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EFFICIENCY OF USING TURNING MACHINING CENTERS

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Abstract: The article examines ways to improve the quality of machined surfaces at modern machining centers. In particular, the possibility of using cutters made using Wiper technology . The efficiency of using modern machining centers was evaluated, the corresponding dependencies were built, which prove the feasibility of using turning machining centers. Further prospects are established for further improving the productivity of processing parts at machining centers, in particular, the use of automatic parts loading devices or industrial robots that allow reducing equipment downtime.

Keywords: machining center, cutting speed, spindle speed, Wiper technology, surface roughness, productivity

Machining centers are the most optimal solution for the production of products in the conditions of serial and small-batch types of production. Such machines are high-performance equipment that allows you to manufacture complex and high-precision parts with a large number of machined surfaces with minimal time spent on preparing their production.

Lathe processing centers differ from universal lathes by increased accuracy and stability of processing, increased rigidity of the bed, shorter auxiliary time and lower surface roughness during the production of parts. It is also possible to install a drive tool on this equipment. Such machines are equipped with high-speed and high-precision spindles. Turning processing centers have high productivity and, accordingly, quick payback [1].

Therefore, the study of the effectiveness of the use of processing centers is an urgent issue that will allow to expand the degree of their introduction into production, improve the quality and competitiveness of products and increase productivity.

As you know, to improve the quality of the machined surface (reduce the roughness of the machined surface) it is necessary to reduce the feed and increase the spindle rotation frequency.

JSC “Iscar”, offer constructively new plates with a modified radius at the top (new Wiper geometry). Using of this cutting tool in combination with the capabilities of modern machining centers makes it possible to significantly improve the quality of processed surfaces when using the same cutting modes compared to plates with a normal radius at the top [2] .

In fig. 1, a, the principle of operation of Wiper technology is shown, fig. 1, b - standard plate [2] .

A study of the dependence of the roughness of the processed surface on the value of the longitudinal feed was also carried out at a cutting speed of V=335 m/min. The results of the analysis are shown in fig. 2.

