TEKA Kom. Mot. i Energ. Roln. – OL PAN, 2010, 10B, 260-265

AN INVESTIGATION OF THE PROCESS OF ANTHRACITE PARTICLES DESTRUCTION IN PERCUSSION CRUSHING MACHINES

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Summary. In the given article we investigate the process of anthracite destruction in percussion crushing machines under circumstances of matching of processes of conveyance and crushing. We adduced the dependence of the received dispersion on the speed during the hit of anthracite particles angularly against a hard obstacle

Key words: anthracite, percussion crushing machine, destruction, thermal power plant

INTRODUCTION

One of the most important factors of using solid fuel on thermal stations and in boiler rooms is its grinding fineness before its feed to burners.

In heat and power engineering of Ukraine the thinning of grinding is especially important because thereto low reactionary anthracite and lean coal are used, and fine grinding allows compensating to a considerable degree deleterious effect of small output of coal-volatile matter by the increase of speed of burning of particulate matter thanks to the developed surface [1, 2].

However it is known [3] that the dose of electricity which falls on the grinding of fuel on thermal power plant under existing equipment (generally these are ball grinders) is 1,5-2,5 % of the all energy which is produced by the thermal station but during the thinning of grinding this percent will considerably increase. Besides the time of grinding will considerably increase which inevitably will lead to installation of additional grinders for supply of necessary productivity and also tear and wear of crushing machine will increase.

That is why the effort to find effective and economical methods of coal grinding on thermal energy enterprises is a very actual task.

RESEARCH OBJECT

One of the most effective methods of fine grinding is material particles destruction by high-speed hit [4]. This method may be implemented during the combination of pneumotransporting of coal by using zigzag pipe where in each elbow there is a grindability plate fulfilled as lined inclined inset [5].

But the additional resistance of the pipeline implies additional energy consumption which depends on technological and constructive factors. Apparently, under certain combination of these factors energy consumption for coal grinding will be minimal. In the given article we investigate the impact of some factors on the process of anthracite grinding.

RESULTS OF THEORETICAL RESEARCH

The fineness of grinding may be characterized by particles specific surface area [6]:

$$S_m = \frac{S \cdot g}{\rho \cdot \upsilon} , \quad (1)$$

where: S_m is particles specific surface area, m^2/kg,

S is the particles surface, m^2,

g is the free fall acceleration, g = 9,81 m/s^2,

ρ is the particles specific weight, N/m^3,

υ is the particles volume, m^3.

During reiteration of hits against the solid flat obstacle which is placed angularly to the direction of particulate matters movement the growth of the surface during each hit may be defined as [7]:

$$\Delta S = \frac{D^3}{2 \cdot k_r} \cdot \left[\frac{\rho \cdot V^2}{g} (1 - \sin^2 \alpha - k_в^2 \cdot \cos^2 \alpha) - \frac{\sigma_p^2}{E} \right]. \quad (2)$$

where: D^3 is the average size of the particle before the destruction, m,

k_r is the empirical coefficient of proportionality which represents specific work on the formation of new surface unit, J/m^2,

V is the speed of the particle in the hit moment, m/s,

$k_в$ is the restorability ratio during the hit which depends on form and physic-mechanical characteristic of grinding material and obstacle, $0 < k_в < 1$,

α is the angle between the normal to the obstacle surface and the direction of particles movement,

σ_p is the limit of grinding material strength, Pa,

E is Young modulus, Pa.

The average size of particles received after the destruction:

$$d = \frac{6}{\rho \cdot S_m} . \quad (3)$$

The surface of particles after the hit:

$$S_1 = S + \Delta S \ . \tag{4}$$

Particles specific surface after the hit:

