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Analysis Of Methods For Increasing The Efficiency Of The Use Of Crushing Working Bodies Of Crushers

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ABSTRACT

The article examines the principles of operation and distribution of cone crushers when crushing nonmetallic materials. Significant results have been achieved in improving the efficiency of work at the Karatau open pit. Practical work on equipment deformation was carried out. When crushing rocks, individual rock fragments were obtained in a standard manner.

KEYWORDS

Ore and nonmetallic materials, Cone crushers, wear, career Karatau, power, Crushing efficiency, deformations, pieces of mountain breeds.

INTRODUCTION

Analysis of ways to improve the efficiency of crushers

Shredding of materials is an important step in the processing of materials from the coal and mining industries. The quality and physical and mechanical properties of the crushed material determine the final technical and economic indicators of the product. [1]

For crushing materials in various industries, different types of crushers are used in terms of design and crushing effect. This is explained by the specifics of the material itself, namely, the required values and types of grinding forces, as well as the size of the particles obtained after processing.

Cone crushers are also used in the mining industry. The destruction of the material occurs due to compression between the cones of the crusher. When grinding the material, intensive wear of the cone surface also occurs. Comparing the data of NPK Mekhanobr-Tekhnika, OJSC Uralmashzavod and other

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scientific and industrial organizations, a large amount of scientific research was carried out on the operation of conical rock crushers at the Karatau open pit.

In particular, manufactured cone rock crushers are being carried out at OJSC Uralmashzavod; they have proven their effectiveness during testing and operation in the Karatau quarry, and comprehensive theoretical and experimental studies have been developed to clarify the mathematical models of the process of crushing rocks in eccentric cone crushers during technological tests of new equipment.

CONE CRUSHER CALCULATIONS

Calculations were made according to two models of material destruction - free and constrained destruction by the "piece on armor" method. The technological characteristics of the crushing process with constrained destruction by the "piece on armor" method, depending on the degree of material loading into the crusher chamber, are similar to the characteristics at the destruction by the "in-layer" method. [2]

Table 2 shows the results of technological tests of the KMD 2200T7-D crusher, designed to produce cube-shaped crushed stone, at crushing diorite.

As follows from the given data, with the constrained destruction of the material and the volumetric effect of loads, the quality of crushed stone increases (the flakiness of the grains decreases). In this case, the power consumption of the motor (and current) increases by 1.4-1.5 times. [2]

Table 1

Main technological results of testing the KMD-2200T7-D crusher

№ Sample (date)	Slot size, mm	Drive current, A	Productivity, t / h				Lamellar (flakiness),%		
			by factions			total			
			4/8	8/16	16/31,5		4/8	8/16	16/31,5
Constrained material destruction									
1(20.06.2021)	12,4	42	85,0	293,1	57,3	440,0	12,2	10	4,9
1(20.06.2021)	12,4	40	101,4	212,4	74,2	398,1	13,4	7,9	6,4
3(21.06.2021)	12,4	42	92,5	250,4	65,0	418,2	11,8	8,9	5,9
4(22.06.2021)	13,8	39	70,4	184,0	135,0	396,0	12,6	10,2	5,8
5(22.06.2021)	14,2	38	91,3	220,4	102,0	420,9	-	-	-
6(22.06.2021)	12,1	38	80,0	200,2	120,1	400,5	12,6	10,0	5,1
Destruction in the "piece on armor" method									
7(25.06.2021)	15,4	35	72,4	196	126,4	401,3	15,1	9,7	10,3
8(27.06.2021)	15,6	34	84,4	200,3	140,5	430,4	22,1	17,52	8,9
9(30.06.2021)	15,4	35	90,0	206,7	135,4	433,3	15,7	10,3	4,1

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10(30.06.2021)	15,4	35	110,9	210,8	142,8	468,6	13,7	10,3	6,9
11(01.07.2021)	15,5	35,5	90,8	203,7	135,6	433,3	15	10,4	7,3
12(02.07.2021)	20,4	32	62,2	162,6	216,1	446,1	20,2	12,4	8,4
13(02.07.2021)	20,2	32	59,7	180,4	176,7	419,1	20,1	13,4	9
14(03.07.2021)	20,4	32	60,5	171,5	196,4	432,6	20,2	13,2	8,4
15(03.07.2021)	24,4	30	72,7	173,4	225,2	475,5	19,0	14,8	8,4

CONE CRUSHERS ANALYSIS

Eccentric drive cone crushers are designed for crushing ore and nonmetallic materials (except plastic ones). Crushers can be manufactured in the following types:

Crushers can be manufactured in the following types:
KKD - cone coarse crushing in two versions - with one motor on the drive, with two motors on the drive;
KSD - conical medium crushing in two versions - coarse crushing (Gr) and fine crushing (T);
KMD - conical fine crushing in two versions - coarse crushing (GR) and fine crushing (T, T1, T2, etc.)
The values of reliability indicators of crushers when crushing material with ultimate compression strength in the range of 100 - 150 MPa are shown in table. one.

