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DEFINITION OF TERMS DESTRUCTION (SHREDDING) PARTICLES DIFFERENT FORMS IN APPLYING RPA

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Grounded conditions for grinding particulate material to a certain extent. Retrieved technique that allows to estimate energy consumption for disaggregation of dispersed materials. The mechanisms of action of RPA working on material crushed, and on this basis the conditions of the guaranteed destruction of particles of different shapes.

Grinding, rotary - Pulse machine, cavitation.

Shredding - one of the oldest processes known to man. However, despite this, its theoretical foundations are still subject to change and are not yet fully formed, which complicates the calculation of energy consumption for its implementation. Since this process is energy intensive, the establishment of the relationship between size and grind the crushed particles and expended in their production of energy is an important task.

The purpose of research - the study of conditions for guaranteed grinding particles of different shapes in conjunction with working bodies pulsating rotary machine and finding dependencies to measure energy in obtaining homogeneous mixtures.

Materials and methods research. In a variety of industries and, in particular, chemical technology, there is a great need for finely divided materials. This grinding can play as the main and supporting roles (eg, intensification mass transfer processes).

For several reasons crushing process appropriately carried out in the liquid phase. In this case, no dust formation, which significantly affects the working conditions as well as under the influence of fluid wetted, to some extent reduced the strength of material grind, which yields smaller particles with less energy. In practice, the organization of such best results are achieved in the chopper, which to a small volume environment, processed, brought a lot of energy.

Such equipment includes machines, rotary-type pulsation (RPA). However, despite the numerous works devoted to the processing of different environments in the RPA, the process of grinding the dispersed solid phase in such equipment is not adequately explored. This work is mainly devoted to the analysis of particle size distribution of processed particles, whereas for the calculation of the energy it takes to grind in devices of this type, the information is practically nonexistent.

Studies. The process of grinding material accurately described by P. Rittinhera theory, according to which the power consumption is proportional to the square of the newly formed surface. On the other hand we know that any change in particle size, including grinding, results in changes in the free (surface) energy system Epov according to the equation W. Thomson:

$$\Delta E = 2\sigma V\left(\frac{1}{r_k} - \frac{1}{r_н}\right), \quad (1)$$

where - the surface tension of the material that is crushed at the interface with the environment, Dzh/m2; V-grind material volume, m3; - the final and the initial radius of the particle or aggregate.

At the same time, only a portion of the energy supplied, Ezovn spent directly on grinding. Assuming that some of the energy expended to increase the surface energy of the crushed particles of given density and mass of material to cut, equation (1) can be represented as:

$$\frac{i\sigma}{3\rho_{ТВ}}\left(S_{ПИТ.К} - S_{ПИТ.ПОЧ}\right) = \frac{E_{зовн}\eta}{m_{тв}} = \varepsilon, \quad (2)$$

where - the degree of grinding - density of the material is crushed, kg/m3; - respectively the initial and final specific surface area m2/m3 - efficiency. Slasher - weight material crushed kg.

The equation (2) can be conveniently applied for calculation of it to determine the energy consumption for grinding particulate material. When processing suspensions of vehicles, rotary-type pulsation is needed to assess the possibility of guaranteed grinding particles defined shape. As an example, consider grinding particles in the form of a parallelepiped. The figure shows a diagram of the destruction of such particles in the working bodies of the RPA.

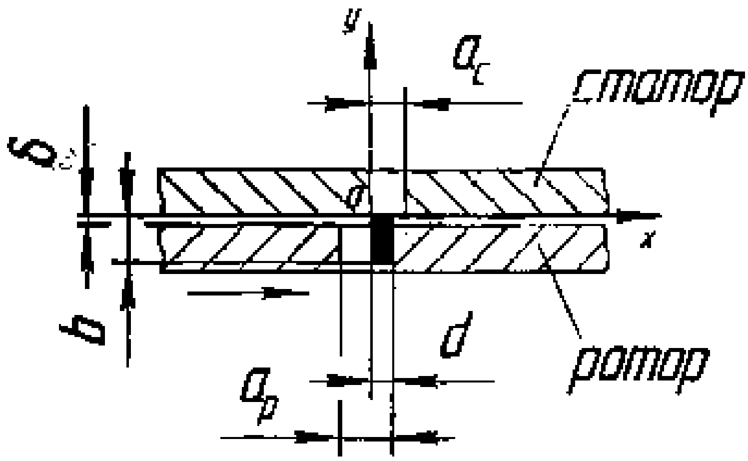

Figure destruction of particles in the form of a parallelepiped

In that position, "breakthrough" naymovirnishe particles as they are closer than others to the channel of the stator. The particles of the material can be there by transit flow in the gap between the rotor and stator, which always takes place in the apparatus of this type.