$$S_{m1} = \frac{S_1 \cdot g}{\rho \cdot \upsilon} \ . \tag{5}$$

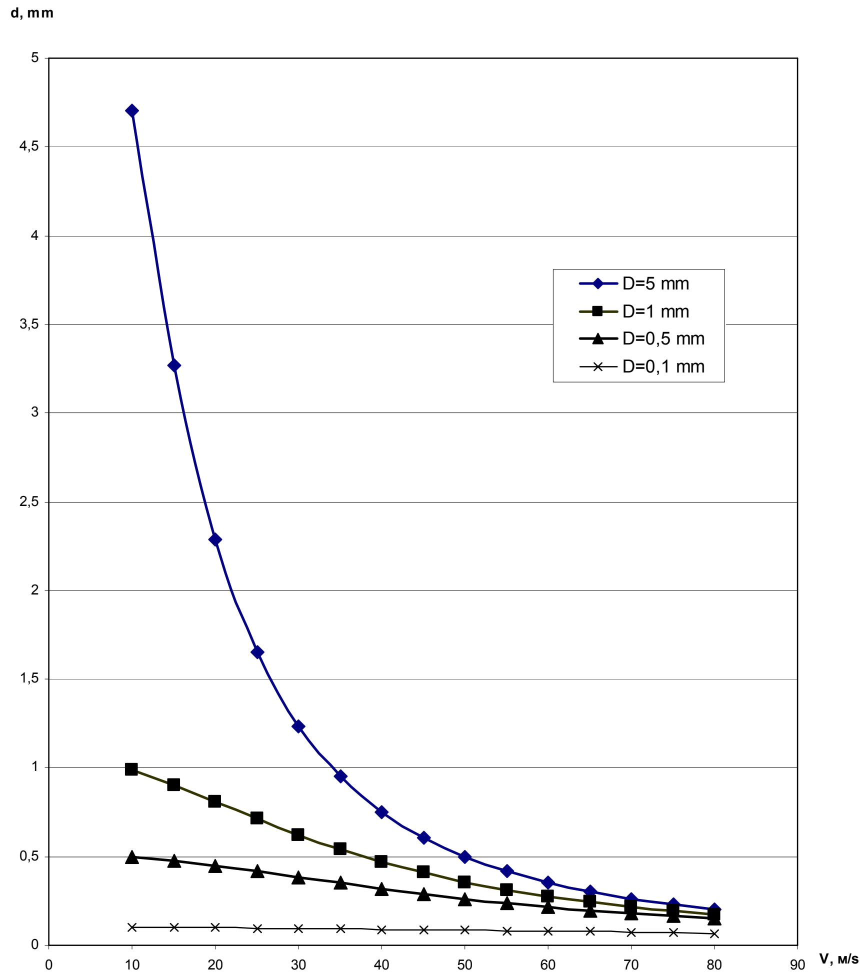

Fig. 1. The diagram of dependence *d=f(V)* for single-phase destruction of the particle of *D* size under $\alpha = 30^{\circ}$

The average size of particles received after the hit:

$$d = \frac{6 \cdot g}{\rho \cdot S_{m1}} . \quad (6)$$

As we can see, on the size of particles of destroyed definite material (grinding fineness) a great impact has the speed of movement of particles in the moment of hit against the obstacle and the angle of the attack. Ratios k_r and $k_в$ characterize destructing material property.

On the ground of a priori information [8-12] for anthracite during the hit against the steel obstacle (grindability plate) may be accepted $k_r = 120$ J/m^2, $k_в = 0{,}21$, $\sigma_p = 25$ MPa, $E = 7000$ MPa, $\rho = 14715$ N/m^3, however, those ratios and characteristics for anthracites of certain deposits demand experimental grounds.

The diagram of dependence of size of material after the unit hit against grindability plate on the speed is shown on Fig. 1.

As we can see before the speed $V = 10$ m/s the destruction of particles does not happen under any primary size. During the increase of speed to 80 m/s the intensity of destruction grows, however, for particles with the primary size less then 0,5 mm this growth is unimportant and increases only at higher speeds (Fig. 2).

The angle of the installation of grindability plate influences the process of anthracite particles destruction especially at low speeds during the hit. The most intense destruction happens at the angle less then 30º (Fig. 3).

