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Basic Directions of Improvement and Improvement of Efficiency Ore Grinding

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ABSTRACT: The article describes the main directions and improvements and improving the efficiency of ore grinding. Automation of grinding processes and classification to improve equipment performance with the issuance of products of a given particle size distribution, as well as the choice of the optimal configuration of the mill.

KEYWORDS: Drum mills, grinding, productivity, efficiency increase.

I.INTRODUCTION

The economic potential of the country, the development of productive forces, our current well-being and the development of future generations largely depend on the mineral and raw material base, the scale of mining and mineral processing.

The semi-self-grinding process for the first time began to be seriously considered when designing ore preparation cycles since the mid-1960s. as an alternative to standard technology (three-stage crushing followed by grinding in rod and ball mills). For a long time, the widespread introduction of this process was hampered by its high sensitivity to the variability of the physicomechanical properties (strength, grain composition) of the processed raw materials and higher energy intensity in comparison with standard technology. It was believed that the best indicators of self-grinding are achieved when processing wet, viscous and clay types of raw materials, when crushing in cone crushers is ineffective or difficulties arise during transportation and storage of crushed products. After the appearance and successful testing in the 70-80s of the last century of such methods of intensification of the process of self-grinding, as loading into a mill of steel balls, withdrawal from the mill of difficult to grind critical size classes.

II.OVERVIEW OF DRUM MILLS

With the development of intensified methods, the productivity of PSI mills increased, they began to be used to grind stronger ores. The technology of self-grinding for different types of mineral raw materials has become virtually universal and in most cases provides high technical and economic indicators. To intensify the process of semi-self-grinding, reduce operating costs by increasing the performance of installed grinding capacities at a number of foreign enterprises in the 90s, a technological technique was developed and implemented. The purpose of this technique is to exclude the critical size classes directly from the power of the wet semi-grinding mill. Some overseas processing plants operate under semi-self-exclusion schemes like Kidston (Australia), Mintek (South Africa), Codelco (Chile), Geita Tanzania, Ray (USA), Troylus (Canada), Fimiston (Australia), St. Iven (Australia). [1]

Drum mills are relatively simple in design and easy to operate. However, they have significant drawbacks: small speeds of the impact of the grinding bodies on the material, only part of the grinding bodies takes part in the work, the working volume of the drum is used at 35-45%, the energy consumption is 35-40 kWh / t. As it is known for many technological mechanisms, the most common factor on which the total and specific energy consumption depends is the performance of the mechanism. The fundamental difference in the estimates of the impact of mill productivity on the power consumed by the mill is a rather complicated question and not fully understood. In our opinion, the performance of the mill cannot but affect the power consumed by the mill, and it is precisely in the sense of increasing the power consumption with increasing productivity of the mill. In fact, when a mill is operating with a certain capacity, the total mass of the mill load, in rotational motion, is larger compared to the total mass of the load of the same idle mill. The increase in the mass of the load of the mill at the same time occurs due to the milled material entering the mill. The

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choice of the optimal configuration of the mill depends on the granulometric composition of the feed, the required size of the grinding product, as well as other properties that determine the relative hardness and abrasiveness of the material.

III.RESULTS AND DISCUSSIONS

The performance of ore mills depends on the grinding material resistance, its particle size distribution, humidity and temperature, the fill factor, the range of grinding media, their mode of operation (lifting height, size classification by mill length), aspiration intensity, adsorption properties of the medium and a number as well as particle size the composition of the feed, the desired size of the grinding product, and other properties that determine the relative hardness and abrasiveness of the material of other factors. During the processing of coarse-grained material, the total intramill filling of a wet semi-self-grinding mill is 25–30%, in a ton of balls per hour — 8–15%, which contributes to the stable operation of the mills and ensures the most complete use of the installed capacity. When working on a small diet, an increase in cycle productivity is achieved with a higher level of ball loading and a decrease in the total intramill filling to 15–18% (2–5% higher than the level of ball loading). The work of the wet semi-self-grinding mill with a low level of ore filling is characterized by:

- increased wear of lifters and lining;
- reduced lining life
- high price for the service of the fine crushing unit;
- unstable mode of operation of the wet semi-self-grinding mill when changing (reducing) the ore fortress, the amount of circulating halia, which leads to overflow of the mill and, consequently, to a decrease in power consumption.