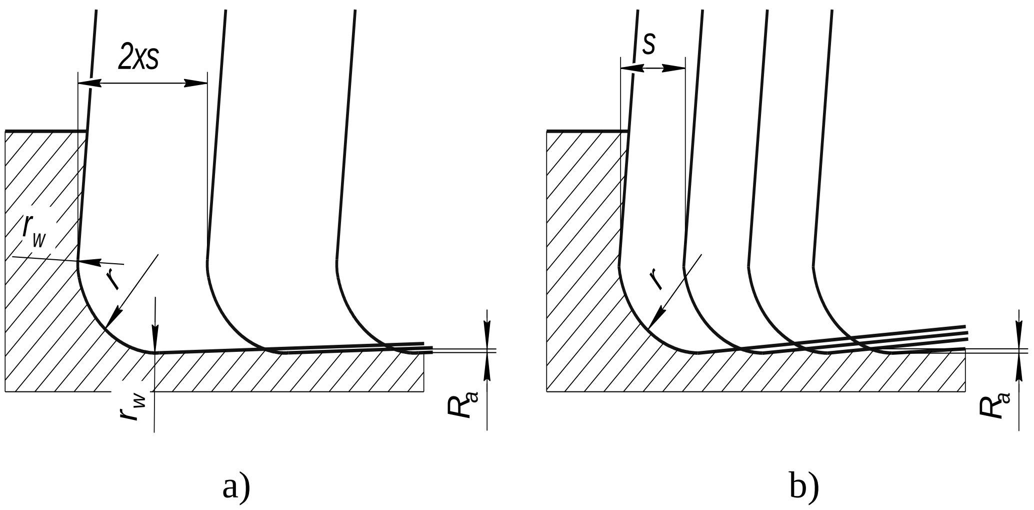

Fig. 1. The principle of operation of Wiper technology

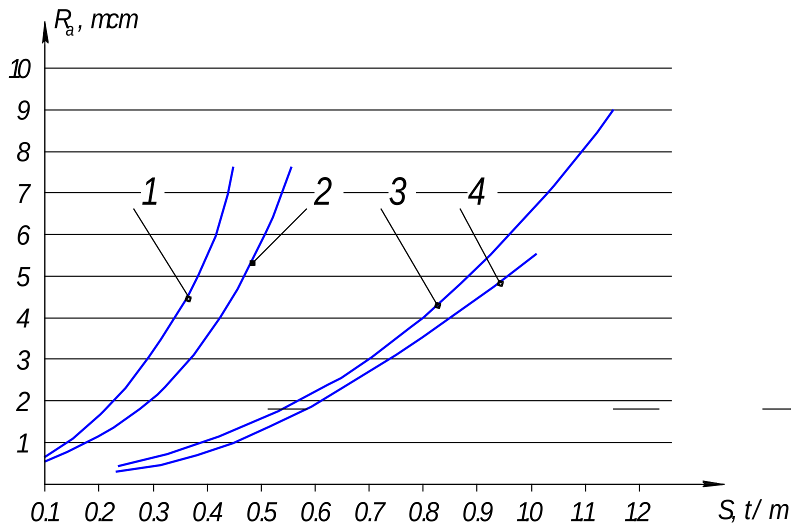

Fig. 2. Dependence of the cleanliness of the treated surface on the feed:

1 – rough turning plate; 2 – finishing turning plate; 3 – Wiper draft plate ;

4 – Wiper cleaning plate

Graphs 1 and 2 correspond to testing conventional turning inserts (roughing and finishing respectively), and graphs 3 and 4 correspond to testing turning inserts with Wiper technology (roughing and finishing respectively).

Wiper plates provide a better roughness of the processed surface, provided that the same feed is used. This makes it possible to increase the feed and, accordingly, reduce the main processing time and increase productivity and obtain the necessary surface roughness [2] .

The efficiency of using modern machining centers can be evaluated from the point of view of increasing cutting speeds, and accordingly increasing productivity due to their technological capabilities.

Let's use the known dependence:

$$V = \frac{\pi \cdot D \cdot n}{1000},$$

where D – the diameter of the processed part; n – the spindle rotation frequency.

MathCAD software, we will plot a graph of the dependence of the cutting speed on the spindle rotation frequency for different diametrical dimensions of the processed part.

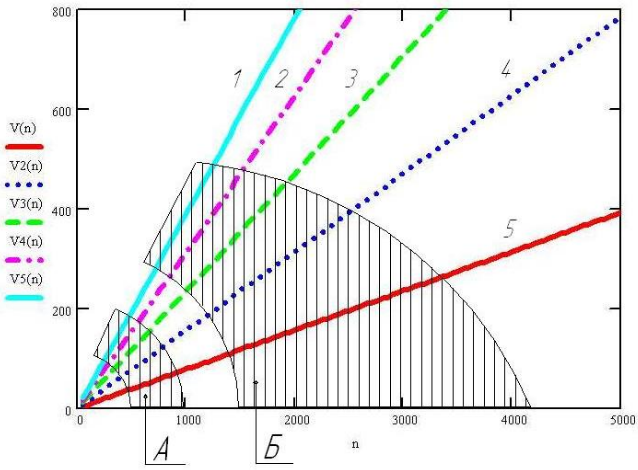

Fig. 3. Graph of dependence of cutting speed on rotation frequency spindle: 1 – D=125 mm; 2 – D=100 mm; 3 – D=75 mm; 4 – D=50 mm; 5 – D=25 mm

Analyzing the graph, it can be concluded that an increase in the spindle rotation frequency leads to an increase in cutting speeds, and accordingly to an increase in labor productivity. Such an increase is possible only on modern machining centers, when using progressive cutting tools.

Two zones can be distinguished on the graph: A – zone of cutting speeds in which automatic lathes, semi-automatic lathes and revolving machines work; B - cutting speed zone in which modern machining centers operate.

Since an increase in rotation frequency leads to a decrease in the main processing time, it is reasonable to analyze this effect. According to the formula:

$$t = \frac{L_{px}}{s \cdot n},$$

where L_{px} – amount of working stroke; s – minute supply; n – the spindle rotation frequency.

These graphs were built at a constant feed value of 0.2 mm/rev. Two zones can be distinguished on the graph: A – the zone in which automatic lathes, semi-automatic lathes and revolving machines work; B – zone in which modern processing centers work.

Analyzing the graph, we can conclude that the decrease in spindle speed is less than 500 rpm. leads to a rapid increase in the main processing time. This once again confirms the expediency of using modern machining centers in production.

