International Journal of Advance Scientific Research
(ISSN – 2750-1396)
VOLUME 02 ISSUE 11 Pages: 35-43
SJIF IMPACT FACTOR (2021: 5.478) (2022: 5.636)
METADATA IF – 7.356

ISSN-2750-1396

Journal Website: http://sciencebring.com/index.php/ijasr

Research Article

INFLUENCE OF PREVIOUS MECHANICAL TREATMENTS ON MATERIAL GRINDING

Submission Date: November 05, 2022, **Accepted Date:** November 10, 2022,
Published Date: November 18, 2022
Crossref doi: https://doi.org/10.37547/ijasr-02-11-06

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ABSTRACT

The article analyses the factors contributing to the crushing of building materials and the study of the reasons for their formation.

KEYWORDS

Molecule, crack, a thermal, micro, macro, surface, mechanical, thermal, polycrystalline, plastic, crystal, dislocation, atom, chamotte, deformation.

INTRODUCTION

It is known that the freshly exposed surface of many minerals has high chemical activity. Adsorption of this surface by foreign ions or molecules leads to chemical corrosion and partial destruction of the surface layer [1-7]. For example, the breakdown of quartz occurs with the breakdown of Si-O bonds and the formation of microcracks on the surface of the structure of the crystal itself. In this case, in cracks on the surface, Si and O ions are formed with unsaturated valence bonds. Such a surface has high energy and is characterized by a very reactive effect, on which oxygen atoms from the ambient air are immediately adsorbed, which leads to a decrease in surface energy [8-14].

The formation of cracks in dislocation causes requires some precision. If the crystal does not have dislocation-type defects, we imagine that we move the top half of the crystal according to its relationship at a lower interatomic distance. To do this, it is necessary to roll all the atoms in a row on top of each other.

The main part

The next stage of development of Griffiths' theory is aimed at clarifying the factors that lead to the formation and development of microcracks and the crushing of real materials.

According to Griffiths' athermal theory and modern molecular theory, the crushing of real materials is represented by the dependence of the number of microcracks on the surface. It is impossible to immediately determine the reasons for their formation [17-23]. There can be many such reasons. Here are the main ones:

a) mechanical damage to the surface in the process of obtaining finished material;

b) thermal expansion of polycrystalline material at different coefficients in individual phases;

c) chemical corrosion of the surface during material production;

d) connection of dislocations during plastic deformation of the material.

In fact, the process of obtaining the finished material is always related to its primary mechanical processing. For raw materials, this is the process of mining, subsequent crushing and characterization, and for moulded materials, it is the process of mixing the initial compounds. At all these boundaries on the surface, the initial joints have a partial mechanical effect, which leads to the formation of not only microcracks but also macrocracks. Here we are talking not about the technological cracks of the products, but about the defects on the surface of individual compounds [24-31].

We will explain this with the next example. We assume that the crystal has several dislocations when a dislocation occurs, and when a foreign atom is introduced, the bonding strength of neighbouring atoms in the crystal lattice becomes sufficiently large compared to the atomic bonding in the crystal itself. In this case, the movement of the first dislocation is stopped by its exit from the crystal, and the movement of atoms is stopped by the attraction of a foreign atom. The displacement of the atoms of the second and third dislocations causes the atoms on the left side of the crystal to become denser and the voids on the right side to be concentrated. However, such dislocations can be abundant in a real crystal. The sum of the individual dislocations in the entire gap can turn into cracks on the crystal surface. Such restrictions in a real crystal are not only foreign atoms but also Schottky defects at the crystal boundaries, they greatly hinder the free movement of the dislocation. Therefore, the presence of cracks leads to the strengthening of the crystal lattice and the formation of surface cracks. The distribution of all such restrictions in the crystal leads to the alignment of the forces imposed by the direction of the dislocation lines [32-39].

Thus, the initial mechanical damage to the surface, the difference in thermal expansion coefficient in the structure of separate solid phases, chemical corrosion and the presence of dislocations are the reasons for the formation of cracks.

The presence of such cracks has been shown to reduce the strength of the material, resulting in less force being required to crush it.

By using the adsorptive effect of solids, it is possible to sufficiently activate the crushing of solids. This effect was first established by P.A. Rebinder and has a wide field of application in practice [40-46].

All solids have external and internal defects. Existing defects develop and new ones are formed when the body is loaded, causing tension and plastic deformation. In any case, the development of these defects is facilitated by the grinding of objects. The adsorptive decrease in strength is accounted for by the development of various defects at low stresses. The schematic of small cracks on the surface of the material can be considered a pinhole. Both sides of the crack mouth have all the surface properties of surface energy α. According to the size of the free surface loss per microcrack depth, the surface energy is lost at the end of the crack from α to 0. Many construction materials are subjected to heat treatment during the manufacturing process. The difference in the coefficient of thermal expansion is the reason for the formation of surface microcracks. Here we are talking not about technological thermal micro-cracks, but about micro-cracks with a multi-phase structure formed between fireclay and clay particles.

