Substantiation of the optimal angle of intersection of the milling cutting strip determining losses and dilution

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Abstract. This study proposes innovative technological schemes for open-pit mining to reduce costs by minimizing transportation distances. The schemes involve dividing the mining front into sections, mining sections with overburden benches that undercut the mineral layer, and mining benches with the placement of rocks in internal dumps and the advancement of the dump front after bench mining. The research identifies optimal mining block schemes and parameters that maximize productivity. Additionally, the study highlights actual losses in production time due to organizational set and provides strategies to achieve combine efficiency.

1 Introduction

The geological structure of the Jeroy Sardana deposit requires a special approach when determining the angle of intersection when turning the milling combine at the ore-rock boundary, which has a significant impact on the quality of the extracted ore and is one of the criteria for dilution during the extraction of ore mass.

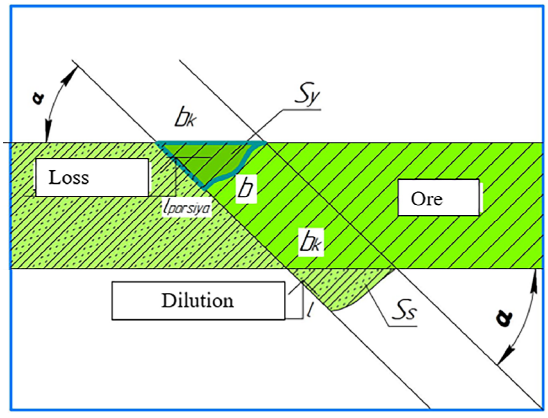

Fig. 1. Diagram of determining the angle of intersection when turning the milling combine at the ore-rock boundary during the processing of phosphoplast.

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Figure 1 shows the permissible length during milling of the ore-rock contact. Which determines the milling width and length b_k of the contact being worked out [1, 2].

2 Materials and methods

The paper proposes the definition of areas at the same intersection of the ore-rock and rock-ore contact, taking into account the load capacity of the dump truck according to the formula: [3.4.5]

At one intersection of the ore-rock contact, the amount of inclusion of waste rocks:

$$K = \frac{b^2 * tg(90-\alpha) * h_{fr} * \gamma}{2 * Q_{as}} * 100\% \quad (1)$$

here b – width of the milling strip, $b = b_к Sin\alpha$. м; h_{ms} – milling depth (thickness of the treated layer), m; $\gamma - density\ of\ rocks,\ \gamma = 2{,}0\ т/m3;\ Q_{as}$ – dump truck load capacity, t; α - the angle of intersection of the ore-rock contact by the combine.

The proportion of mixing of the host rocks is from the "triangle of ore-rock contact in the dredging portion (as the worst option), depending on the load capacity of the dump truck.

$$\alpha = arcctg(\frac{2 * K * Q_{as}}{b^2 * h_{ms} * \gamma}) \quad (2)$$

3 Results and discussion

The results of the calculation using the formulas proposed above are described in graphs 2,3, and 4.

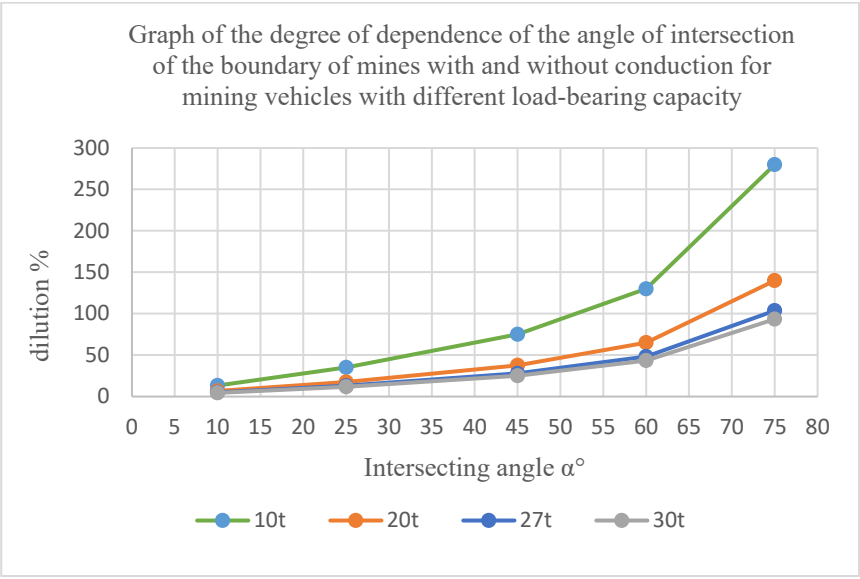

Fig 2. Graph of the degree of dependence of the angle of intersection of the boundary of mines with and without conduction for motor vehicles with different load-bearing capacity.

