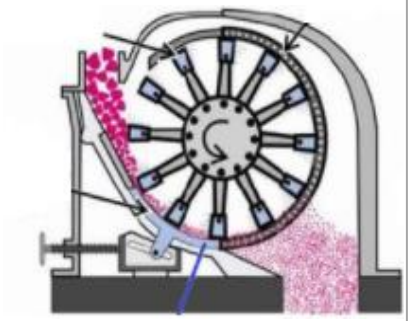
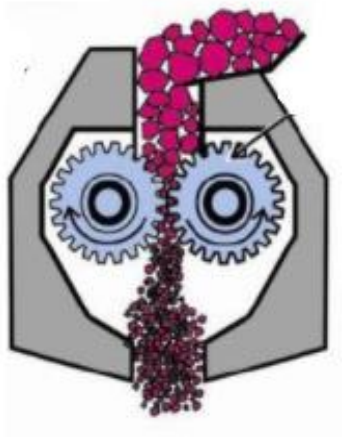
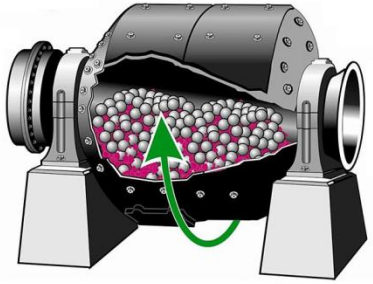
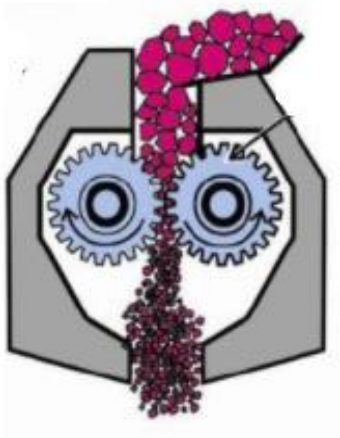
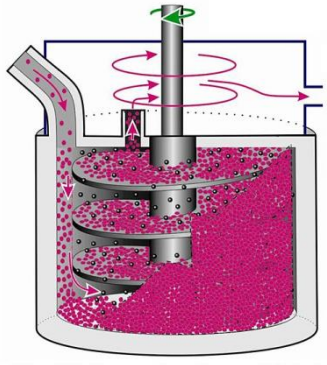




Research of patterns of influence of a particular destruction method of anisotropic materials on their mechanical behavior







INTRODUCTION

Many scientists and researchers are still exploring the dependence of the resulting grain shape on as well as the study of the material's physical and technical properties in order to improve this process and modernize the crushing equipment taking into account the individual texture of different rocks. That is why topic of our research is relevant. However, the method of breaking rock pieces by crushing or free impact force definitely affects the final shape of the grains obtained after grinding as well as other quality indicators of the material.

The purpose of this study is to analyze the data in order to determine the dependence of the resulting grain shape and physical and technical properties of the material under study on the method of disintegration. The mathematical model of the yield of grains with different methods of crushing will enable to consider the physical and mechanical parameters and anisotropy of the textural structure of the crushed rock, which reflects its mineralogical composition, taking into account the specifics of nature, as well as factors independent of human activity..




MATERIALS

In order to determine the dependence of different grain shapes and physical and technical properties of the material under study on the method of disintegration, we consider a mathematical model of the yield of grains of different shapes (ME) using various options for crushing anisotropic rock.
According research of scientists the functional form of the dependence is presented in the form of a mathematical expectation and the variance of their yield in the direction of crushing n (α) in the functional form.

1st

$$\mathrm{ME}(\alpha) = \sqrt{[\mathrm{P}_{\|}]^2 \cos^2\alpha + [\mathrm{P}_{\perp}]^2 \sin^2\alpha}$$

$$DP(\alpha) = DP_{\|}\cos^2\alpha + DP_{\perp}\sin^2\alpha$$

2nd

$$[\mathrm{P}_{\perp}]^2 \le \left(\mathrm{ME}(\alpha)\right)^2 \le [\mathrm{P}_{\|}]^2$$

$$DP_{\perp} \le DP(\alpha) \le DP_{\|}$$

3rd

$$k = \frac{\sqrt{[\mathrm{P}_{\perp}]^2 - [\mathrm{P}_{\|}]^2}}{[\mathrm{P}_{\perp}]}, l = \frac{(DP_{\|} - DP_{\perp})}{DP_{\|}}$$

4th

$$\mathrm{ME} = \mathrm{M}(\mathrm{ME}(\alpha)) = [\mathrm{P}_{\|}]\int_0^{\frac{\pi}{2}} \sqrt{1 - k^2\sin^2\alpha}\, f(\alpha)d\alpha,$$

$$DP = \mathrm{M}(DP(\alpha)) = DP_{\|}\left(1 - \frac{l\left(1 - \int_0^{\frac{\pi}{2}} f(\alpha)\cos 2\alpha\, d\alpha\right)}{2}\right)$$




MATERIALS

Considering the term of mathematical expectation and variance, it is worth noting that they are integrals that were obtained from the product of the tensor-statistical model (slide 3) derived by identical transformations of the expressions (slide 3), as well as the probability density f (α).