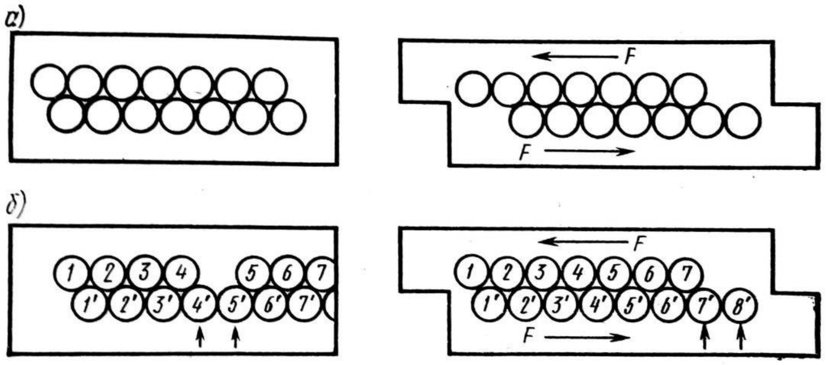

Figure 1. An ideal crystal has a dislocation pattern a, and a dislocation b

In general, other aspects of the effect of shear force on a crystal with dislocations are known (Fig. 1 b). For the sake of simplicity, it contains the minimum number of dislocation rows, which are Frenkel-type point defects. From this, it can be said that the presence of dislocation creates a linear gap between the top two rows of the plane. In the lower formation, there is an excess row of atoms at the border adjacent to the block part. When this row is introduced, the two rows of atoms in the space become extremely compressed.

At some initial moment, there is space between atoms 4 and 5 and atoms - will be compressed. Under the influence of force F, rows 5 and 6 are moved into space. What happens? All dislocations move to the right, and their movement continues in the same manner until the dislocation leaves the boundary of the crystal. As a result, the displacement of an ideal crystal is the displacement of atoms along a series. In the second case, it is not necessary to prove that the shear force will be partially less. In the first case, it is necessary to prevent the interaction of all the rows of atoms, and in the second case, only the atoms. The movement of several dislocations in one formation leads to their joining, the formation of crack states.

The presence of microcracks ensures that the external environment penetrates into the surface layer of the material. If the external environment is liquid, it forms a thin layer in the cracks with a sufficient excess of free energy, where the free energy increases due to the decrease in the thickness of the layer. To reduce the free energy, the liquid layer tries to thicken in the micro-cracks and exerts pressure on the walls of the cracks. This pressure is maximum at the end of the crack, where it can penetrate the liquid. The impact pressure of the liquid is important and it is determined by the heat energy of the liquid surface of the given body. The capillary pressure Rk is characterized by the shear force as follows:

where: θ-edge cooling angle; r-slot width.

Together with the kinetics, the shrinkage η depends on the fluid viscosity:

where: l-the column length of the liquid in the capillary; t-breathing time; ρ-liquid density; angle of inclination of the capillary to the φ -horizon.

In order to enhance the effect, it is necessary to maintain the effect of impact, the absorption of liquid into narrow micro-cracks is sufficiently complete to increase its effective effect.

It is possible to intensify the deformation of a solid body under the influence of a given liquid by introducing external active substances. The external active substance increases the heat energy of the body with liquid. Molecules of the external active substance are moved by adsorption on the surface of a solid body, penetrate into microcracks and cover its walls with a uniform adsorbed layer. The depth of penetration of external active substances is limited by the size of adsorbed molecules. The driving force of the adsorbed layer absorbed in cracks is determined as follows:

where: α0 is the external energy of the solid body; αr -a solid body covered with molecules of external active substances

Adsorption effects are specific and depend on the mineral composition of the rocks. There are highly effective extrinsic active ingredients for each mineral, with narrowly oscillating optimal concentrations that reduce durability. For example, AlCl3, NaCl, MgCl2 and naphthenic soap are effective for quartz; for carbonate rocks (limestone, dolomites) - alkaline electrolytes; for clay rocks - sodium chloride.

During the grinding process, the liquid is dissociated, and the dissociated products are more active during their formation and have the property of forming strong compounds with the surface of the ground material.

CONCLUSION

The analysis shows that until now no law has been created that calculates the grinding processes and works the same for all materials.

The shape and structure of the material being ground has a great influence on its properties and strength. The structure of the material means the distribution and interconnection of gaseous, vitreous (amorphous) and crystalline phases, as well as their size, which determines their location in the material and has its effects on grinding.

According to modern views, there are two types of crushing mechanisms. 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, while the energy reserve is stored in them.

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