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A.S. Mnykh, associate professor, c.t.s.
M.Yu. Pazyuk, manager by a department, d.t.s., professor

TO QUESTION OF RESEARCH OF MECHANISM OF FORMING OF LAYER OF POLYDISPERSE SINTERING MIXTURE

Zaporozhe state engineering academy, Ukraine

Research of mechanism for layer forming of polydisperse sintering charge is carried out, the study of coefficients of friction for wobbling and sliding for the real conditions of production had further development. As a result functions which are got allow to calculate the indicated coefficients for the concrete conditions of charge loading by drum and vibrational feeder, accordance of experimental and calculation values of this coefficients is analyzed.

Keywords: segregation, polydisperse material, factious composition, vibrational feeder, clotting, sintering process, loading tray.

The basic method of clotting of shallow iron ores and iron-ore concentrates is an agglomeration by the method of soakage [1,2]. Due to relative simplicity of technology, high productivity of band sintering machines, high quality of the got product comparatively such method found wide distribution in world practice for production of black metals from iron ores.

Presently on the metallurgical plants of Ukraine conveyer sintering machines are used, losses of products (faction is a 5 mm) only on six machines of OAJ the «Metallurgical combine «Zaporozhstal» at on the average amount 15 %, that makes approximately 899.6 thousands tones/year.

The indicated losses depend, foremost, from quality of primary raw material, however their greater part takes place from imperfection technology for process of agglomeration. So, sintering machines, present on metallurgical plants, work taking into account middle composition of charge and does not take into account the current change of it factious composition, and also processes, flowing at an agglomeration.

The deficit of rich iron ores on the ferrous metallurgy plants of Ukraine all anymore stipulates application of concentrate of the deep enrichment, containing a to 90-95 % faction 0-0.05 mm. The productivity of sintering machine and quality of agglomerate, got from such concentrate, is determined, mainly, by gas-penetrability of layer of material by content of fuel and other components in each horizons of charge, loaded on agglomerated light carts.

It is set [3], that the segregation of charge renders positive influence on quality of the got agglomerate, decrease of consumption of energy resources, decrease of volume of return and harmful emissions. Therefore research of mechanisms for forming of polydisperse layer of charge and possibility of this process control has an important scientific and practical value.

At work [4] equation is presented, qualificatory distribution of particles in a layer depending on the row of factors, one of which the coefficient of friction serves. The purpose of the real work is clarification of the laboratory finding for determination of the real values of coefficient of friction in productive conditions.

In the process of motion for mass of polydisperse material in the system «Feeder - a loading tray - a slope of charge layer» separate particles in a stream co-operate between itself, that causes deviation of their action from conformities to law, got by calculation way. Large particles, losing part of kinetic energy at hitting with shallow particles, will stay too long on higher horizons in relation to calculation position. Shallow factions of material, in turn, under act of motion of large particles, will be moved to large distances, what it is expected in accordance with a model.

In connection with that the process of co-operation of separate particles in a locomotive stream is subject to considerable influence of casual out-of-control influences the real values of friction coefficients can be certain only by experimental way for the concrete conditions of forming of structure of friable material.

For a calculation $f_2' = \varphi(d_i)$ in the real conditions of charge loading on the agglomerated light carts of sintering machine equations, presented at work [4], decided relatively f_2'. For the case of the clean woobling of particle on the surface of loading tray and slope of the formed charge layer, dependence for determination of coefficient of friction for woobling looks like:

$$f_2' = \operatorname{tg}\alpha_2 \cdot \left(\frac{l_1 \cdot (\sin\alpha_1 - f_1' \cdot \cos\alpha_1)}{h_i} \right); \qquad (1)$$

where h_i is position of i of the particle in a layer in relation to his surface, m; α_1, α_2 are corners of slope of loading tray and surface of slope of layer, hail; f_1' is a friction of woobling coefficient of particle on the surface of loading tray.

Coefficient of friction for woobling of spherical form particles on the surface of polydisperse material, in the case of their woobling with sliding on a loading tray and clean woobling on the slope of the formed layer, it is possible to describe equation:

$$f_2' = \operatorname{tg}\alpha_2 \cdot \left(\frac{l_1 \cdot (\sin\alpha_1 - f_1 \cdot \cos\alpha_1)}{\nu \cdot h_i} \right); \qquad (2)$$

where f_1 is a coefficient of friction of sliding of particle on the surface of loading tray; ν is a coefficient for form of particle.

Dependences (1) and (2) were used for the calculation of coefficient of friction for woobling f_2' for a charge, loaded by means of oscillating and drum feeder.

The analysis of results of calculations allowed to set that in the case of the use for loading of charge of oscillating feeders there is weakening of connections between the particles of locomotive mass. In the total there is a decrease of value f_2' in the interval of change of diameter of particles d_i (0-4.5 mm), as compared to the case of loading of sintering charge drum feeder.

With the use of software, on the base of certain experimentally values of friction coefficient f_2', dependences, allowing to expect coefficient of friction for the case of loading by a drum feeder, are got:

$$f_2' = 34{,}07 + 3{,}14\, d_i - 20{,}15\, d_i^2 \ . \qquad (3)$$

Thus, size of mean square rejection of calculation facts, got on dependence (3), does not exceed 0.741 from experimental.

For the case of the use of oscillating feeder:

$$f_2' = 41{,}3 - 11{,}84 d_i + 1{,}15 d_i^2 - 0{,}0037 d_i^3 \ . \qquad (4)$$

The size of mean square error of accordance of experimental and calculation values f_2' does not exceed 0.922.

Influence of type of loading device, at the diameter of particles d_i < a 4.5 mm on dependence $f_2' = \varphi(d_i)$, is characterized by a presence along with the friction of woobling of the substantial on the size of friction sliding which increases as far as diminishing of size of locomotive particles. For granules the size of which exceeds d_i > a 4.5 mm, a form becomes near to spherical, as a result there is practically complete disappearance of sliding at motion of the last.

Conclusions. The realized researches allowed experimentally to define the real values of coefficient of friction in productive conditions, which allows setting distribution of particles on the height of agglomerated light cart, making the polydisperse layer of sintering charge. It is set that basic influence on conformities to law of forming of physics and mechanical properties of polydisperse material is rendered by it factious composition, features of loading device, and also type of metering device, angle of slope and length of loading tray.

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