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Indication of connectivity of the disperse material

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Abstract. In order to obtain quick information about the connectivity of the dust in the production test system-cleaning it is advisable to use the concept of connectivity indicator, which characterizes all kinds of strength characteristics of particulate material when changing conditions of particle interactions. Offers a simple method of indication of cohesion of particulate material, influencing the formation of sediment particles in the nozzle.

1. Introduction

In systems dedusting gas buildup of small particles occurs by reacting aggregates with surfaces enclosing space separation apparatus [1]. At the surface of the inertial unit particle density has a maximum value in each section of the apparatus, the number of collisions between particles is large, so that aggregates of fine particles produced in the cyclone. Thus, the operational reliability of dust and ash collection autohesion depends on the properties of the dispersion medium. Durability depends Fat effort interaction aggregates of particles with a surface and autohesion properties. The overall efficiency of dust removal gas is determined by measuring the flow of gas and dust concentrations at the inlet and outlet of the apparatus, as well as the hydraulic resistance. At the same time, as a rule, not an analysis of health system, since there is no information on the reasons for the rejection of the installation parameters design data due to lack of information about autohesion characteristics and behavior of dust in the machine.

2. Theoretical bases

Attention was given to develop a method in which there are no factors that lead to gross errors, and that would be easy to implement in a production environment.

Consider the state of stress in the compaction of the particulate material in a cylindrical array. A layer of dust in the bulk state, formed from fine aerosol particles composed of agglomerates and compression in the matrix volume is reduced while increasing the number of contacts between particles.

The dust compression process in the cylindrical matrix under load not exceeding 50 kPa autohesive break the connection between contacts new particles are formed between the particles, is compacted material without deformation and fracture of the particles themselves. It is known that for a purely elastic (reversible) deformation pressure load is balanced by the elastic deformation resistance of the body. When irreversible deformation work is performed, which determines the value of the voltage of the final position of the plunger $\sigma_{пл}$ at the stop ie after removal of the load. Thus on opening ends of the cylinder axial stress is zero, and the lateral pressure of $n\sigma_{пл}$ becomes paramount. In this case, the adhesion of the particles dispersed in the body is in the range $C_{св}=(0.3 \div 0.45)n\sigma_{пл}\approx 0.38n\sigma_{пл}$ [2].

$$\pi R^2 d\sigma_э = -\sigma_{пл} n 2\pi R k_э dh - \sigma_э 2\pi R k_э dh; \quad k_э = \mu_э \frac{\nu}{1-\nu}, \tag{1}$$

where R– radius plunger $\sigma_{плn}$ – residual voltage $\sigma_э$–napryazhenie when the elastic deformation during the extrusion process, $k_э$ –factor resistance equal to the factor of friction $\mu_э$ multiplied by a factor of lateral pressure, which is determined by Poisson's ratio ν, due to the elastic deformation during extrusion.

Integral expression is

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$$\int_{p_э}^{0} \frac{d\sigma_э}{\sigma_{пл} n + \sigma_э k_э} = -\frac{2H}{R}, \text{ or } \left[exp\left(\frac{2H}{R}k_э\right)-1\right]\frac{n\cdot\sigma_{пл}\cdot S}{P_у} = \frac{P_э}{P_у}, \quad (2)$$

where $p_э$ –voltage extrusion (extrusion). $P_э = p_э \pi R^2$– extrusion force, P_y – sealing force, S–area plunger, H– height matrix.

3. Research method and results

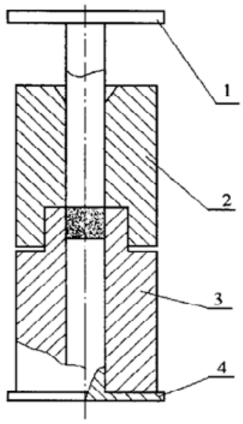

Figure 1. The apparatus for compacting and extruding the material

Disperse material sift through a sieve with a cell 1 мм2 and порционно load into a matrix consisting of details 2, 3. Thus the rod 4 is in the channel of a detail 3, and плунжер 1 is removed. A material fall asleep послойно, each time condensing плунжером 1 with a cargo creating pressure upon surfaces of a layer from a range of loads 10-40 кПа. After filling with a material of the channel of a detail 3 spend a socket of details 2, 3 and on a detail 3 surplus of a material cut off level with an end face. During this procedure occurs разрыхление surfaces of a layer.

Therefore, parts 2 and 3 again and the mating plug 1, carried out additional sealing in the same load. Plunger 1 is removed, parts 2, 3 is disconnected. Compacted mass is weighed, the values obtained are entered into the table. For a single powder test was conducted under different loads. In experiments to determine the sealability and strength extruded powder used two mating cylinder - basic (3) and support (2). Weight main cylinder – 15.31 g, size: diameter– 1.5 cm, height –1.2 cm.

Table 1 shows the weight of the powder in the matrix volume depending on the pressure seal.

Table 1. Weights of powders in the matrix depending on the condensing pressure

	M1				M2				M5				cement			
$m_н$(г)	0,9				1,2				1,7				2,1			
$P_у$(кПа)	1	10	20	50	1	10	20	50	1	10	20	50	1	10	20	50
$m_у$(г)	1,3	1,8	2	2,2	2,1	2,4	2,5	2,8	2,6	2,8	3,2	3,4	2,2	2,9	3,2	3,5

The reproducibility of the density values is improved by using pre-screening procedure powders.

