DETERMINING THE LOAD ON RKS-TYPE TANGENTIAL PICKS

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ABSTRACT

The article deals with the issue of determining the load on RKS-type tangential picks under lab conditions. The tests were performed with three specially prepared RKS-type cutting tools. The cutting force components and resultant values were determined for each type. It was found that the change in the cutting angle from 70° to 110° has a weak effect on the ratios between the individual forces.

A test stand shown in Fig. 1 was used to determine the load on RKS-type tangential picks. The shearing drum is a strainmeasuring head by which it is possible to measure and record the resultant cutting force and its components. The test stand consists of a frame 1, a welded structure made of steel sections and sheet iron. The casket 5 and the hydraulic system 11 are mounted on it. The hydraulic cylinder 7 feeds the strainmeasuring head 6 to the casket 5 where the rock fragment is fixed. The driving screw 12 is used to move the casket horizontally for a new sickle and the straight-line movement of the cutting tool is achieved by supports 2 and 9, slides 8 and guides 13. The stand is fitted with limit switches 4 serving to protect the strain-measuring head and the cutting tool against inadmissible overloads. The hydraulic cylinder is fixed on the panel 10 thus obtaining the necessary rigidity and stability of the structure.





The cutting force components are oriented along the axes of the spatial rectangular coordinate system designated by P_x , P_y and P_z , respectively, where P_x is the side cutting force, P_y is the vertical cutting force and P_z is the tangential force. The

resultant cutting force is designated by $\mathsf{P}_{\mathsf{res}}$ and is determined by the analytical relationship

$$\mathsf{P}_{\mathsf{res}} = \sqrt{\mathsf{P}_x^2 + \mathsf{P}_y^2 + \mathsf{P}_z^2} \tag{1}$$

After making observations under the conditions of the Babino Mine at Bobov Dol we found that the broken mining mass comes in contact not only with the hard alloy plate (the pin) but also with the head (holder) of the cutting tool. In order to determine what part of the cutting force is exerted on the pin and what part is taken up by the holder, a series of long-term measurements were carried out in the lab. As an object of breakage we used representative fragments of material from the Babino Mine and the cutting tools were prepared in accordance with the picks shown in Fig. 2. Fig. 2a presents an original RKS1pick and Fig. 2b depicts a pick with an elongated head, in which the cutting force is exerted on the hard alloy pin. The sample shown in Fig. 2b is without a hard alloy pin. The cutting force in that tool is distributed only on the head (holder). The tests were performed under the following operating conditions: blocked cutting along a smooth surface; thickness of sickles h = 10 mm; cutting angle β from 70° to 110° changing within the range of 10°; material strength from 2.5 to 3 by Protodyakonov's scale and rate of feeding the tool V^p = 20 mm/s.



Figure 2 Experimental RKS1picks a – original pick; b – pick with elongated head; c – pick without head

The experimental studies were necessitated by the heavy conditions of cutting tool operation at Babino Mine. Due to the higher rock hardness, the hard alloy pin of some picks is broken from the very beginning and they cut the mining mass only with their holders thus causing a negative effect on the whole machine.

The results of the experimental studies are presented in Table 1. The same table gives in percentage the ratios between the resultant cutting forces for each type of tested pick. The graphic dependencies of the test results obtained are shown in Fig. 3



Figure 3

	Cutting forces, N												Ratio between	
Cutting angle β	Original pick				Pick without pin				Pick with elongated head				resultant cutting forces, %	
	Px	Py	Pz	p _{res}	Px	Py	Pz	p _{res}	Px	Py	Pz	p _{res}	Pwp/Por	Peh/Por
70	0.22	1.28	1.53	2.01	0.06	0.54	1.21	1.32	0.14	0.98	1.33	1.66	82.5	65.7
80	0.23	1.29	1.57	2.04	0.07	0.55	1.24	1.36	0.17	1.01	1.35	1.69	82.2	66.7
90	0.25	1.33	1.61	2.10	0.09	0.57	1.27	1.38	0.19	1.03	1.41	1.76	83.8	68.6
100	0.27	1.34	1.64	2.14	0.10	0.59	1.29	1.47	0.21	1.05	1.44	1.79	84.8	68.9
110	0.28	1.37	1.69	2.19	0.10	0.61	1.31	1.51	0.22	1.07	1.49	1.85	84.4	69.3

Table 1

The results showed that the resultant cutting force in the original picks is determined by the forces acting on the hard alloy pin and the body. Furthermore, the greater part of that force is taken up by the central pin (approx. 80-85%), whereas 15-20% of it is taken up by the body. A different picture can be observed with respect to the vertical (P_y) and side (P_x) forces, which can be explained by the profile of the groove formed by the pin as well as by the fact that these two forces have considerably lower values.

In general we can conclude that the change in the angle of cutting from 70° to 110° has a weak effect on the ratios between the individual forces discussed above.

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