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CHANGES IN THE COEFFICIENT OF FRICTION OF PAIRS FROM VARIOUS TOOL AND MACHINED MATERIALS DURING THEIR MAGNETIC PROCESSING

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INTRODUCTION:

The cutting process is a complex complex of physicochemical phenomena, which include the kinematics of the process, stress state, plastic deformation, destruction in the cutting zone, friction, thermal, chemical, electrical and magnetic phenomena on contact surfaces.

Based on the analysis of works [1, 2, 4], performed in our country and abroad, the impact on the electromagnetic system when cutting metals can be carried out in the following ways:

a) by magnetizing the tool;
b) by magnetizing the workpiece;
d) creating a magnetic field in the cutting zone;
e) pulsed magnetic processing.

One of the important advantages of these methods is their simplicity and the possibility of using them in any production environment.

One of the promising directions for increasing the productivity of machining through tool life is the magnetization of the cutting tool.

Numerous experiments have established a significant effect of the magnetic field on the durability of the cutting tool [3, 5, 6].

MAIN PART:

When working with magnetized cutters, the magnetic field of the cutter, closing on the workpiece when processing ferromagnetic materials, changes its magnetic state.

The mechanics of the cutting process provide a physical representation of machining; it allows you to establish the conditions for the mechanical interaction of the working edges of the tool with the material being processed. In accordance with this, the mechanics of the cutting process considers elastic plastic deformations of the processed material, as well as its destruction, taking into account the friction on the contact surfaces of the tool.

As you know, the friction force is:

$$F = N \cdot f_{\text{тр}} \qquad (1)$$

Here F is the normal force toward the front of the tool.

As can be seen from expression (1), with a decrease in the friction coefficient ffr, the value of the force F decreases. If, during the magnetization of tools, there is a change in the chemical composition and structure of the surface layers in relation to the base material, this should accordingly be reflected in the value of ffr, as a result the force F also changes. These factors, in turn, will affect the wear resistance of the tool.

In order to check the correctness of theoretical conclusions, we carried out experiments to determine the coefficient of friction of rubbing pairs. Friction was carried out between specimens made of high-speed tool materials (P18, P6M5), of machined steel 45, 30XGCHA. Friction was carried out according to the disk-block scheme. The disk made of the material being processed rotated at a certain speed, and the block made of the tool material was fixed stationary and with a given specific pressure came into contact with the disk. In all experiments, the disc-pad friction pair was run-in for 45 minutes with a specific pressure of 5 kg · s / cm2 and a friction rate of 157 m/min, after which the main experiments were started.

The disk made of the material being processed rotated at a certain speed, and the block made of the tool material was fixed stationary and with a given specific pressure came into contact with the disk. In all experiments, the disc-pad friction pair was run-in for 45 minutes with a specific pressure of 5 kg · s / cm2 and a friction rate of 157 m / min, after which the main experiments were started. As you know, the value of the coefficient of friction depends on the physical and mechanical properties of rubbing pairs and the state of their surfaces, as well as on the temperature and specific pressure at which the process of friction occurs. The temperature of the rubbing surfaces, in turn, depends on the physical and mechanical properties of the rubbing pairs, the friction rate and specific pressure. In order to determine the influence of the magnetization of the tool material on the coefficient of friction, the experiments were carried out at various specific pressures and speeds of friction.

In the first series of experiments, at a constant value of the friction velocity V_{tr} = 157 m/min, the pressure varied from 5 to 125 kg · s / cm^2. It can be seen from the results obtained that, within the experimental conditions, the greatest value of the friction coefficient is observed in the pair P18 - steel 45. In all cases, when the tool material is magnetized, the friction coefficient decreases in comparison with the friction before magnetization. Moreover, this difference increases with a decrease in specific pressure (Fig. 1, 2, 3).

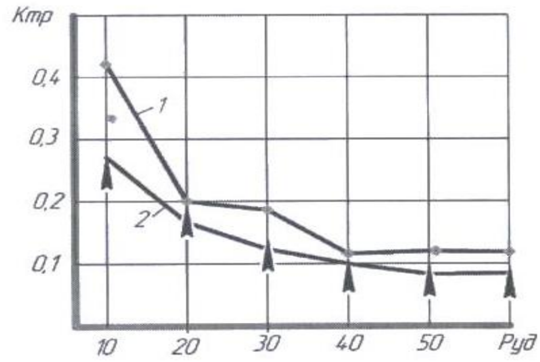

Fig. 1. Influence of the magnetization of the tool material and specific pressure on the coefficient of friction.

