Influence of construction of bearing assembly on the size characteristic of crushing by a jaw crusher

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Abstract. Results of an experimental study on crushing granite from Iset deposit of the Ural region on the SHD-10M jaw crusher has been presented. Degree of influence of a bearing assembly of the SHD 10M crusher on fineness of final product by fractions has been determined, experiments with sampling has been conducted, results has been recorded, fineness characteristics of crushing product by “plus” and “minus” using the A-20 analyzer has been determined. Values of productivity, crushing time by fineness classes has been given.

1 Introduction

With increasing intensity of operation of crushing and processing plants and growing load on crushing and grinding equipment, an increase in cost of electricity and so on, it becomes necessary to select the most energy-efficient [1, 2] modes [3, 4] of operation of technological equipment [5-10].

Evolutionary development of rock disintegration processes during mechanical processing of minerals is characterized mainly by modernization of crusher designs and significant increase in efficiency of ore preparation operations.

2 Materials and methods

Laboratory sample SHD 10M is a jaw crusher with a complex swing of a cheek, in which destruction of material occurs due to deformations, compression and shift. [3] Fineness of crushed material is determined by the gap between cheeks in the lower part (discharge gap) and physical properties of material. During exploitation of this machine, a work on studying a bearing assembly of cheek swing has been done, an experiment on collecting data on “plus” and “minus” has been conducted with further drawing of dependency graphs, see Figure 1 and 2.

3 Results and discussion

The purpose of the experiment is to prove effect of elements of a bearing assembly on characteristic of size of crushing, to show that replacement or adjustment in design of some elements of assembly can affect the end product. The ore that has been selected for the experiment is Isetsky granite with hardness about 6-7 on the Mohs scale, size of loadable particles - from 22 to 60 mm, required output product - 4 mm, gap between cheeks of the SHD 10M crusher has been set to 4 mm, weight of loaded raw material - 645 g, time spent on crushing minerals - 31s, with performance output of 77.8 kg / hour. The data obtained after working with original construction of the crusher were imported in table 1.

Table 1. Data from the first experiment on crushing granite by the SHD 10M crusher with factory bearing.

Isetsky granite				
Weight, gr	"minus",%	"plus",%	Fineness in proportion to discharge gap	Fineness of particles obtained, mm
275	61,93	38,07	1,2	+4...0
155	78,15	21,85	0,73	+3…4
90	82,05	17,95	0,4375	+1…3
65	89,92	10,08	0,1875	+0,3...1
50	91,50	8,50	0,06	+0,071…0,3
10	96,45	3,55	0,00525	+0,05…0,0071
645		100,00%		

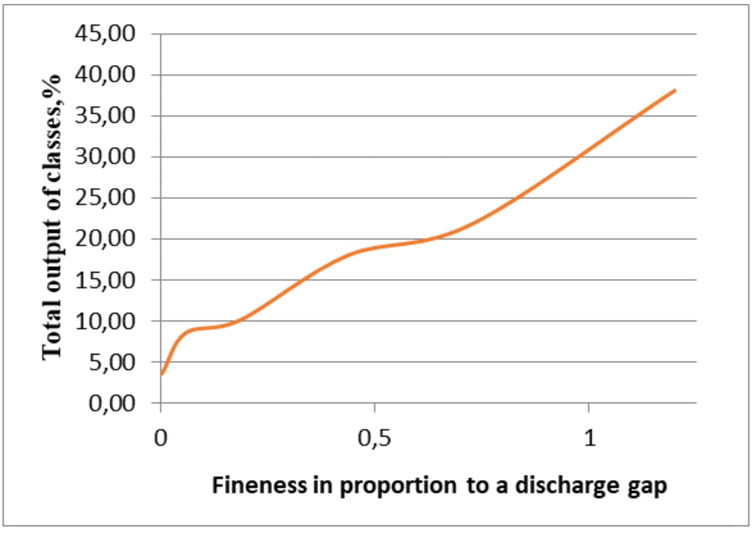

Fig. 1. Fineness characteristic by "plus", SHD 10M crusher, ore - Isetsky granite.

