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STUDY OF WET KINETICS GRINDING AND APPLICATION OF SURFACE-ACTIVE AGENTS (SURFACTANTS)

Bozorov Nosirjon
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0000-0002-1795-7004
e-mail: nosirjonbozorov934@gmail.com

Melibaev Muxtardjan
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0009-0009-4708-1649
e-mail: meliboyev1950@mail.ru

Kukonboyeva Shaxlo
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0009-0009-9231-8369
e-mail: shaxloxonqoqonboyeva@gmail.com

Eshboltayev Iqbol
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0000-0003-3988-9372
e-mail: 998911558383a@gmail.com

Madaliyev Akmaljon
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0000-0002-6181-3852
e-mail: akmalmadaliyev86@gmail.com

Ibragimova Rano
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0000-0002-0674-8701
e-mail: ranoibragimova2024@gmail.com

Sattorova Dilshoda
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan
https://orcid.org / 0009-0009-5531-3497
e-mail: sattorovadilshoda78@gmail.com

Tokhirova Makhfuzakhan
Kokand State Pedagogical Institute named after Muqimi, Uzbekistan

https://orcid.org / 0009-0009-2381-8087
e-mail: mahfuzatohirova87@gmail.com

Abstract

This paper is devoted to the study of grinding kinetics and the use of surfactants in the grinding process. Wet grinding, as a key technology in the mining, metallurgy and construction industries, demonstrates advantages over dry grinding, in particular, by reducing the strength of materials and improving grinding conditions due to the interaction of particles with a liquid medium.

The study emphasizes the importance of choosing adequate technologies and additives to improve productivity and quality of the final product. The results of the work open up prospects for further research aimed at creating more efficient grinding technologies that contribute to the sustainable development of various production processes.

Keywords. Wet grinding, strength, mill, grinding kinetics, grinding, fraction, damping character, ball mill, energy.

1. Introduction

The grinding process plays a key role in various industries, including mining, metallurgy and construction. The efficiency of grinding materials depends on many factors, one of which is the chosen grinding method. In particular, wet grinding is an important technology that can significantly improve the results compared to dry grinding.

During wet milling, particles interact with a liquid medium, which helps reduce the strength of the material and facilitates the grinding process. The use of surfactants in wet milling opens up additional opportunities for optimizing this process. Surfactants not only reduce the strength of the particles, but also help to more effectively separate them from the mill, which ultimately increases the productivity and quality of the final product.

The kinetics of the wet milling process in ball mills is described by the Kolmogorov equation, which reflects the dependence of the coarse fraction content on time. This process has a fading nature, which is associated with changes in the mechanical properties of the material and the interaction of particles during the grinding process. Introduction into the details of these changes, as well as into the mechanisms of action of surfactants, allows a deeper understanding of the nature of wet milling and its advantages

.

2. Methods

Thus, the study of wet milling kinetics and the role of surfactants is a relevant area in the field of grinding technology, which helps to improve the efficiency of production processes. This study will consider the mechanism of action of surfactants, the effect of their concentration on the grinding process, as well as the main factors determining the efficiency of wet grinding compared to dry grinding.

The process of wet fine grinding in a ball mill has a fading nature. The kinetics of grinding in a

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periodic ball mill is described by the Kolmogorov equation [1]:

$$R_t = R_0^{-kt_m}, \quad (1)$$

where R_t — content of large fraction after time t from the start of grinding, %; R_0 — content of large fraction in the source material, %; k — the grinding rate constant (characterizes the relative grinding rate) — the ratio of the number of particles of a large fraction ground per unit of time to the total number of particles of this fraction in the mill at a given moment in time.

If the relative rate of grinding does not change *m* = 1 if *m increases* more than 1, if it decreases - less than 1. In the process of real grinding *m* decreases for the following reasons:

1) As the material is crushed, it becomes less and less defective, so it becomes stronger;

2) fine material acts as a shock absorber, so the ground material must be removed immediately from the grinding environment;

3) as a result of the increase in internal energy, finely dispersed particles under the mechanical action of grinding bodies after reaching a certain state stop being ground, the reverse process is observed - the formation of fairly strong conglomerates of particles, their adhesion under the action of adhesive forces. This is a manifestation of the system's desire to resist external influence and reduce the level of internal energy, since during aggregation, partial compensation of free chemical bonds of surface atoms (ions) occurs.

grindability coefficient is used as a technical characteristic of the degree of grinding :

$$M = g_m/g_э \quad (2)$$

where g_m — mill productivity for a given material ; g_e — mill performance according to the reference sample.