Particles that do not have time to take this provision because of the large channel length of the rotor can be there when you open the next channel in the direction of rotation of the stator. Given the minimal hydraulic resistance created by the particles of the material, we assume that the particles are oriented along the channel axis. Assume also that the particle velocity is equal to the velocity of the fluid (no slip). The figure shows that the motion of a particle starts at the moment when it "left edge is aligned to the left channel of the stator, so the starting point is taken point O. The analytical expression for the fracture conditions such particles, which are given as:

$$\tau_x = \frac{\left(a_p + a_c - \mathrm{d} - \sqrt{d^2 - \delta^2}\right)}{2\pi n R_p}, \quad \tau_y = \frac{(b - \delta)(d + a_c)z}{2kn}, \tag{3}$$

where - the channel width of the rotor, m - channel width of the stator, m - typical particle size, m - value of radial clearance between the rotor and stator - rotor speed, r / min - the movement of particles along the x-axis, p. - the movement of particles along the y-axis, p.; - the radius of the rotor, m - length of the particle cut, m - height of the channel, m - number of simultaneously open channels pcs.; - empirical coefficient.

From equation (3) that the increase in the frequency of rotation of the rotor RPA does not change the relationship between and, which may indicate the nature of the fracture usually movable particles.

Since the processing of RPA takes place in a liquid medium, then under certain conditions may cause cavitation. Clearly, the shredding of dispersed particles is only possible under certain correlations between their size and the size of cavitation bubbles. Diameter of cavitation bubbles at the time of its "collapse" does not exceed the diameter of particles are crushed, as in this case, the cumulative jet formed can not be focused on its surface. There is, perhaps, the lower limit of this ratio because of a decrease in the size of cavities decreases the energy released bubble. Therefore, to evaluate the effectiveness of exposure to the material cut, you can use the criterion of cavitation crashing:

$$K_{подр} = \frac{\mathrm{d}}{\mathrm{d}_П}; \tag{4}$$

where $$\mathrm{d}_П = 9\sqrt[3]{\frac{E_{зовн}}{33.8 \mathrm{u} p}}, \tag{5}$$

where - number of cavitation bubbles pieces.; - pressure, Pa.

To calculate the minimum energy required to fracture a particle, you can use previously derived equation (2). In view of formulas (4) and (5) expresses the condition (6), the performance of which will occur guaranteed cavitation destruction of particles:

$$1 \langle K_{подр} \langle \frac{d}{9\sqrt[3]{\frac{E_{зовн}}{33.8 u p}}}, \tag{6}$$

Previously obtained expression (2) to determine the energy consumption for dis ultrafine particles. Since direct measurement of the surface tension at the interfaces "machine-environment" is not possible, then it's best to associate the specified parameter from dzyeta-potential - an important metric that determines the resistance of fine aggregate particles. Dependence, which connects the surface tension of dzyeta-potential can be written as:

$$\sigma = \sigma_o - \frac{\pi \varepsilon_A^2 \zeta^2}{r_н}, \tag{7}$$

where - the interfacial tension on the flat edge distribution Dzh/m2 - absolute permittivity of the medium, F / m

However, for some materials in ultra state can not be calculated because they simply do not exist in conventional (macroscopic) state, due to the peculiarities of their synthesis. Therefore, instead of (7) we use the equation GI Lippmann, which connects the surface tension and surface charge of particles (aggregate).

$$\frac{d\sigma}{dU} = q_{пов}. \tag{8}$$

After some transformations of (8) we obtain:

$$\sigma = \frac{\mu \nu_q U}{\zeta}, \tag{9}$$

where - coefficient of dynamic viscosity of the medium, Pa - velocity of the particle, m / s - potential difference V.

Thus, defining dzyeta-potentsinal by electrophoresis and calculating the equation (9) to interfacial tension at the border unit dispersive medium by using formula (2) to determine the energy required for its destruction.

The resulting design according to estimate energy consumption for dis ultrafine materials.

Conclusions.

The following method allows to experimentally evaluate the energy consumption during the "wet" grinding in the RPA and to establish the degree of exposure to technological parameters.

That is, the production of mixtures of agricultural equipment application, rotary-type pulsation is quite effective for intensification of fine dispersion of the solid phase.

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