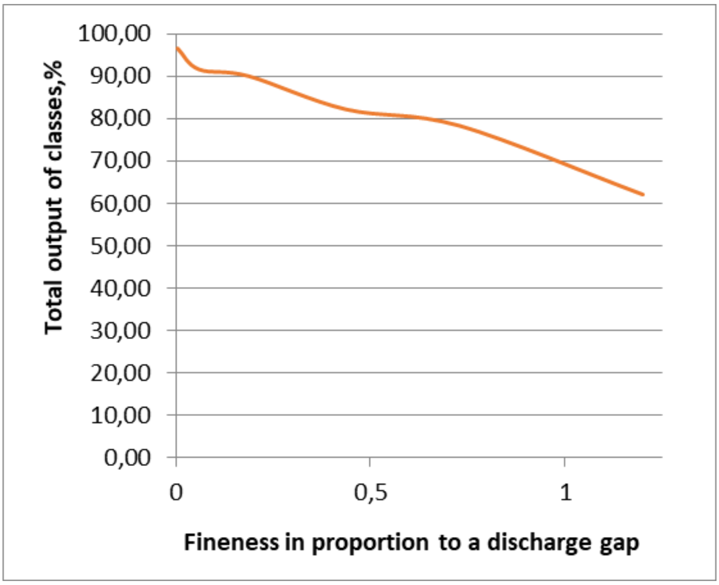

Fig. 2. Fineness characteristic by “minus”, SHD 10M crusher, ore - Isetsky granite.

In process of studying the crusher, a theoretical study of its bearing assembly has been conducted in order to identify the load which affects a bearing itself and related elements. [1] As a result, a theoretical calculated model of shape of a bearing has been obtained, see Figure 3, which simplifies calculations and makes it possible to estimate with high accuracy zones of action of forces and their values inside the model.

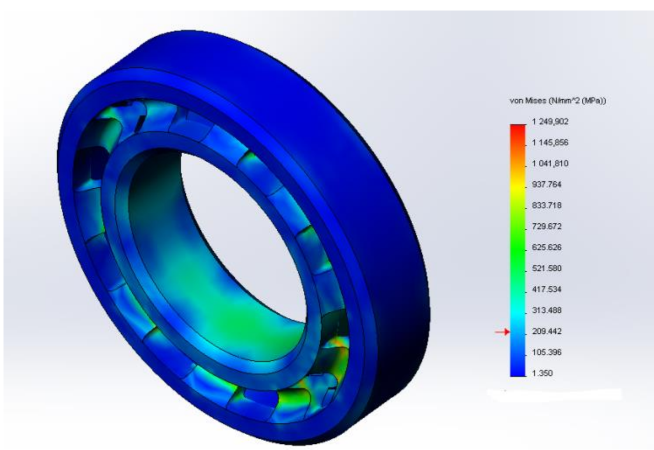

Fig. 3. Theoretical model of a bearing of a SHD 10M crusher.

The study consisted of working with the exact bearing model, 210 GOST 8338-75, installed directly in the SHD 10M crusher, as well as with simplified theoretical models, see Figure 4, of the same bearing, in order to replace a complex and programmatically bulky model with a simple one without loss of accuracy. As a result, it allowed to accelerate multiple processes of calculating existing forces inside the assembly and the bearing, as well as to exclude software errors when calculating complex conjugated 3D models.