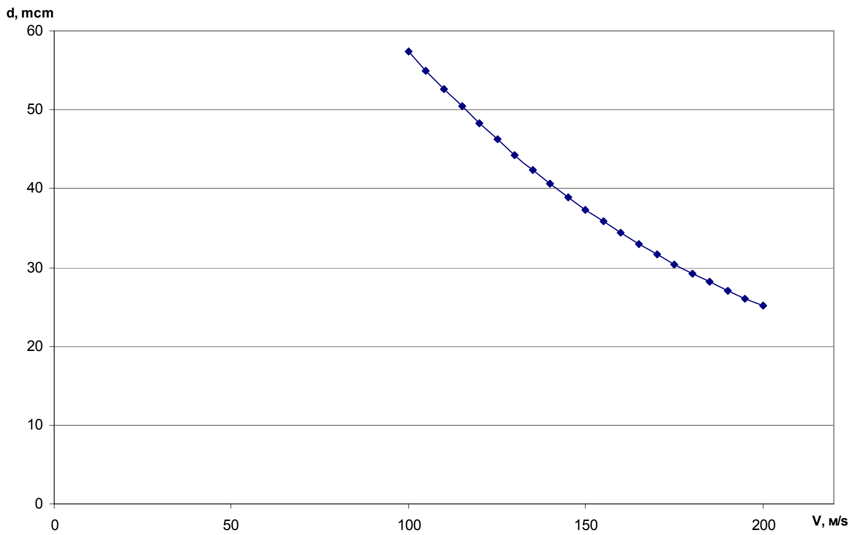

Fig. 2. The diagram of dependence *d=f(V)* for particles of size 0,1 mm (100 mcm) at $\alpha = 30º$

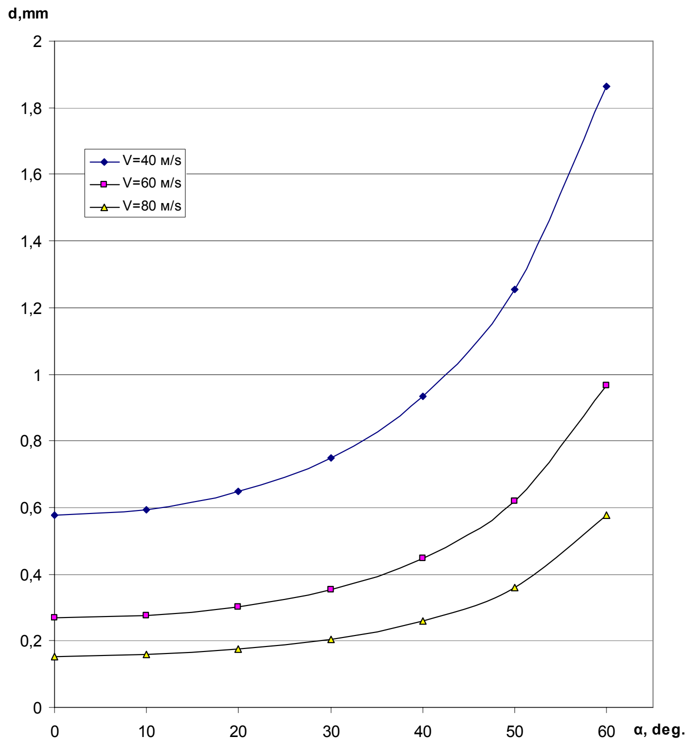

Fig. 3. The diagram of dependence *d=f(α)* for single-phase destruction of particle of 5 mm size

CONCLUSION

Given results of research allow to define the size of material particles which move with the definite speed after the hit against flat obstacle installed angularly to the motion path and also the quantity of destruction receipts for receiving of particles of necessary size characterized by grinding fineness.

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ИССЛЕДОВАНИЕ ПРОЦЕССА РАЗРУШЕНИЯ ЧАСТИЦ АНТРАЦИТА В ИЗМЕЛЬЧИТЕЛЯХ УДАРНОГО ДЕЙСТВИЯ

Турушин В.А., Ленич С.В.

Аннотация. В статье исследован процесс разрушения антрацита в измельчителях ударного действия при совмещении процесса транспортирования с измельчением. Приведена зависимость полученной дисперсности от скорости при ударе частиц антрацита под углом о жесткое препятствие.

Ключевые слова: антрацит, измельчитель ударного действия, разрушение, теплоэлектростанция.