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Choosing the Optimal Processing Method to Improve the Productivity of Machine Tools and Machine Systems

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Abstract

This article provides the materials of the tools for comparing the performance of the selected optimal methods that provide opportunities to improve efficiency. The table of performance indicators is supplemented by the surface plastic deformation treatment method and the tool used for this finishing treatment. There is also a graph indicating the processing performance by the years of appearance of various tool materials.

Keywords: *Productivity; Technology; Machine; System; Deformation; Ball; Grinding; Processing; Efficiency; Improvement; Comparison; Material; Operation*

Introduction

Each creation is evaluated by its positive aspects relative to the other. For a comparative assessment of the technical level of machine tools and machine systems, as well as for the selection of machines in accordance with the solution of a specific technological problem, several indicators are used that characterize the quality of machine tools and machine equipment, tools with guiding or forming movements, as well as the types of processing processes performed on them. One of these indicators is the efficiency of machine tools and machine systems. The latter helps to increase the processing productivity and, accordingly, reduce the labour costs for forming machine parts.

Materials and Methods

Efficiency is characterized by calculating the cost of operating technological equipment and the time of machining a single part.

$$Э = 1/c_1 \cdot c_2 \quad (1)$$

Where, c_1, c_2 – respectively, the cost of operating the process equipment and the cost of machining a single part. When designing or selecting machine tools and machine systems, you should always strive for maximum efficiency, i.e.

$$Э = N / \Sigma c_i \cdot c_j \quad (2)$$

Where, N - the number of processed parts in the batch or the annual production of the part;

Σc_i, c_j – respectively, the sum of the costs for the operation of technological equipment and the sum of the time spent on the mechanical processing of a batch of parts. The values of the indices i and j – 1, 2, 3 ... depending on the number of technological equipment and the time for mechanical processing of the batch of parts.

When designing or selecting machine tools and machine systems, it is necessary to strive to reduce the total cost of Σc_i, c_j to become minimal. The productivity of mechanical processing is determined by the tool path of the surface of the workpiece to be processed in units of time. This indicator is used to evaluate the capabilities of machines for pre-processing, as well as to compare different technological methods of mechanical processing. The table shows data for comparing different methods of mechanical processing in terms of power consumption when removing 1 cm^3 of metal in 1 minute [1, 2].

The data in the table below includes the power consumption for machining parts by surface plastic deformation (SPD) of an area of 6 cm^2 in 1 min, which means that the area of the hardened surface corresponds to the volume of metal chips removed in 1 min. A ball head is used as a deforming tool (Fig.1).

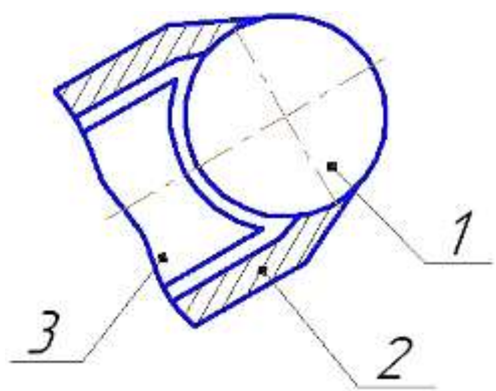

Fig. 1. Ball head: 1- ball; 2-cap; 3- substrate.

The results of the calculation of productivity and power are included in the table of two types of processing, turning and grinding (Table 1).

Table 1. Performance calculation results

Types of processing	Performance, cm^3/min	Power, kw
Turning	1500	0,06
SPD	1000	0,04
Grinding	800	0,6
Electrospark	15	1,0
Electrochemical	15	10
Ultrasonic	1,0	25
Laser	0,01	4000

The "Ball Head" tool designed for deformation machining can be installed by adapting it to the tool holder, turrets and tool magazine of general-purpose metalworking machines, multi-tool machines and flexible manufacturing system (FMS) machines. Ball 1 is made of ball bearing steel “ШХ”, diamond (natural and artificial); cap 2 and substrate 3 are made of copper-containing metals - alloys, if necessary, can be made of steel or its alloys.

The main ways to increase the productivity of machine tools and machine tool systems are associated with the following parameters:

- an increase in technological productivity;
- by combining different operations in time;
- reduction of time for auxiliary movements;
- the use of mechanical processing by the method of surface plastic deformation (SPD);
- reduction of all kinds of non-cyclic losses.

Technological productivity increases with an increase in the speed of machining and is limited by the properties of the material, such as cutting tools used by types and methods of processing. The graph (Fig. 2) shows performance correlated with the history of the occurrence of tooling materials. Improvements in tool materials and their optimization have led to an increase in processing speed over time. The increase in technological productivity is achieved by increasing the processing speed and combining various operations at times.