The figure shows the dependence of productivity and power consumption on the diameter of the mill. [2]

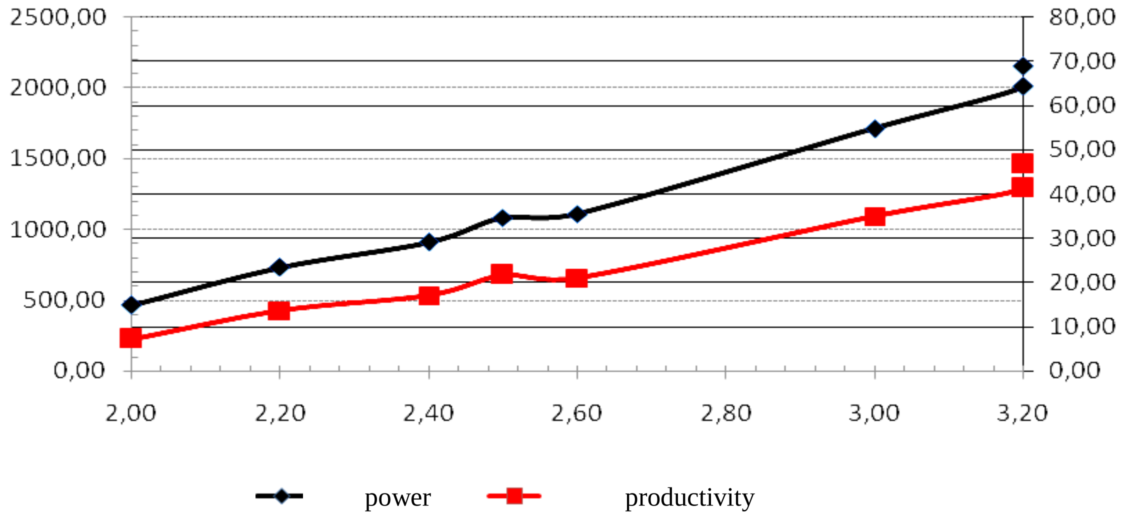

Figure 1. Dependence of productivity and power consumption on the diameter of the mill

$$N_э = 3{,}46\,\frac{M}{\varphi}\sqrt{D}\cdot\varphi^3\left[2(1-\kappa^4)-\frac{3}{4}\psi^4\left(1-\kappa^6\right)\right]$$

Where M - is the mass of balls in the mill, the degree of filling of the mill with balls, the proportion of units. D - is the diameter of the mill drum, is the relative frequency of rotation of the mill mill, is the ratio of the radii of the inner and outer layers of the grinding bodies.

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From the experimental graph it can be seen that the larger the diameter of the mill, the greater the productivity and power consumption.

IV. CONCLUSION

Thus, to increase the efficiency of the use of electricity, the productivity of the ore-dressing plants largely depends on the automation cycle. Regulation of the grinding cycle is to ensure maximum performance of the mill with a given particle size characteristic of the crushed material. Automation of the grinding and classification processes is used to improve equipment performance with the issuance of products of a given particle size distribution, to ensure optimal parameters for subsequent enrichment operations (flotation, magnetic separation and other operations). For non-ferrous metal ores, the following main automation systems will be provided:
- control and stabilization of feed mills source ore.
- remote measurement of the mass of ore fed to the mill,
- automatic regulation of the speed of movement of the feeder under the hopper for crushed ore, taking into account the circulating load.
- regulation of the supply of reagents, depending on the amount of incoming ore (for mills of the first grinding stage) and on the solids content in the pulp supplied for regrinding or on the residual ion concentration of the dosed reagent.
- regulation of the supply of balls in the mill, depending on the supply of ore in them
- control of the circulating load of the classifier on the ore consumption coming from it to the mill, or on the power consumed by the electric motor of the classifier. [3]

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