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MODELLING OF MANAGEMENT SYSTEM BY WORK OF BUNKERS AT TERMS OF ARCH SUPPLE BY FRIABLE MATERIALS

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For determination of the rational mode of operations for area of receiving bunkers of sintering bay of agglofactory taking into account the features of motion for friable materials at the conditions of arches formation the mathematical model of prognostication of motion for burdening materials at expiration of them from a bunker and management system by work of distributive device at loading of technological tanks were worked out. On the basis of the worked out model it is possible at the change of parameters of burdening materials to determine the effective mode for operations of automatic self-unloading trolley.

Keywords: flowing material, bunker, arch, automatic self-unloading trolley, system of management, modelling

The most wideaccepted technological capacities on the areas of sintering and blast-furnace workshops are bunkers [1]. Their basic task is providing of inventories of friable materials with the purpose of diminishing of vibrations influence for delivery volumes of raw material and non-cootdination of work for adjacent technological aggregates. Motion of friable materials in capacities determines also efficiency them additional avetading on granulometric and chemical distribution, therefore modern developments in relation to the construction of bunker devices are intended to the search of optimal form and their volume for concrete technological terms with the purpose of diminishing of quantity for making of archs and bridgings [2,3].

A basic task to the area of receiving bunkers for sintering machines are providing of the set supplies of friable materials and their additional averaging before giving on a sinter belt [4]. Maintenance of material at set level is provided as a result of application of movable devices by means of which in the set mode carry out loading of all bunkers.

In work [5] the modelling of management system by motion of distributive device of automatic self-unloading trolley type depending on technical descriptions of equipment and technological features of work for sintering area of agglofactory at the terms for OAJ «Metallurgical combine «Zaporozhstal» is executed. On the basis of the given model it is possible to carry out research of influence for the modes of automatic self-unloading trolley operations on oscillation of quantity of friable materials in the receiving bunkers of sintering machines. However the features of motion of the noted materials are not taken into account in capacities and it is accepted, that they are loaded and off-load during time τ with the set productivity q.

For establishment of mechanisms of motion for friable materials into capacities depending on their parameters the authors of different works executed experiments and created different theories for description of action of the noted materials. It is

considered most popular the model of friable body, that is offered L.V. Goryachev [6], what describes an ideal friable body from position of his discreteness. The continuation this theory found in works of I.A. Zatsarinna [7].

Development of mathematical model, which describes treason of degree of filling for bunkers friable material depending on position of distributive device, was carried out on the basis of balance method [4]:

$$\Delta Q = \sum_{i=1}^{n} \Delta Q_i = \sum_{i=1}^{n} \int_{0}^{\tau_{u}} (q_i^{3} - q_i^{6})d\tau ,$$

where ΔQ, ΔQ_i are common quantity of friable materials in receiving bunkers and quantity of friable materials in i receiving bunker of sintering machines, m^3, accordingly; $\int_{0}^{\tau_{o}} \left(q_i^{c} - q_i^{a} \right) d\tau$ is a difference between the quantity of friable materials which load and off-load from a bunker for time τ_c, m^3; τ_c is time of complete cycle of automatic self-unloading trolley motion, s; $i = 1...n$ is a quantity of bunkers in the sintering area of agglofactory.

The task of management system by motion of automatic self-unloading trolley is providing of current quantity of friable materials in bunkers between minimum (Q_s^{min}) and maximally (Q_s^{max}) possible level [4,5]. The loadtime of material in a bunker is determined as a correlation between the necessary quantity of friable materials in a capacity and productivity of automatic self-unloading trolley.

For calculation of time of outflow for friable materials from a bunker in work used the mathematical model of I.A. Zatsarinna [7], what is adapted to the terms of sintering area of agglofactory, and also describes frequency and quantity of making during unloading of the noted materials. Determinations of these parameters carry out taking into account the diameter of bleak-hole and angle of angolarity of wall to the vertical line in bunkers and granulometric distribution and humidity of materials.

Realization of mathematical model which describes treason of degree of filling for bunkers friable materials depending on position of distributive device during their loading and features of motion of materials after their unloading executed by means of programmatic package «*MatLab*» and additions «*Simulink*» and «*Stateflow*».

It is set as a result of the execution researches, that at the different parameters of bunkers in a time of unloading of friable material it humidity and granulometric distribution influences substantially. So, at d_{ave} = 6 mm and W = 6 % time of unloading of material presents 15620 s, and the quantity of formed archs is evened - 19867. At W = 10 % the same material is unloaded after 15380 s with the quantity of archs - 8987. The best indexes answer the terms of unloading for material with d_{ave} = 9 mm and W = 10 %, here unloading time is evened 6801 s, and the quantity of the formed archs is folds 1585.

For the estimation of work of area receiving bunkers of sintering area on the worked out model research of work of management system by the process of distribution of charge in the successive, cyclic mode, and also mode «after a call» taking into account treason of parameters of charge are executed.

In accordance with the got results evidently, that the maximal downtime of bunkers without friable material, regardless of it parameters, is observed on their cyclic loading: a distributive device not effectively squanders time on a move from a sixth bunker to the first. During loading of bunkers in the successive mode look downtime outage only of extreme bunkers which three cycles of work for automatic self-unloading trolley fill two times, in that time as middle bunkers - three times each. It follows to consider that the rational mode of loading of bunkers «after a call», when is absent a long downtime of capacities without material.

Conclusions. Application of the adapted mathematical model for process of motion of friable materials in technological capacities allows to perfect the model of management system by work of area of receiving bunkers of sintering machines and determine the effective mode of distributive device motion at treason of parameters of the noted materials.

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