On hard-to-break materials with a ultimate compression strength of more than 150 MPa, the service life is halved. [3]

The crusher must be equipped with an electrical protection and interlock system to turn it off when the temperature of the oil or bearings rises above the maximum allowable temperature, to prevent spontaneous switching on of the crusher drive after a sudden loss of voltage and to exclude the simultaneous remote and local control of the crusher mechanisms.

Crushers (except for KSD-600, KMD-600, KSD-900 and KMD-900) must be equipped with sound and light alarms informing about normal operation or malfunctions in the drive and lubrication systems. Signal lamps should be labeled with the meaning of the signals.

Table 2

Name reliability indicator	Norms by types of crushers in years, not less	
	KKD	KSD and KMD
80% service life crushers before decommissioning	15	12,2

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80% service life up to replacements:		
traverse	6	-
antifriction layer eccentric bearings	1	1,25
drive shaft gears	4	2,5
cogwheel eccentric	6	3
conical and cylindrical eccentric bushings	-	1,25
body and shaft of crushing cone	8	5,5
Technical coefficient use	0,8	0,8

Crushers are manufactured in accordance with the requirements of technical conditions and working drawings, approved in accordance with the established procedure.

Ergonomic requirements are established for those elements of equipment that are associated with a person when he performs labor actions during operation, installation, repair, transportation and storage of equipment are regulated (basic requirements) GOST 12.2.049-80.

In fig. 1. shows the total characteristics of the size of the products of destruction with free and constrained movement of the crushed material. The broken line, which determines the particle size characteristic in constrained movement, has a relatively large concavity,

which indicates the predominance of the small class in the destruction product.

A comparative analysis of two types of cone crushers of fine crushing - eccentric type KMD and inertial type KID on the main technical (the frequency of oscillations of the cone, the installed power of the motors or the power-to-weight ratio of the crusher) and technological (the productivity of the crusher, the size of the product, the given uniformity or unevenness of the distribution of the grain size in the product) indicators [2].

Table .2. the technical and technological indicators of cone crushers of fine crushing for ore preparation operations are given. Comparative analysis was carried out in terms of relative indicators - crushing efficiency [3] and conditional stress in the material.

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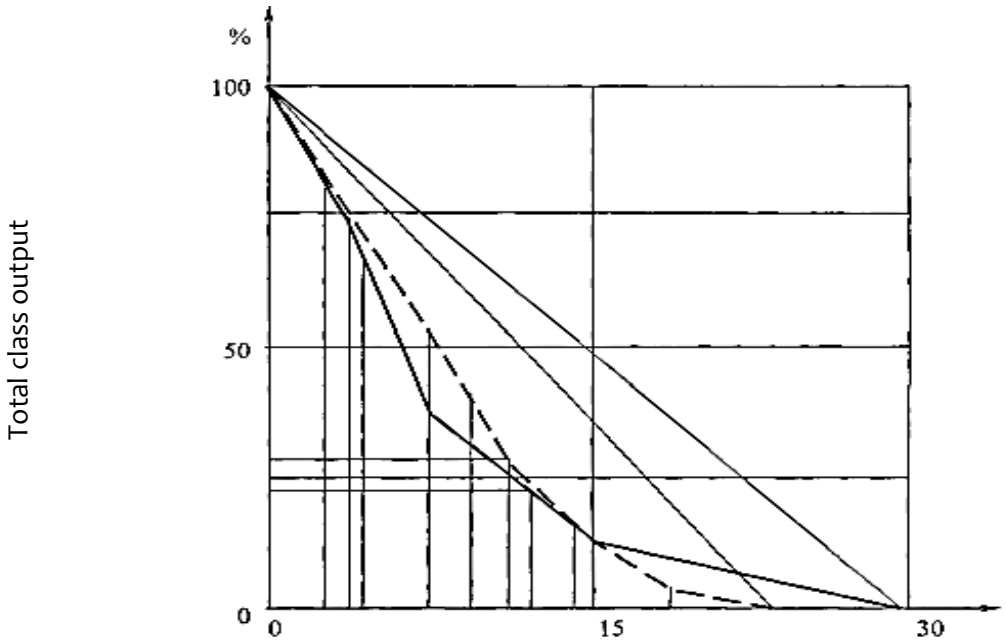

Fig. 1. Total characteristics of the size of the crushing products for various methods of destruction of the material:

——- cramped (surrounded by little things) destruction;

