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Research Article

GRINDING OF MATERIALS: MAIN CHARACTERISTICS

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ABSTRACT

The article is written about the fact that a lot of electricity is consumed in the process of grinding materials in cement production technology, and to ensure the efficiency of material grinding by studying the reasons where it is spent.

KEYWORDS

Technology, grinding, clinker, powder, slurry, surfaces, forging, friction, molecule, deformation crystal, soft, elastic, plastic.

INTRODUCTION

The process of grinding materials is very complicated and depends on the following factors: physical and mechanical properties of the material, its shape, size and granularity, the number of defects in the material, its strength, hardness or softness, and the construction and types of other grinding machines [1-7].

In order to correctly interpret this situation, it is necessary to study the physical state of the grinding process. For example. The grinding process due to any deformation can be explained as follows. The external force causes the accumulation of elastic deformation stresses in the body [8-15].

THE MAIN PART

If we compare the above-mentioned hypotheses and compare the grinding with the work done, and put the pieces of grinding on the Hooke diagram, we get the following [14-21].

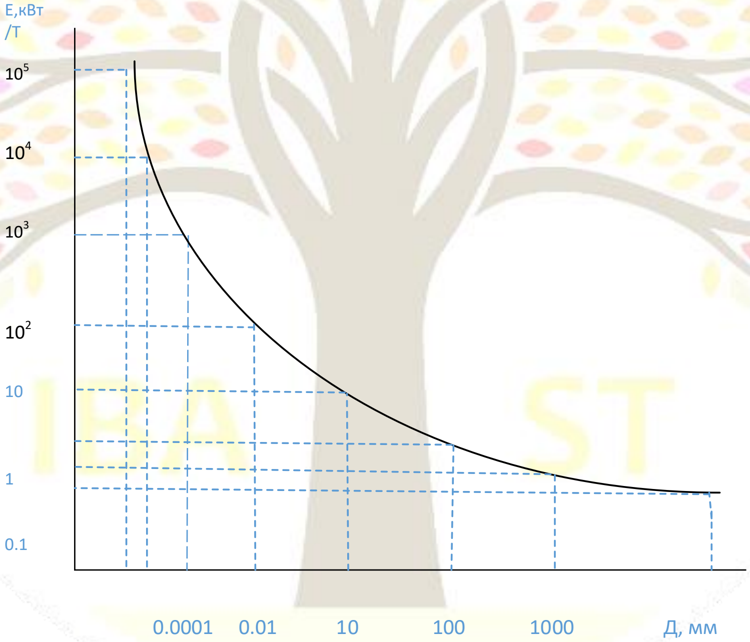

Figure 1. The relationship between the unit energy consumption E and the final size of the material being crushed D.

As can be seen from the diagram, the energy consumption is 0.4kW to get 1t rubble 5-40mm; Grinding 1t of sand is 2kW with a unit surface area of 1800cm2/g; 1t of cement (from clinker) is

2800-3000 cm2/g and 7 kW of energy is consumed. In fact, it takes 35-45 kW of energy to produce 1 ton of cement from clinker, which is very energy intensive. This shows that such calculations Rittinger, Kirpichev-Kick and Bond hypotheses do not accurately represent this process. But it correctly expresses the quality characteristics of grinding processes [22-28].

According to Griffiths, the difference between the theoretical and actual strength of solid bodies occurs due to the formation of small cracks in them, resulting in strong concentrated stress. The basic idea used by Griffiths is that under the influence of the recommended tensile stress at the tips of small cracks, a local overstress σ is calculated in all sections of the sample, which is many times more than the average stress σ.

If the stress is too high, dangerous cracks will reach the theoretical strength σK, in which the crack will grow violently and break the specimen into pieces. The recommended average voltage at this time should correspond to the peak voltage σK. When the ultimate stress is less than the theoretical strength, the crack does not grow and the material does not crush. The coefficient of stress concentration in microcracks is equal to β=σ*/σ. It depends on the direction, size and shape of the micro-cracks according to the direction of elongation. Therefore, tensile strength is not considered to be related to the material constant. Different samples differ in the size of critical microcracks [29-33].

In justifying the formula for the calculation of concentration stresses, Griffiths based on the following cases:

a) thermal failure of brittle material does not depend on temperature;

b) if an increase in the free plane energy is observed to increase tension micro-cracks in the sample, the growth of micro-cracks may occur.

c) the length of microcracks is much shorter than the cross-section of the sample, and the cross-sectional stress in the crack practically corresponds to the average stress calculated at the nominal strength.

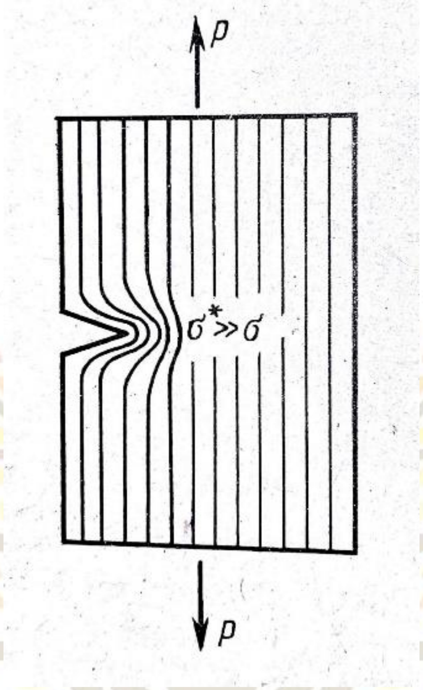

Figure 2. The diagram of stress concentration at the crack tip.

