Complex automation system of iron ore preparation for beneficiation

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Abstract
The functional flowsheet of automation complex system of ore preparation process for beneficiation is developed. This system allows to control centralized the grinding process, to coordinate the information flows and to control the mill loading process more precisely, considering the volume of incoming ore and water, grinding balls and circulating load.
Keywords: AUTOMATIZATION, ORE GRINDING, MILL VOLUME LOADING, PULP DENSITY

One of the most priority activities in our region is the mining industry. In current conditions, the most relevant research topics are improving the quality of iron ore concentrate and energy efficiency improvement of iron ore raw material processing, to which a series of works are devoted [1-6].

The relevance of the work lies in the fact that at the present time ore is supplied from different open pits with different contents of magnetic iron to the ore-dressing plants of Kryvyi Rih without the prior averaging, which leads to changes in the ore mineral content, which is supplied to the first stage of magnetic separation. This leads to significant variations in the quality of the concentrate. In the sectoral problem laboratory of automatic control and quality of mineral raw materials, the methods and facilities for stabilization of iron mass fraction on the conveyor using the magnetic and gamma-gamma methods being developed [7, 8]. Also on the stage of ore grinding, there is a necessity of the mill volume loading control. This is due to the mill drive high power consumption (3-4 MW), at which even a few percent of underloading turns into energy losses [9]. At the same time, the mill overload can lead to an emergency situation. By maintaining the volumetric loading at the highest possible level the following results can be achieved: to use the mill in a mode of the maximum possible performance; reduce the absolute and specific energy consumption; stabilize the circulating strain [10]. Furthermore, before the ore supplying to magnetic separation stage, it is necessary to stabilize the density of the pulp on the sink of classifier. Existing stabilization systems allow to stabilize typically the technological process on the one of the grinding process loops. However, much more profitable to combine all stabilization systems into a single information system with a single calculation block, by which the information flows will be received. Using ore grinding process centralizing control, it is possible to monitor the state of grinding installation workload more precisely (considering the supply of ore, water, grinding medium, circulating load and ore mineral content in the crushed ore), furthermore it will simplify the ore grinding process control and allow to maintain the required process parameters more precisely. In this regard there is an urgent need to create an automation complex system of ore preparation process for beneficiation, which will stabilize the mass fraction of magnetic iron, arriving to the 1st stage of magnetic separation, mill volume filling stabilization and the density modes in it, as well as the stabilization of pulp density on the sink of the classifier.

Let's consider the functional flowsheet of ore pre- paration process for beneficiation (Fig. 1): 1) in a control system the plan by magnetic iron is set; 2) ore is fed into the mill via a feeder, on which using corresponding sensors the ore portion mass and its useful component content is measured; 3) to control the grinding installation volume filling the mill noise vibroacoustic sensor is used; 4) after crushing the ore is sent to classifier, wherein it is separated on a fairly milled product and a sand fraction; 5) when mill overloading the control system disables the feeder electric motor and stops the supply of ore into the mill.

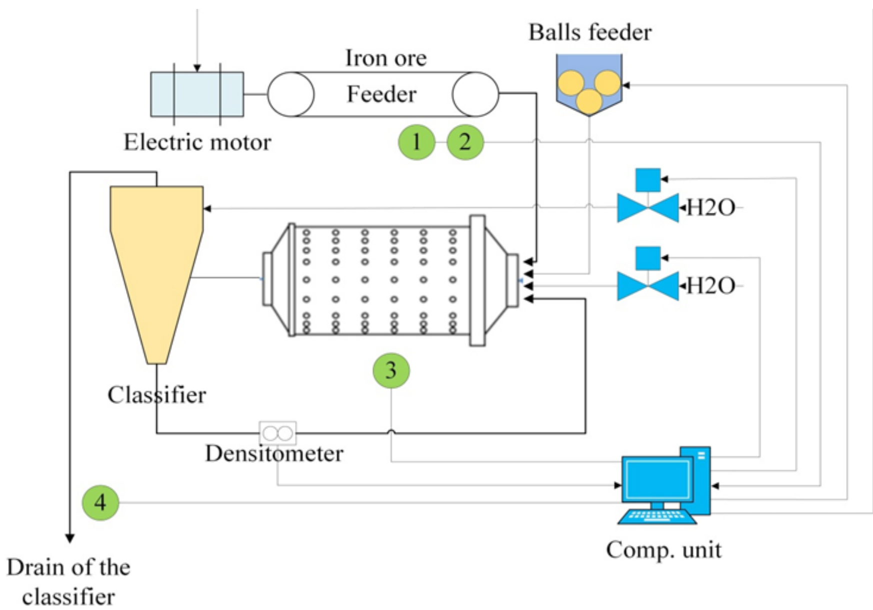

Figure 1. The functional flowsheet of automation complex system of ore preparation:
1 - the sensor of ore mass on the conveyor; 2 - the sensor of magnetic iron content in the ore on the conveyor; 3 - the sensor of mill volume loading; 4 – the pulp density sensor on the sink of classifier.

Furthermore, there is “liquid-solid” ratios recalculation. The control action is sent to the actuator valve, which controls the supply of water to the mill. By the signal about reduction of the mill loading critical level the ore supplying continues; 6) the pulp density control occurs on the sink of classifier, and when a deviation from the preset parameters, the control action is supplied on the valve, which adjusts the supply level of water to the mill; 7) control system provides timely supply of new portions of the grinding balls in the mill to ensure the effective grinding; 8) the number of magnetic iron, which supplied into the mill, are also calculated, and at achievement of the planned value the feeder engine is switched off.

This work will allow the realization of ore preparation first stage automation, to reduce the amount of magnetic iron losses to tailings, the cost price of the final product, to improve the concentrate quality and energy efficiency.

Conclusions

The functional flowsheet of automation complex system of ore preparation process for beneficiation, allowing to control centrally the mill loading level by controlling the amount indicators of ore, water, grinding balls and, magnetic iron content and to control the pulp density on the classifier sink is developed.

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