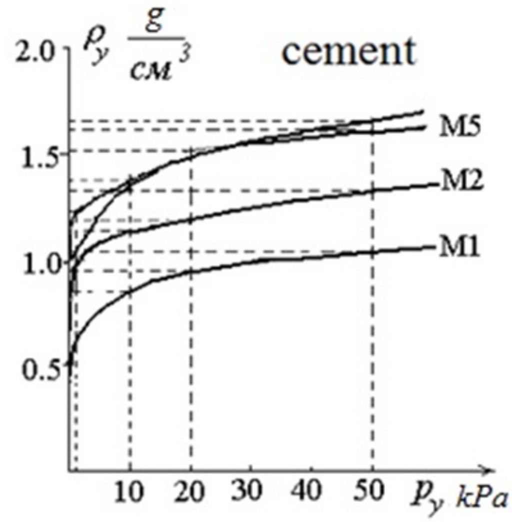

Figure 2. Density powders according to the pressure

Fig. 2 shows the powder density curves as a function of voltage packaging (1кПа 10g/cm2). Within the sealing load changes 1 ÷ 20 kPa is a rapid increase in the density of the material. Loose body after sealing is in a stressed state, which is determined by the autohesive. There are various ways the analytic representation of curves pressing [8, 9]. The relationship between the density of the material in bulk and compacted states can be represented as

$$\frac{\rho_{у}}{\rho_{н}} = 1 + b \ln \frac{p_{у}}{\rho_{н} g H}, \tag{3}$$

where the value of the empirical constant b is in the range 0.1–0.5. The value of bulk density is determined by a preliminary screening with an error 10–12%, without sifting 20–25%, and the spread of empirical constants is large. Therefore, the direct determination of the ratio ρу/ρн the relative sealing voltage requires the use of experimental data.
In our experiments, the extrusion material is compacted by increasing the weight of the load mounted on the plunger. When the material is ejected from the cylinder load is transmitted to all segments of the dispersed body in the matrix volume.

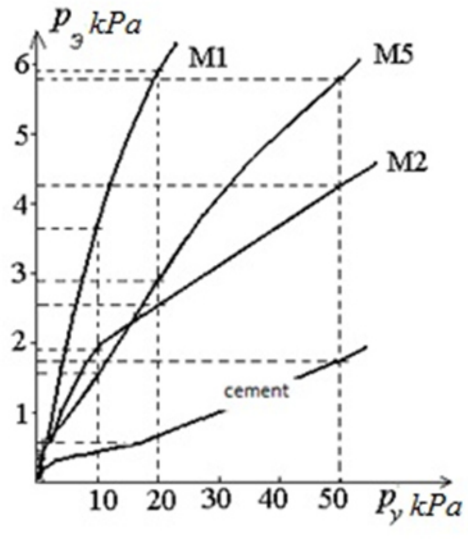

Figure.3. The dependence of the ejecting pressure of the sealing load

Fig. 3 shows the dependence of the ejecting voltage stress on the seal. The value of re undergoing major changes as compared to the density of the particulate material in the whole range of loads. In expression (2) value of the exponent depends on the ratio of the height to the radius of the matrix and the coefficient of resistance in the elastic deformation of the particulate material in the extrusion process. Since the drag coefficient to determine the coefficient of lateral pressure determined by the Poisson's ratio and the coefficient of friction in the elastic range, the range of which are known, we can calculate the value ranges of the exhibitors.
The coefficient of friction of the particulate body if known reference values can be found by an inclined platform. The platform is fixed a plate made of the same material as the material of the main cylinder. On the plate is placed powder thickness 1-2mm. Powder is placed on rectangular matrix. Shape layers filled with the powder is compacted load, create a compressed volume reduction and the formation of particulate body. Then a smaller weight load is placed, creating elastic deformation medium.

The angle of inclination of the platform at which the movement took place with the particulate matrix body and the load is determined by the friction coefficient. The value of the connection is the relation $C_{\text{св}} \approx 0,38 n\sigma_{\text{пл}}$ determined by the sealing pressure. Therefore, this voltage should be attributed to the sealing pressure. Using (1), we find

$$\frac{C_{\text{св}}}{P_{\text{у}}} \approx 0.38 \frac{P_{\text{э}}}{P_{\text{у}}} \frac{1}{\exp\left(\frac{2H}{R} k_{\text{э}}\right) - 1} \tag{4}$$

The value kэ is in the range 0.4 ÷ 0.7, the relative sizes of the matrix used in the experiment 2H/R=3.2, thus evaluating the connectivity in the experiment gave the following values Cсв=(0.05÷0.15)Pэ. Moreover, with the increase in the ratio of height to radius value matrix Pэ increases exponentially.

4. Conclusion

Indicator connectivity change is determined with respect to a change in the ejecting pressure sealing pressure for a given cylinder. The value of this indicator depends on the composition of the particulate dust, and the thermodynamic properties of the surfaces of the particles and the gas phase. In accordance with this value can be classified as an incoherent material, loosely connected, secondary materials, increased, strong connectivity and thus meaningfully indicator can predict the behavior of dust on the various stages of the separation process [3]. The method showed good reproducibility of experiments.

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