P18 - steel 45, V_{tr} = 157 m / min.

1 - non-magnetized sample

2 - magnetized sample

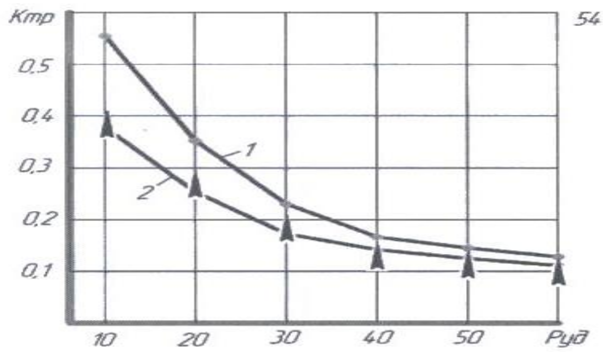

Fig. 2. The influence of the magnetization of the tool material and specific pressure on the coefficient of friction.

P6M5 - steel 45, V_{tr} = 157 m / min.

1 - non-magnetized sample

2 - magnetized sample

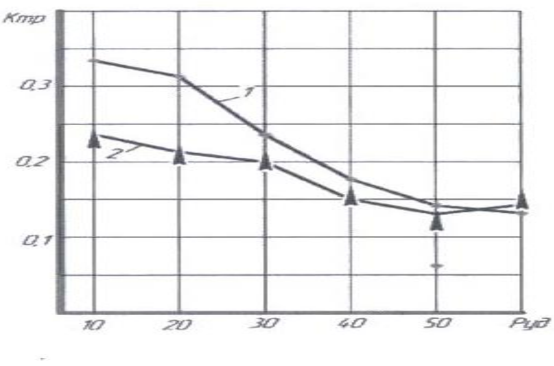

Fig. 3. Influence of magnetization of the tool material and specific pressure on the coefficient of friction.

P18 - steel 30HGSNA, Vtr = 157 m / min.
1 - non-magnetized sample
2 - magnetized sample

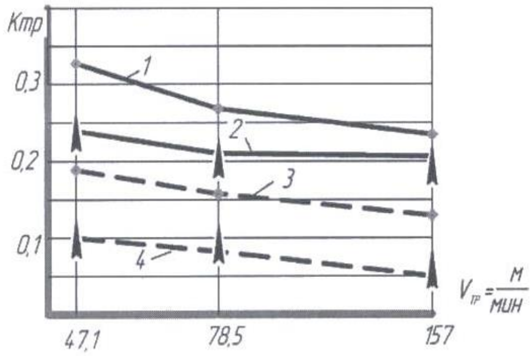

Fig. 4. Influence of magnetization of the tool material and specific pressure on the coefficient of friction.
P18 - steel 30XGCNA, Vtr = 157 m / min.

1 - non-magnetized sample at R_{ud} = 30 kg · s / cm^2
2 - magnetized sample at R_{ud} = 30 kg · s / cm^2
3 - non-magnetized sample at R_{ud} = 75 kg · s / cm^2
4 - magnetized sample at R_{ud} = 75 kg · s / cm^2

With an increase in the specific pressure, a general decrease in the coefficient of friction is observed for both magnetized and non-magnetized pairs, with an insignificant difference between them. The greatest decrease in the coefficient of friction during magnetization of specimens made of tool material was observed in the pair P18 - steel 45.

To determine the effect of the friction velocity on the friction coefficient, experiments were carried out at various values of the friction velocity (V_{fr} = 47.1; 78.5 and 157 m / min) with a specific pressure of 30 and 75 kg · s / cm2 for a pair of P18 - steel 30XGCNA (fig. 4). The results obtained show that at both values of the specific pressure, a decrease in the coefficient of friction occurs in the case of using a magnetized sample made of a tool material. A greater decrease in the coefficient of friction is observed at the value of the specific pressure Psp = 30 kg · s / cm^2.

Based on the data obtained, it can be assumed that during the preliminary magnetization of samples made of high-speed steels, their surface layer changes, which leads to a change in the friction coefficient, and the magnitude of the effect depends on the specific pressure and friction rate, with a decrease in which the friction temperature increases.

CONCLUSION:

If we consider this phenomenon in the process of cutting with the use of magnetized high-speed tools, it can be assumed that due to a decrease in the coefficient of friction in a certain range of cutting speeds, there should be an increase in the wear resistance of the cutting tool [1].

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