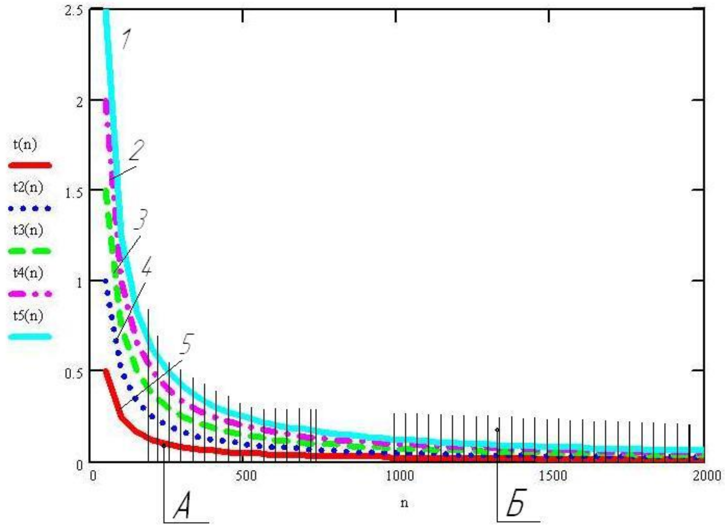

Fig. 4. Graph of the dependence of the main time on the spindle rotation frequency: 1 – L $_{px}$=125mm; 2 – L $_{px}$=100mm; 3 – L $_{px}$=75mm; 4 – L $_{px}$=50mm; 5 – L $_{px}$=25mm

Since the main processing time is also strongly influenced by the amount of feed, in the Stati stica system let's analyze the complex impact on the value of the main processing time, both the spindle speed and feed rate.

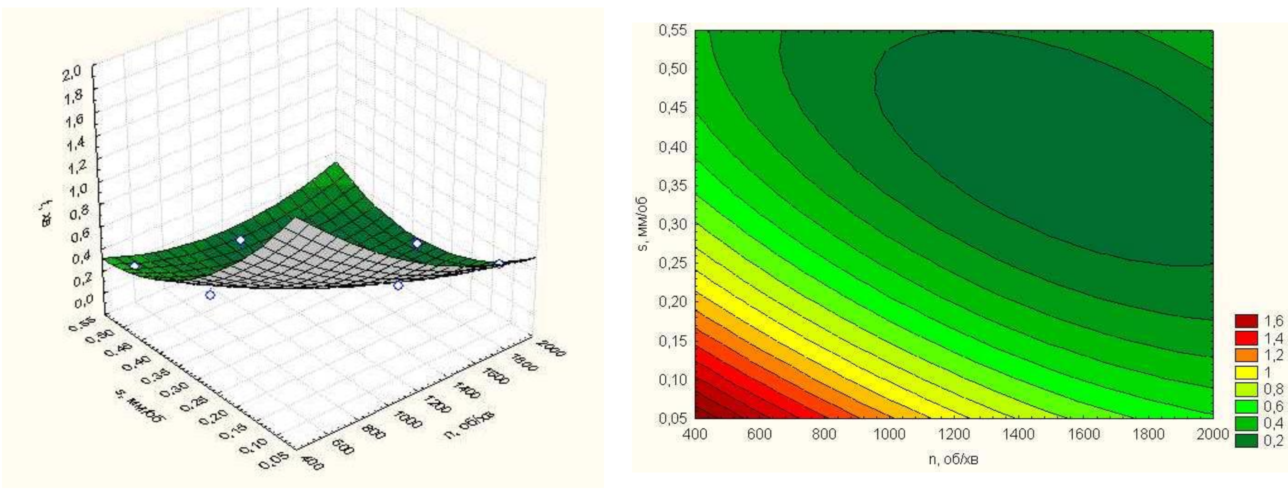

Fig. 5. Graph and level lines of the dependence of the main processing time on feed and spindle speed (at Lpx = 75 mm)

Analyzing the graphs, we conclude that in order to increase the productivity of the equipment (reduce the main time), it is necessary to increase both the frequency of rotation of the spindle and the amount of feed. Such conditions, without loss of processing quality, are possible only if modern processing centers and progressive cutting tools are used.

Another way to improve efficiency is to use automatic bar feeders or automatic part loading devices.

Conclusions. Ways of improving the quality of machined surfaces at modern machining centers have been investigated. In particular, the possibility of using cutters made using Wiper technology. Using such a cutting tool allows you to increase productivity by 200%. The efficiency of using modern machining centers was evaluated, the corresponding dependencies were built, which prove the feasibility of using turning machining centers. Further prospects are established for further improving the productivity of processing parts at machining centers, in particular, the use of automatic parts loading devices or industrial robots, which allow to reduce the idle time of the equipment.

LIST OF REFERENCES

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