In this regard, the obtained equations (slide 3) create a mathematical model of the yield of diversiform grains with different methods of crushing anisotropic rock. The presented model reflects, first, the physical and mechanical parameters, the mineralogical composition of the material, as well as the anisotropy of its structural texture - which refers to natural factors of the first kind and does not depend on human activity. It is also necessary to note the law of the distribution of the probability of the direction of the impact α-the probability density f (α). It is formed as a result of human activity and corresponds to a known or new used method of crushing.






RESULTS AND DISCUSSIONS

We will analyze the existing model in order to establish the reliability of the final material state after crushing and predicting these calculations. Figure 1 clearly shows the direction of the impact of $n^{-}(\alpha)$ on the crushed material of a shale or layered texture and the indicatrix of $P(\alpha)$ of the anisotropic structure of the grain yield.

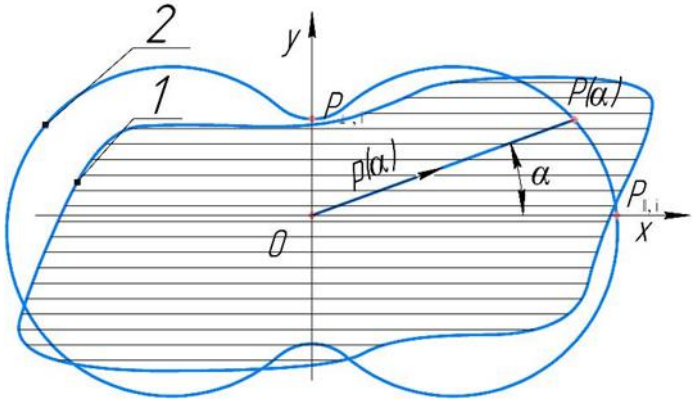


Figure 1. Direction of the impact of $n^{-}(\alpha)$ on the crushed material of the layered texture (1) and the indicatrix $P(\alpha)$ (2) of the anisotropic structure of the grain yield (final material).

RESULTS AND DISCUSSIONS

We analyzed the developed model by performing the calculation with two simplified hypothetical examples, according to our interpretation.
For the calculation, we tooks the parameters of organogenic limestone materials and amphibolites (Kursk Magnetic Anomaly or KMA deposit).

Table Characteristics of physical and technical properties of materials

Name of the material	Compressive strength, MPa		Anisotropy coefficient, k_R
	Perpendicular to the shale, $P_\perp$	Parallel to the shale, $P_\parallel$	
Organogenic limestone	95	65	1.46
Amphibolites (KMA deposit)	145	75	1.93

we made a very average model of the yield of plate grains during crushing of anisotropic rocks in jaw crushers, which corresponds to the assumption, and therefore contains modeling errors. After all the mathematical transformations, we obtained the final equation.

$$\mathrm{ME} = [P_\parallel]\frac{(0.667\pi - 2\alpha^*)\cdot E(\alpha^*;\ \ k) + 0.666\alpha^*\cdot E\left(\frac{\pi}{2};\ \ k\right)}{\alpha^*\cdot(\pi - 2\alpha^*)}.$$

$$DP = DP_\parallel\left(1 - l\cdot\left(1 - \frac{(0.667\pi - 2\alpha^*)\cdot\sin 2\alpha^*}{2\alpha^*\cdot(\pi - 2\alpha^*)}\right)\right)$$

RESULTS AND DISCUSSIONS

In our research, the dependence of the resulting grain shape on the specific method of destruction was studied.
In addition, in order to improve the crushing process, we made a mathematical model for the yield of the final material of organogenic limestone and amphibolites of various shapes with different crushing methods and it will enable to consider the physical and mechanical parameters and anisotropy of the structural texture of the crushed rock, which reflects its mineralogical composition.

Our results allow us to draw the following conclusions:

1. Industrial mining enterprises will be able to improve the process of destruction, crushing, grinding;
2. The obtained mathematical model and equations will enable to calculate the destruction of rock materials to establish the reliability of the material final state after crushing and resulting these calculations;
3. Determine the dependence of the grain shape of the material on the specific method of destruction.





The presentation was created by group of authors

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