. 2: Schematic diagram of transfer point within quarry limits for hydraulic backhoe excavator

There can be two types of the transfer point organization. In the first case, the receiving trench is divided lengthwise into two sites (receiving and shipping ore). This provides independent work in the areas of receiving trenches and mining face. In the second one, the receiving trench is a whole unit and the operations for receiving and loading ore alternate between receiving trench and extracting mine.

Selection of design warehouse shall be determined due to the intensity of turnover through transshipment point.

Professor M.V. Vasiliev offered to separate ore in the bulk stock into active and passive reserves. Active ore reserves should provide its current fuel stock at a fixed position of transport means, while a passive stockpile serves as a reserve. The magnitude of the active stock must satisfy the condition:

$$V_a \geq L \cdot A \cdot H_w,$$

where,

L - Length bulk warehouse, meter;
A - Width cut dredge, meter;
H_w - Height of the warehouse, meter.

By analogy with the bulk warehouses ore can be divided in the stock within quarry limits with receiving trench. Herewith active reserve is ore, located directly at the reception trench and passive - ready to stock mining in the adjacent with trench advance heading.

Total storage capacity at the initial stage of its operation is:

$V_s = V_z + V_t$
$V_f - L_t \,.\, A \,.\, H_f$
$V_t - L_t \,.\, B_t \,.\, H_t,$

where,
L_t - The length of the receiving trench, meter;
H_t - Mining height ledge, meter;
B_t - Receiving trench width, meter;
H_t - Depth of the receiving trench, meter;

Daily turnover of transfer point consists of loading ore from receiving trench as well as from advance heading:

$Q_s = Q_{sf} + Q_{sw},$

where,
Q_{sf} - The daily loading of ore from the face, t / day;
Q_{sw} - Daily loading of ore receiving trench, t / day.

The time of ore processing in the mine within a transfer point limits:

$$T_e = \frac{V_f \cdot \gamma}{Q_{s\,f}},$$

where
γ - The specific density of the mineral, ton per cubic meter.

Let us introduce a factor of ore shipment from the mining face:

$$k_f = \frac{Q_{s\,f}}{Q_s}$$

Then the time of ore processing in the mine can be represented as follows:

$$T_e = \frac{V_f \cdot \gamma}{Q_s \cdot k_f}$$

After the exhaustion of ore reserves within the length of the receiving trench this site starts to work in the filling mode. Time to fill work out space of advance heading is:

$$T_f = \frac{V_f}{V_a \cdot n_p \cdot N_a},$$

where,
V_a - The capacity of a dump truck serving transfer warehouse, cubic meter;

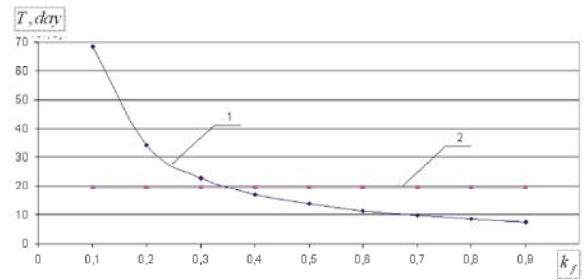

Fig. 3: Dependence of warehouse life cycle on the ore shipment coefficient from the mine working

n_p - The number of trips per day;
N_a - The number of dump trucks.

For the transfer points having a receiving trench the period of the discharge-filling cycle is determined by the daily shipment and can be calculated according to the formula:

$$T_{st} = T' + m \cdot z,$$

where,
T' - The pure time of processing ore at the advance heading within the transfer point limits (provided the loading is carried out only from the advance heading), the day:

$$T' = \frac{V_f \cdot \gamma}{Q_s};$$

where,
m - Period, on which the rock mass stock in the warehouse is calculated, the days;
z - The number of filling times in the receiving trench during the ore mining in advance heading:

$$z = \frac{T'}{T_w},$$

where,
T_w - The time needed for filling the receiving trench.

$$T_w = \frac{V_t}{V_a \cdot n_p \cdot N_a}$$

Fig. 3 shows the dependence $T_{st} = f(k_f)$ (1) for variant when receiving trench has two sections (filling and shipment).

As for initial data the following: excavators Komatsu PC 1800-6, irregularity factor of ore filling are accepted. In case of the reception trench is constituted one entire unit, the graph will have a line (2). This line separates coefficient of shipping ore from the advance heading, in which it is advisable to divide the receiving trench into two sections. So, for the given conditions at $k_f > 0.35$ it does not make sense to divide the receiving trench into areas.

CONCLUSION

The analysis and assessment of open-pit using combined means of transport, as well as existing design techniques of transfer points of the rock mass have been carried out. The scheme of warehousing in quarry and transshipment of ore in the warehouse with receiving trench and a hydraulic backhoe excavator has been developed. The regularity of transshipment warehouse lifecycle, depending on the coefficient of ore shipment from the trench adjacent to the reception area of the mining face has been derived.

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