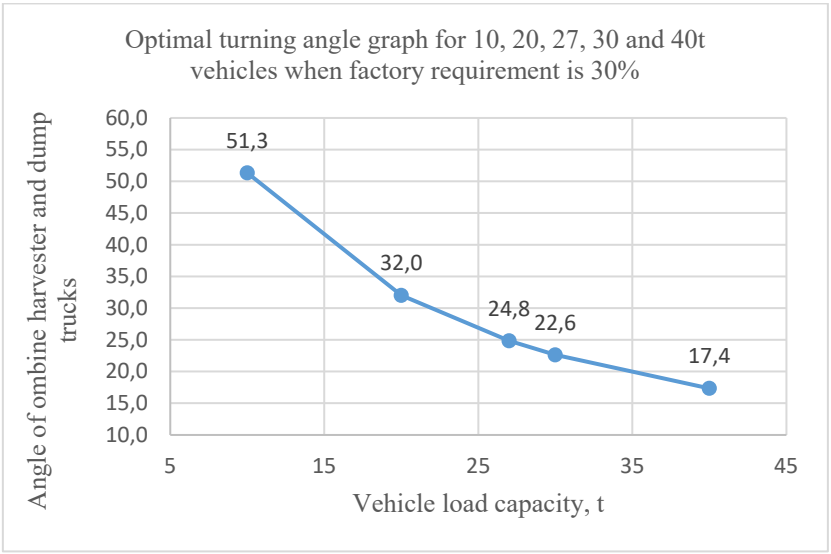

Fig 3. Optimal turning angle graph for 10, 20, 27, 30 and 40t vehicles when factory requirement is 30%.

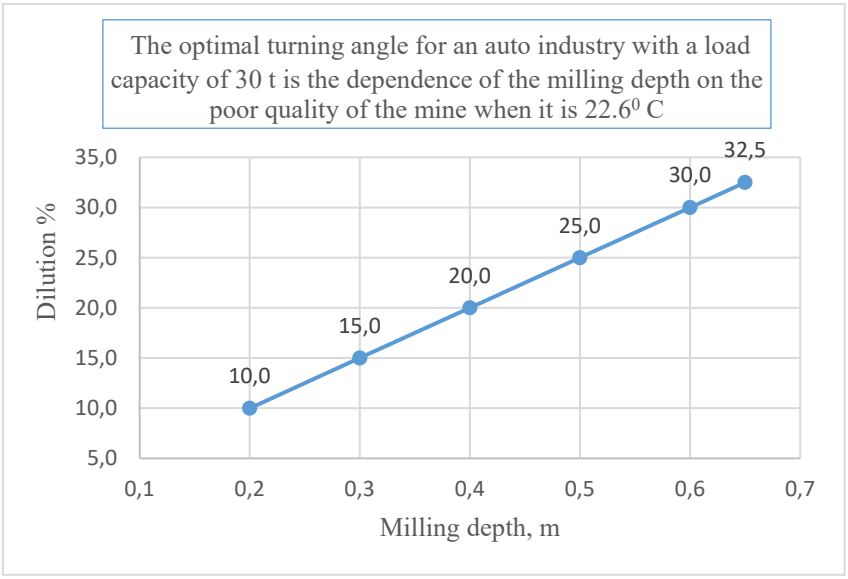

Fig 4. The optimal turning angle for vehicle with a load capacity of 30 t is the dependence of the milling depth on the poor quality of the mine when it is 22.6 C.

The analysis of the graphs in Fig. 2, 3 and 4 shows that with an acceptable proportion of host rocks mixed in the dump truck body equal to 30%, the appropriate angle of crossing the ore-breed border by the combine harvester should be more than 53.1 ° for dump trucks g/p 10t, more than 32°– for dump trucks g/f 20t, more than 25° dump trucks g/f 27 tons, more than 22.6 ° dump trucks g/n 30 tons and more than 17° dump trucks g/f 40 tons. [6,7].

Thus, on the basis of the developed methodology, a rational scope of application has been established in combination with a milling combine of dump trucks of different load capacities, depending on the angle of intersection of the ore-rock boundary with the milling

strip. So, for dump trucks with a lifting capacity of 30 tons, this angle should be no more than 22.6 °.

4 Conclusion

It was found that during the development of the "South Jeroy" quarry of the Jeroy-Sardara phosphorite deposit by milling combines using layer-by-layer mining technology, the main disadvantage of the technology in the conditions under consideration is the lack of quality control of the extracted ore mass.

The procedure for carrying out research to substantiate the parameters and indicators of the development of complex-structured deposits of phosphorite ores has been developed. The sequence of the mining system of combine ore extraction and its determining factors in the development of phosphoplast have been established. The angles of the optimal intersection of the milling cutting strip of the ore-rock and rock-ore boundaries are substantiated, which determine the indicators of dilution and losses.

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