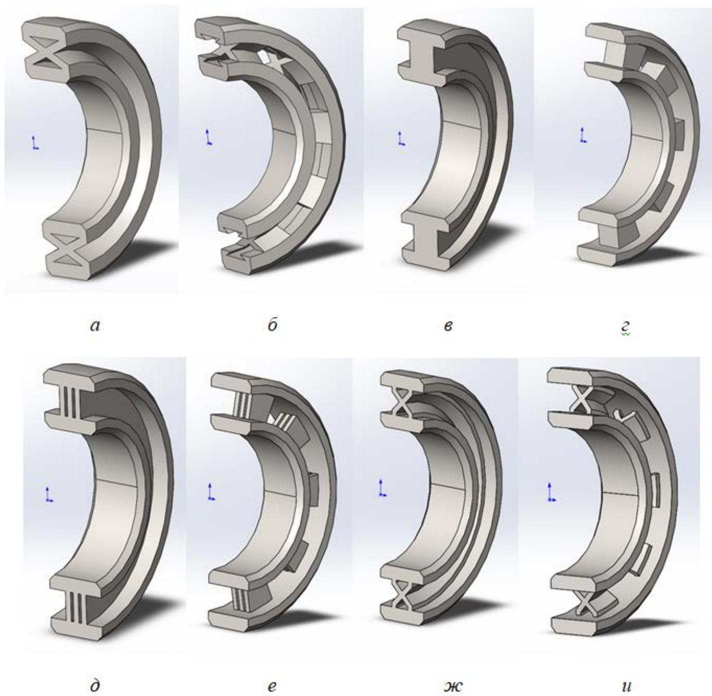

Fig. 4. Simplified theoretical models of the 210 GOST 8338-75 bearing.

A similar method has been used to study another bearing assembly of a larger crusher, the SHDS12x15 with 23196 SAKW33 bearings installed in it. [2] See Figure 5. The bearing is more complex, spherical, roller, double row. The experiment is absolutely similar to the previous one with the 210 GOST 8338-75 bearing. A theoretical model that is comparable in characteristics to the real one has been developed, shown in Figure 5, maps of the reaction of models to phased loading has been considered one of thm is also presented in Figure 5.

The bearing showed more even distribution of load inside the assembly and its constituent elements, besides thanks to the simplified model, the experience has been less labor intensive since the exact model had not been convenient for its use in calculations from a software point of view due to large number of links and elements included [4]. In addition, not all popular model databases contain the model of this bearing which initially made it difficult to find information.

According to the results of two studies of bearings of two different crushers, it has been decided to put the data into practice and install a bearing similar to 23196 SAKW33 of suitable size in the SHD 10M crusher in order to determine the effect of actual elements of the assembly on the final product.

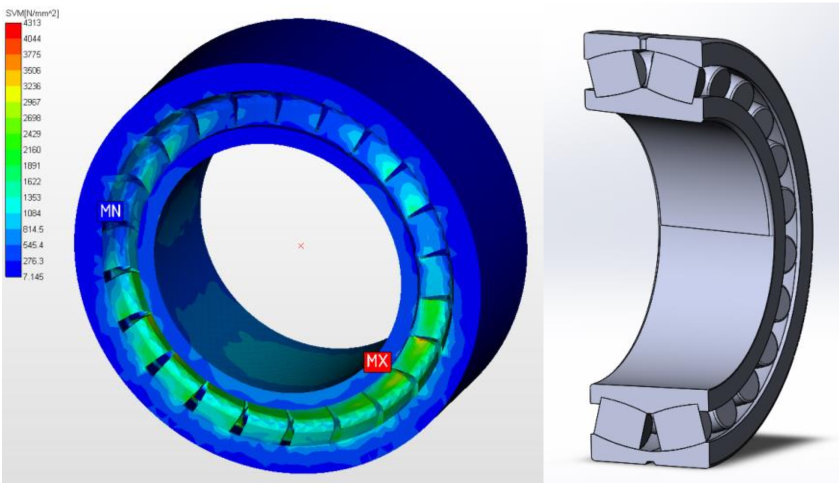

Fig. 5. Theoretical model of a bearing of a SHD 10M crusher.

The MPZ 1210EKP, a radial, roller, self-aligning bearing has been chosen for this. [5] Modification of the SHD 10M crusher has been done. After that the experiment with crushing Isetsky granite has been done, as well as new graphs has been drawn for characteristics of the “plus” and “minus”, Fig. 6 and 7, respectively, according to the new data, see table 2. Characteristics of the experiment remained unchanged (hardness 6-7 according to the Mohs scale, size of the loaded particles from 22 to 60 mm, required output product - 4 mm, gap between cheeks of the SHD 10M crusher - 4 mm, weight of loaded raw material - 645 g, time spent on crushing minerals - 31 s, with performance output of 77 ,8 kg / h), only the result has been adjusted.