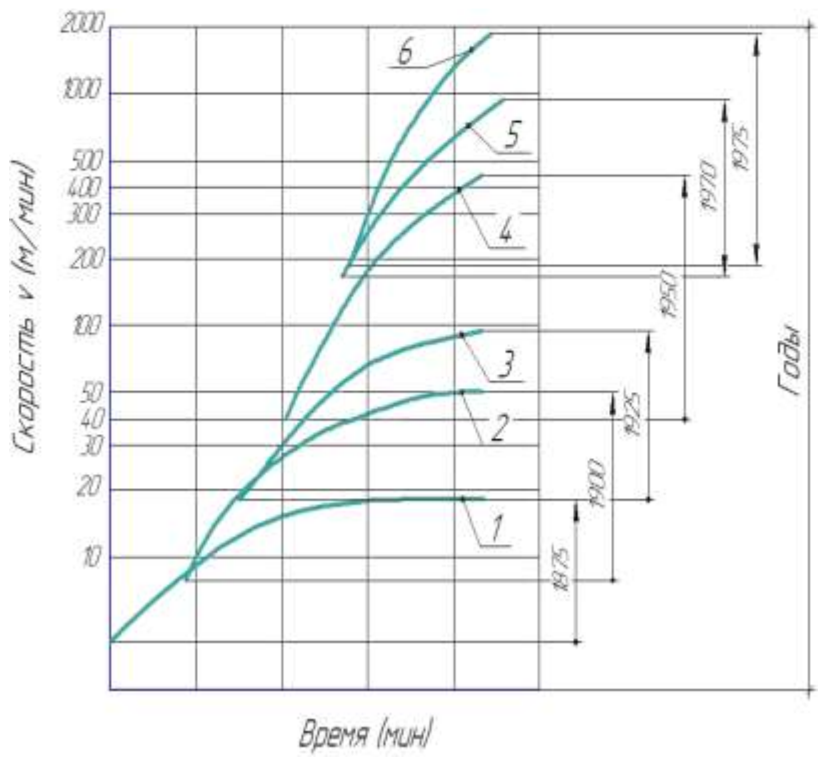

Fig. 2. Change in cutting speed (approximate values) when using machining tool material from 1- carbon tool steel; 2- high-speed steel; 3- hard alloy; 4- powder material; 5- ball-bearing material; 6- ceramics.

By increasing the speed, especially when processing, multi-edge abrasive tools, the processing surface will be painted, burned and crumbled. The increase in machining speed is limited by the material properties of the tool. A sharp increase in speed is possible when switching to new tool materials and the type of construction of the latter. When replacing the cutting tool with cutting tools made of high-speed steel and hard alloy with a powder hard alloy tool, abrasive and diamond tools, it is possible to achieve a significant increase in cutting speed and feed. When replacing an abrasive and diamond tool with a deforming ball, you can achieve maximum economic efficiency and improve the quality indicators of both micro geometric parameters and physics - the mechanical properties of the surfaces of parts at finishing. This is due to the simplicity of the design and the low cost of the deforming tool. The productivity of the grinding process is higher compared to the process of processing with a ball deforming tool, see table 1. But the complexity of the design and the high cost of abrasive tools lead to a decrease in the economic efficiency of using an abrasive tool.

A large reserve for increasing productivity is the combination in time of various operations, both main and auxiliary.

The combination of the main and auxiliary operations is carried out on multi-operational and positional machines of the flexible production system (FPS).

The combination of working operations with an auxiliary one always leads to an improvement in the result, if this is not associated with an unnecessary complication of technological operations performed on the machine tool system. Where it is difficult to use abrasive tools for finishing processing. In the process of using abrasive tools in the technological process, constant regrinding of abrasive tools is required to maintain the shape and size of the abrasive wheel.

The use of continuous processing methods such as centerless grinding, thread rolling, rolling of outer cylindrical surfaces, rolling of the inner surfaces of holes in continuous ways, makes it possible to combine all types of auxiliary operations with working operations and ensure the highest productivity of the machine and machine tool systems.

Reducing idle time to increase the productivity of the machine and machine systems is ensured by the improvement of the drive mechanism and the system with modern control devices. Limitations on the speed of auxiliary movements with the resulting inertial loads and their hereditary influence according to various criteria of durability in the operation of parts and mechanisms of the machine tool and machine tool systems. All types of accumulated losses are reduced with integrated automation and improvement of the control system for individual machine tools and machine tool systems, as well as the control system for all automated production based on modern information technology (IT).

Conclusion

Automation of tool change and the combination of the operation of changing out of order tools on the machine with work operations reduce the loss of time for tool change. Improving the accuracy and rigidity of machine tools and machine tool systems reduces the number of stops and the overall cost of debugging unforeseen failures in machine tools and machine tool systems that occur during production. To select the optimal processing method in order to increase the productivity of machine tools and machine tool systems, the authors recommend using tabular materials, where the parameters are indicated.

References

1. Пуш, В. Э. (1985). *Металлорежущие станки: Учебник для втузов*. Высшая школа. 256 с.
2. Л. В. Перегудов, А.Н.Хашимов, И.К.Шалагуров, С.Л.Перегудов. (2001). Технологическое оборудование автоматизированного производства. Т: «Узбекстан»,– 496 с.

3. Тураев, Т. Т., Батиров, Я. А., & Мадаминов, Б. М. (2021). Сравнительной оценки технического уровня станков и станочных систем. *Збірник наукових праць ΛΌГOΣ*.
4. Turaevich, T. T., & Mirodilovich, M. B. (2020). Physical Foundations Structural-Formation, Surface Layer of Parts. *The American Journal of Engineering and Technology*, *2*(09), 71-76.
5. Тураев, Т. Т., Батиров, Я. А., & Тожиев, Б. А. Ў. (2019). Модернизация процесса волочения проволочного изделия. *Universum: технические науки*, (3 (60)).