Based on this situation, Griffiths defined the intensity as follows:

$$\sigma_{\kappa} = \sqrt{2\alpha E / l_0}$$

where: a-energy of free formation of a tense body; E-voltage module; 1_0-angle microcracks initial depth.

According to modern views, Griffiths theory has a number of shortcomings. The main ones are:

1) The calculation of concentration stresses does not depend in principle on the equality of the tension energy change and the change of the energy of free formation, in which, according to the law of conservation of energy, it is necessary to take into account the mechanical loss of the crushing energy of a brittle body;

2) Griffiths's theory does not take into account the dependence on temporal stability;

3) Molecular structure is not taken into account.

In justification of the final state, we consider the molecular model of microcracks and the mechanism of their growth in a brittle solid. At the boundary of the integral transition to free formation, a discontinuity occurs between atoms. Atoms up to 1...5 are located in the volume of the body, and up to 6...10 are in free formation. Due to thermal motion and fluctuation, the atoms at the tip of the cracks periodically generate sufficient kinetic energy or try to restore the bond between them. This process is observed when the potential overcomes the E and E1 barriers. The kinetic energy of particles is the activity energy of breaking processes or restoring chemical bonds. E- E^1 differences have a potential generation energy, which can be considered as a function of the distance between particles in the direction of elongation [34-41].

$x=\lambda_0$ and $x'=\lambda_0'$. The charge equal to should correspond to the balance of the distance between the intermediate atoms on the surface of the layer in the non-given body. The maximum of the potential curve indicates the influence of the nearby layer of atoms on the bond breaking process. The presence of particles in the x zone in the loaded material x' is higher than in the zone [42-46]. After unloading, the crack coalesces to the defect. In a loaded material, the tensile stress prevents the bonds from breaking and restoring them, which in turn means that in the unloaded state, the bonds are short and require a large kinetic energy to break. At high strain, the bond discontinuities are large and lead to the growth of microcracks. $\sigma=\sigma_0$ is assumed to be safe in case of potential failure and the equality of restored connections.

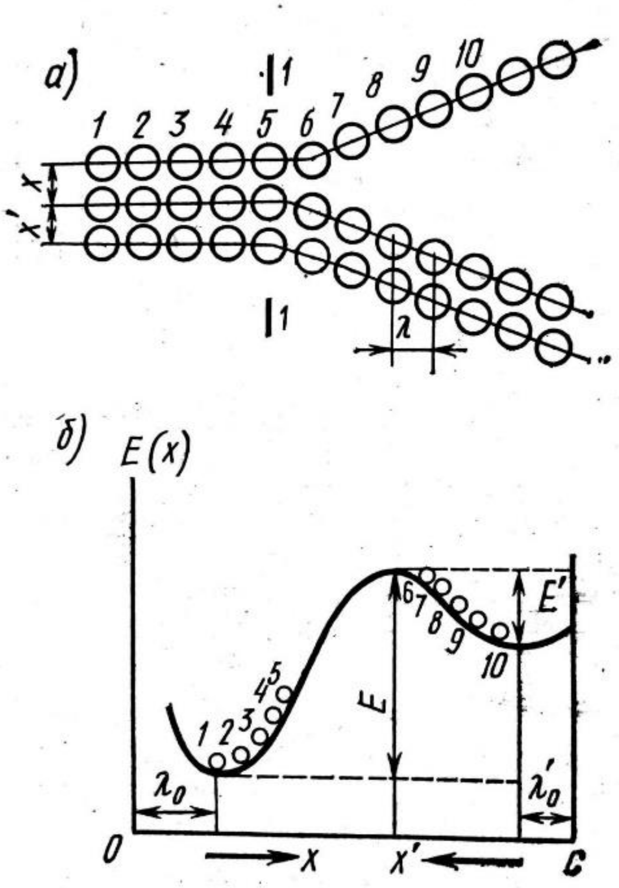

Figure 3. molecular model of α-microcracks;

β-potential energy change.

The external force causes the accumulation of elastic deformation forces inside the body (piece). The concentrated stress formed as a result of a defect somewhere in the piece increases without reaching the strength limit, and part of it is spent on the newly formed surface, this energy is useful energy and grinds the piece. And the rest are distributed in the case of elastic deformation to compress the piece, in the case of thermal energy and in the case of other energies.

Thus, according to modern views, there are two types of crushing mechanism. In the first stage, the cracks are provided by thermofluctuation, and in the second stage, the tensile properties of the solid body are determined by the growth of the cracks, and the energy reserve is stored in it.

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