—— free destruction

Table 3

Indicators of fine crushers for ore preparation operations

Indicators	KMD 1750 T2-D	KMD 2200T	KMD 2200T5-D	KMD 2200T6-D	KMDД 3000T2-DP
Crushing methods	k-b*	k-b	k-b	k-b	k-b
Receiving slot, mm	70	100	85	70	85
Discharge slot, mm	8-12	5-15	7-12	6-12	8-15
Maximum piece size mm feed Dmax product dmax (at)	60 16		80 18	60 16	80 18
Crushing degree $i= D_{max}/d_{max}$	3,8		4,4	3,8	4,4
Drive power, kW	200	250	315	315	500

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Open circuit capacity, m^3 / h (t / h)	80-110	160-250	160-235	140-180	350-450
Mass t	52	93	94	94	229
Crushing efficiency m^3 / (kW.w)	0,4-0,55	0,64-1,0	0,51-0,75	0,44-0,57	0,7-0,9
Conditional stress in the material, MPa	9,0-6,5	5,6-3,6	7,1-4,8	8,2-6,3	5,1-4,0

* k-b piece about armor, k-k - crushing a piece about a piece "in a layer"
*- with a bulk density of the material 2 t / m^3.

EFFICIENCY CRUSHER

Crushing efficiency characterizes the relative productivity of the crusher in relation to the installed drive power.

$$E_{crushing} = \frac{Q}{P_{ins}}, \ m^3/(kW \cdot w)$$

The crushing efficiency depends on the size of the starting material and characterizes the value of the conditional stress in the processed material.

$$\sigma_{ins} = k \ E_{crush}^{-1}, \ MPa,$$

where k = 3,6 is the proportionality coefficient

As follows from the calculated data table. 2, the crushing efficiency depends, ceteris paribus, on the crushing method.

PRODUCTIVITY OF THE CRUSHER

When crushing "In the layer" energy consumption for deformation of the dense "packing" of small material (with a loosening coefficient Kp ~ 1.1) increase, decrease the magnitude of the relative deformation of the layer and, accordingly, the speed of passage of the material through the crushing chamber and the productivity of the crusher decrease.

ANALYSIS OF METHODS FOR CRUSHING

Ultimately, the efficiency of crushing the material "in the layer" is significantly lower than the efficiency of crushing by the "piece on armor" method, and the conditional stress in the material of the layer is correspondingly higher.

Based on a comparative analysis of methods for crushing pieces of rock breeds found:

- With different methods of destruction, the limiting relative deformation of the material (deformation of pressing) practically (within 95% of the confidence interval) does not depend on the initial size;
- The particle size distribution of the destruction product depends on the method of destruction and relative deformation of the material. At the same time, for each method of destruction, the characteristics of the size of the crushing products of pieces are different the sizes at the same value of the relative deformation are geometrically similar, that is, the characteristics of the relative size, expressed in fractions of the original size of the piece or the average diameter of the layer, practically coincide;
- An increase in the relative deformation of the original piece or layer leads to an

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improvement in the shape of the grain of the product of destruction in small classes, but this increases the dropout rate;

- Regardless of the method of destruction of rocks, the energy intensity of the process crushing is proportional to the degree of crushing of the material;
- Crushing by the "piece on armor" method gives an effective use of the properties of crushing of rocks in terms of reducing the size of the material, but the uneven distribution of the particle size in the product and the uncontrollable shape of the grains. When crushing by the "piece on armor" method, parts of the pieces have different configurations (needle, columnar, flaky, etc.) depending on the place of application of the external load and the position (orientation) of the piece relative to the supporting surface of the armor;
- The method of crushing the "piece on armor" is well studied, has reliable technical means of its implementation and is characterized by a stable relationship between the level of external influence on pieces of rocks with the parameters of the process of their destruction;
- The method of crushing "in a layer" has a number of advantages due to volumetric stress-strain state of the material in the layer at destruction. Such loading promotes the destruction of lumps mainly along the intergranular bonds and the formation of an isometric product.

VOLUMETRIC COMPRESSION

When crushing "in a layer", pieces of rock are subjected to volumetric compression, which leads to the destruction of all pieces in contact. In this case, to achieve the required product size, it is required less energy input due to its full use. Moreover, the intensity of the crushing process increases and the productivity of the crusher increases.

REFERENCES

1. GOST 6937-91. Cone crushers. General technical requirements. "Mechanical equipment of enterprises of building materials", Moscow: publishing house of standards, 2008.
2. Lagunova Yu. A. Reserves for increasing the efficiency of equipment for ore preparation // Mining machines and automation. 2004. №. 3. S. 49-53.
3. Sapozhnikov M.Ya. Mechanical equipment of enterprises of building materials and structures / M.Ya. Sapozhnikov - M .: Higher school, 1971, -382s.
4. Gerasimenko VB, Fadin YM . Technical foundations for creating machines, Belgorod, BSTU publishing house. 2014.119 p.
5. Krivov D.A. Problems of using roller crushers for grinding grain crops // Materials of the XIV International Scientific and Practical Conference "Science and Education: Experience, Problems, Development Prospects", Krasnoyarsk, 2016, p. 55-56.