Table 2. Data of the second experiment on crushing granite on the SHD 10M crusher with a new bearing.

Isetsky granite				
Weight, gr	"minus",%	"plus",%	Fineness in proportion to discharge gap	Fineness of particles obtained, mm
275	57,36	42,64	1,2	+4...0
155	75,97	24,03	0,73	+3…4
90	86,05	13,95	0,4375	+1…3
65	89,92	10,08	0,1875	+0,3...1
50	92,25	7,75	0,06	+0,071…0,3
10	98,45	1,55	0,00525	+0,05…0,0071
645		100,00%		

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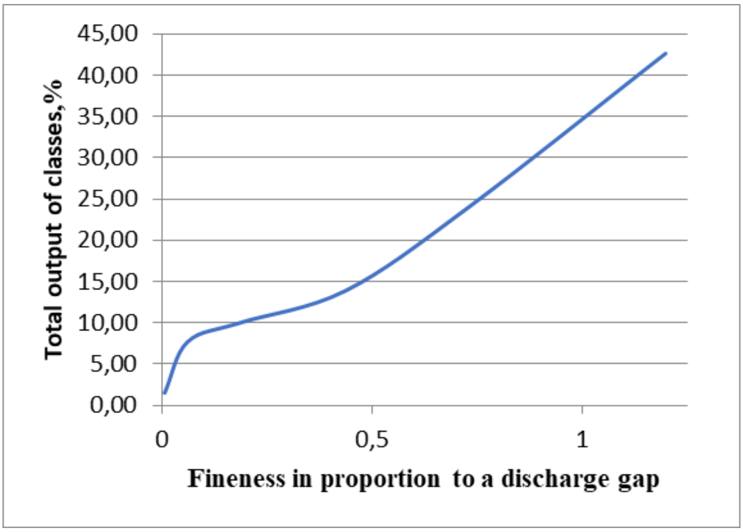

Fig. 6. Fineness characteristic by "plus", SHD 10M crusher, ore - Isetsky granite, new bearing.

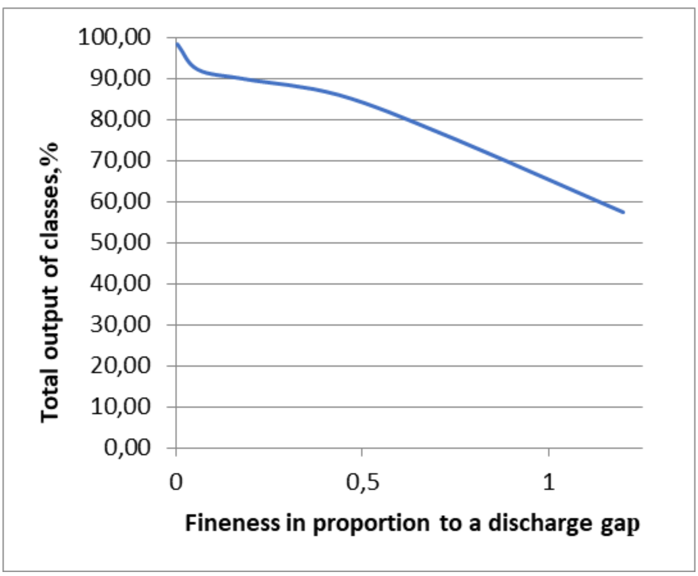

Fig. 7. Fineness characteristic by "minus", SHD 10M crusher, ore - Isetsky granite, new bearing.

Comparing the graphs of Figures 1 and 6, 2 and 7, it can be seen that after replacement of bearings, product output of the required size has increased, the amount of small fraction particles in the range of + 0.05 ... 0.0071 has decreased, while the content of the + 1 ... 3 fraction has also decreased, transitions between fractions became smooth, graphs became more classical.

4 Findings

The bearing assembly and its design directly impacts operation of a crusher and output product.

We receive satisfactory result regardless of bearing type, but the result with a radial roller bearing is considered more acceptable due to the content of larger number of required particle size in the output product.

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