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A MODELING OF HOPPERS WORK AT LOADING OF THEM BY DISTRIBUTIVE DEVICE IN CYCLIC MODE

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The features of application of distributive device cyclic mode of motion at loading of the consistently located hoppers friable materials are considered. On the basis of the worked out model study of influence of hoppers location, speed of movement of distributive device and its productivity on providing of the set level for materials in technological capacities is executed. Recommendations over in relation to application of tits mode of operations of distributive device at productive conditions are brought.

Keywords: hopper, friable material, distributive device, cyclic mode, modeling

Introduction. One of the basic requirements to work of sintering section of sintering plant there is continuity of charge on pallets of sintering machines [1]. The volume of necessity of sintering mixture supply in receiving hoppers in a considerable measure is deconditionined by the productivity of sintering machines, properties of charge, technical descriptions and mode of work of distributive loading device (DLD).

Analysis of the state of question. Efficiency of process of distribution of sintering mixture between receiving hoppers depends on a choice as DLD, to the algorithm of its movement and exactness of determining the current quantity of friable material in capacities. DLD of any simple type is supported in practical realization cyclic mode. During the use of this mode the successive loading of capacities will be realized in two mutually opposite directions, adhering to the conditions of maintenance of permanent quantity of material in receiving hoppers during time of DLD every cycle motion.

In connection with the structural features there is DLD of type autostella allow to realize the cyclic mode of loading of hoppers only, on which look considerable vibrations of the level of materials in extreme hoppers, whatever the necessary supply of charge is not supported, and also there are frequent cases of their devastation.

Raising of task. For the ground of choice of the cyclic mode of movement of autostella during loading of technological capacities sintering mixture for the different conditions of production it is necessary to work out the model of control system by work of receiving hoppers, execute study and define at what conditions its application will be effective.

Main part of srudies. Development of model of control system by work of receiving hoppers was carried out on the basis of balance method [6], what allows to describe the processes of loading-unloading of technological capacities by friable materials, depending on position of DLD:

$$\Delta Q^j = \sum_{i=1}^{n} \Delta Q^j{}_i = \sum_{i=1}^{n} \int_0^{\tau^j_{ö}} q_i^{çj} - q_i^{âj} \; d\tau^j \;, \qquad (1)$$

where ΔQ^j – a quantity of friable materials in hoppers on j cycle, m^3; $\Delta Q^j{}_i$ – a quantity of material in a *i* hopper on j cycle, m^3; $\int_0^{\tau^j_{ö}} q_i^{çj} - q_i^{âj} \; d\tau^j$ – a quantity of friable materials which load to the hoppers and unload from them, for time τ_c on j cycle, m^3; τ_c^j – time of complete cycle of motion of autostella, s; *i* = 1 - *n* – a quantity of receiving hoppers.

Knowing the productivity of DLD, there is execute a calculation quantity of material, which load on *j* cycle in a *i* hopper:

$$Q^{ç\,j}_{\ i} = Q^{ï\,j}_{\ i} + \int_{\tau=0}^{\Delta\tau_{ïá^3}} q_3^{ÐÏ^{\ j}} d\tau^j \;, \qquad (2)$$

where $Q^{3\,j}_{\ i}$ – a quantity of material, that load on *j* cycle in a *i* hopper, m^3; $Q^{ï\,j}_{\ i}$ – a current quantity of material in a *i* hopper on *j* cycle, m^3; $q_i^{ÐÏ\,j}$ – the productivity of DLD, m^3/s.

After loading of receiving hopper begin the process of its unloading and supply of charge to the sintering machine. An unloading process takes place to the moment of serve of new portion of charge in a hopper. Quantity of material which remains in a hopper in the moment of beginning of its loading, calculate on a formula:

$$Q^{çàë\,j}_{\ i} = Q^{ï\,j}_{\ i} = Q^{ç\,j}_{\ i} - \int_{\tau=0}^{\tau^j_{ö}} q_3^{â\,j} d\tau^j = Q^{ç\,j}_{\ i} - \int_{\tau=0}^{\tau^j_{ö}} q_3^{æ\ j} d\tau^j \;, \qquad (3)$$

where $Q^{3a\pi^j_i}$ – a quantity of material in a hopper in the moment of beginning of its loading, m^3; $\int_{\tau=0}^{\tau^j_{ö}} q_3^{æ\ j} d\tau^j$ – a quantity of material, that unload feeder from to the hopper for time $\tau^j_{ö}$, m^3; $q_i^{æ\ j}$ – the productivity of feeder of *i* hopper, m^3/s.

The worked out structure of mathematical model consists of blocks of entrance and initial data, and also block of treatment of information.

In a block treatment of information carry out verification of current quantity of charge in every capacity, imitation of processes of loading and unloading of hoppers, count of time of move and position of DLD in relation to hoppers.

As results of work for mathematical model performances the block of initial of data forms position of DLD in relation to receiving hoppers, calculates the current quantity of charge in every capacity and rejection of its value from a maximum.

Programmatic realization of mathematical model was executed by means of package of «MatLab» and additions of «Simulink» and «Stateflow». Basic logic of work of receiving hoppers was described by means of «Stateflow-diagram».

For the estimation of efficiency of application of the cyclic mode for DLD during loading of receiving hoppers of sintering machines examined the different conditions of production. Experiments executed for enterprises, where from three to

six sintering machines of value of quantity of sintering mixture function in hoppers, at which began the process of their loading set in a range 50-80 % from the volume of capacity.

Got results it is shown that on enterprises where six and five sintering machines work and loading of receiving hoppers carry out by means of autostella in the cyclic mode look after considerable oscillation of quantity of friable materials in hoppers. At such productive conditions of breaking of charge on a sintering machine begins already from the fourth cycle of motion of DLD. During the use on enterprises four and three sintering machines autostella has time to provide the supply of charge only during the first cycles of work.

Conclusions. Thus, the worked out mathematical model of control system by work of receiving hoppers allows to execute the analysis of efficiency of application of the cyclic mode of work of DLD as on the stage of its choice at planning of production and for treason of values of technological parameters real-time during a control by this area.

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