UDC 621.891

Vasil′chenko T., associate professor, c.t.s.
Shevchenko I., associate professor, c.t.s.
Kobrin Yu., assistant

ANALYSIS OF PROCESS OF DESTRUCTION OF FRAGILE MATERIALS BY BANG

Zaporezhe state engineering academy

The grounds of choice of critical speed in quality the criterion of destruction and mathematical description of its dependence on the size of particles and physical and mechanical properties of fragile materials were given.

Keywords: fragile materials, bang, destruction, tension, critical speed, researchs

Under growing there are shallow understand the process of abchesion of solid body on the particles of set fineness by mechanical way at the action of external forces which exceed forces of the molecular cohesion. Cracking materials are fragile and plastic, hard and soft, dry and moist, viscid and abrasive etc.

Unlike ideally solids, mechanical properties of fragile materials are different in different directions and substantially influence on their mechanical properties and conduct during deformation and destruction at the action of the external loading.

There are distinguishing destruction of material of compression and free-bang. At a free-bang destruction of material comes as a result of its clash with the pin organs of machine during flight. The effect of such bang of destruction is determined by speed of clash. At the compression by bang of particle of material distributed between two working organs of machine.

The method of growing shallow is elected taking into account physical properties of cracking material, first of all to its hardness and character of fracture. For materials with considerable hardness more effective is a bang and squashing, for viscid materials there is the best elimination, for fragile materials cleaving. The large growing of soft and fragile materials shallow it is desirable to execute squashing, middle and shallow – by a bang.

Next combinations of different methods of destruction of material apply as a rule, in grindings down: destruction by bang and elimination at operating on material of working organs which are quickly revolved; destruction by compression and change (splitting off and chop up) at operating on material of two surfaces, one of which moves fast, and other moves with insignificant speed, or remains immobile; destruction by compression, change and elimination at operating on material of two surfaces, one of which is mobile, and second is immobile; destruction by squashing or rolling (by a compression) of particles is between two surfaces which move with identical speeds.

Destruction of fragile materials by bang is realized by various structural charts in the crushers of shock action, among which most application were found ordinary the hammer crushers.

In hammer crushers destruction as a result of free-bang prevails. Pieces of raw material, which give to the hammer crusher test the shots of the hammers joint

suspended to the rotor, that is revolved. In the process of growing the particles of material are cast aside on ring-off flags, collide inter se and again head for hammers. Large pieces which remained are ground down at furnace-bar grates.

We considered the particle of fragile material as object of destruction. For its it is possible to take advantage of modern conception of destruction of body as a result of the power dynamic action on its at development of cracks which already are in its and appear again.

At the analysis of processes of distribution of cracks in a body, which destroy, usually use Grifftde formula. So, for a spherical crack we have:

$$2q = \frac{\sigma^2 \cdot R}{2E} \ , \qquad (1)$$

where σ – tension; q – specific superficial energy of destruction; E – the module of resiliency of body; R – radius of crack.

Concordantly M. Maachutov [2], specific energy of flowage it can be approximately to determine on a formula:

$$q_n = \frac{2}{3}\sigma_{\grave{O}} \cdot \mathring{a}_{\grave{O}} \cdot S_{\grave{O}} \ , \qquad (2)$$

where σ_T – a temporal tearstrength of material at the relative flowage of e_T; S_T – a thickness of layer of destruction, which is deformed plastic.

Three main types at development cracks arise up of deformation of superficial crack: normal tearing away, transversal and longitudinal moving. In the particle of fragile material all types of deformations can be realized dependency upon its form, and also direction of shock impulse.

We will consider a case, when a particle has a form of cube with the side b, and the surfaces of hammer and reflecting flag are accepted as a plane. In this case there can be a direct bang ($\alpha = 0$) or bang with deviation from on a corner α ($\alpha \neq 0$). During a bang a hammer gives to the particle of shock impulse :

$$S = m \cdot v_{sp} \cdot \ 1 + k \quad , \qquad (3)$$

where m – mass of particle; v_{sp} - angled speed of hammer in the point of collide; k – a conditional coefficient of proceeding in normal speed of material of particle at a bang.

If to go out from that a particle destribution for conditions, when length of crack ℓ will attain its size ($\ell = b$), then formula for the calculations of critical speed v_{cr} of collide hammer with a particle, after development in its as a result of bang of tensions of the normal tearing away or transversal moving, looks like:

$$v_{\hat{e}\eth} = \frac{T}{\rho \cdot \cos\alpha} \cdot \sqrt{\frac{\pi \cdot q \cdot E}{1 - \mu^2 \ \cdot b^3}} \ , \ , \qquad (4)$$

where T – time of shock impulse; ρ – a closeness of material; μ – Puasson coefficient.

At the bang of hammer on the particle of material in the crushers of shock action a particle in times of T_1 of shock impulse acquires speed v_{sp} point of hammer, where a bang took place, and due to resilient properties will fly away from a hammer.

As most crushers of shock action work on the considered chart, rational is destruction of particles of material due to a bang for them hammer and bang of

particle at a reflecting flag. In this case at the first bang a crack appears long – ℓ_1, after the second – ℓ_2, and its general length is evened $\ell = \ell_1 + \ell_2$. Then at destruction of particle as a result of two shots, taking into account $\ell = b$, $T_1 \approx T_2$ (T_2 – time of shock impulse at the bang of particle at a reflecting flag), critical speed looks like:

$$v_{cr} = \frac{T}{\rho} \cdot \sqrt{\frac{\pi \cdot q \cdot E}{b^3 \cdot \left[1 + \sqrt{1 + k^2}\right]}} \quad . \tag{5}$$

Equation (5) makes sense in that case, when $tg\alpha < f$ and $tg\beta < f$, where f – a coefficient of friction of particle of material at the surface of hammer or reflecting flag.

Conclusions. Most substantially on the process of destruction of fragile materials influence its mechanical properties and method of appendix of the mechanical loading (bang, clench etc.).

The got formulas for the calculations of critical values of speed of collide particles of material with a hammer and refracting flag of crusher can be applied at determination of structurally-technological parameters of hammer crushers.

REFERENCES

1. **Косарев, А. И.** Молотковые дробилки для промышленности строительных материалов [Текст] / А. И. Косарев**,** Д. С. Силенок. – М. : ЦНИИТЭстроймаш,1979. – 40 с.
2. **Махутов, Н. А**. Конструкционная прочность, ресурс и техногенная безопасность [Текст] / Н. А. Махутов. В 2 ч. – Новосибирск: Наука, 2005. Ч.1: Критерии прочности и ресурса. – 494 с.