According to the grinding method, mills are classified into dry and wet mills. According to the nature of the work, two grinding methods are distinguished: open-loop and closed-loop. When grinding in an open loop, the material is not discharged from the mill until its granulometric composition corresponds to the specified one. When grinding in a closed loop, the product leaving the mill is divided into two parts. One part, consisting of particles larger than the specified size, is returned to the mill for re-grinding, the other part, corresponding to the specified grinding fineness, is removed from the grinding cycle.

The powder is always heated during the grinding process. To prevent excessive heating of the mills themselves, they are cooled (aspirated or water cooling of the mill casing is provided in the mill design). Fine grinding of fine- grained masses and powders is currently carried out mainly in ball and vibration mills. The main advantage of vibration mills is a significant reduction in the time of grinding powders to achieve equal dispersion and the possibility of obtaining finer powders compared to grinding in ball mills.

3. Results and Discussion

During dry milling, strong heating of the material being ground is observed (up to 200 $^\circ$C and higher), as well as desorption of water molecules from the surface of the grains and amorphization of the surface layers of the grains to a depth of 15-16 nm .

During milling, a liquid medium is used - water and additives - surfactants that act as hardness reducers . In this case, two processes occur simultaneously:

- reducers , being absorbed by solid particles, cause a decrease in their elastic limits, fluidity and strength and thereby facilitate grinding;
- liquid, penetrating into the microcracks of the pre- fracture zone - , exerts wedging pressure on the crack walls.

Water molecules, penetrating into microcracks, prevent the reverse closure (cohesion) of the bonds between lattice nodes during temporary removal of the load, thereby reducing the likelihood of self-healing of cracks and energy costs for this unproductive stage.

Surfactants are substances of organic nature capable of selective adsorption on the surface of grains of a solid body with the displacement of the adhesive film of water previously bound to it. Such surfactants are fatty acids with sufficiently large hydrocarbon radicals, salts of fatty acids (soaps), sulfonic acids and their salts, alcohols, amines, etc. Surfactant molecules have a larger dipole moment than water molecules and, consequently, a greater affinity for the surface of a solid body. When these molecules are adsorbed, the surface energy of the particles of a solid body decreases more than when water molecules are adsorbed. It has been experimentally established that for each milling accelerator there is an optimum concentration, usually within the range of 0.02-0.2% by weight.

The study of the wet milling process in ball mills and the use of surfactants provides a deeper understanding of the mechanisms that influence milling efficiency. The kinetics of wet milling, described by the Kolmogorov equation, exhibits a decaying nature, which is due to many factors, including the reduction of defects in the material and the formation of conglomerates.

Surfactants play a key role in optimizing the milling process by reducing particle strength and reducing milling energy costs. Their ability to adsorb onto the particle surface significantly improves milling conditions, allowing for finer dispersion and increased overall mill performance.

By choosing the right grinding method – open or closed – and using the right additives, the results can be greatly improved by minimizing heat loss and controlling the process effectively. In the future, further research in this area could lead to more efficient grinding technologies, which could have a positive impact on many industries, including building materials, pharmaceuticals and chemicals.

Thus, the study of wet milling and surfactants opens new horizons for technology improvement, contributing to more sustainable and efficient production.

References

[1] Kainarsky, I.S.Processes of refractory technology / I.S.Kainarsky . Moscow : Metallurgy, 1969. 352 p.

[2] Q.P.Umurqulov, N.S.Bozorov "Aspects of surface processes on a solid body" 2022-yil Galaxy international interdisciplinary research journal

[3] Q.P.Umurqulov, N.S.Bozorov Heat capacity of solid), Published by International journal of

ISSN:1624-1940
http://magellanes.com/

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[4] Leksovsky A.M., Borovikov V.A., Bozorov N.S., & Abdumananov A. A. (1996). Detection of microcracks in rock samples using fluorescence microscopy. *JTP Letters* , *22* (3), 6–9.

[5] Leksovsky A.M., Borovikov V.A., Bozorov N.S., Abdumananov A.A., Sinani A.B., Piletsky S.A. (2002). Damage zone of high-modulus materials under explosive loading of granite. *Letters to the Journal of Technical Physics* , *28* (16), 90-94.

[6] Leksowski A.M., Borovikov V.A., Bozorov, N.S., Abdumanonov A.A., Sinani A.B., & Piletski S.A. (2002). The zone of damage for high-modulus materials in explosion-loaded granite. *Technical Physics Letters* , *28* , 705-706.

[7] Mukhtorov L.T., Abdumananov A., & Bozorov N. (2018). The method of drawing graphs on physics by using Visual Basic 6.0 program. *Scientific notes of the Khujand State University named after academician B. Gafurov. Series: Natural and economic sciences* , (4), 194-198.

[8] Leksovskii A.M., Borovikov V.A., Bozorov N.S., & Abdumanonov A. (1996). Detection of microcracks in rock samples using the luminescent microscopy technique. *J. of Technical Physics* , *22* (3), 6-