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AUTOMATION OF TECHNOLOGICAL PREPARATION OF METAL WORKING ON HEAVY MACHINE TOOLS

The programs for selection of the cutting tools construction and cutting regimes are working in unrestricted surroundings elaborate of addition SharpDevelop in language C#. By the appendix of Cosmos of the program SolidWorks the areas of plate break-age and tensions distributing arising up in it at the different values of cutting force are certain. Based on the conducted researches of durability the rational structural parameters of collapsible chisels, in particular, thickness of plate are grounded that provides the increase of efficiency of treatment of details a hard-alloy instrument on the heavy machine tool.

Keywords: heavy machine tools, technological preparation, cutting force

Introduction

Increasing the efficiency of metal processing, the introduction of resource-saving technologies in engineering, improving the quality and competitiveness of products is impossible without the use of high-performance prefabricated cutting tools that have a significant impact on working conditions and technical and economic indicators of engineering.

The solution of the problems of ensuring the strength is especially important when using cutting tools on heavy machines, the cost of which is high, which makes it necessary to reduce the time of their idle time and organize the rational operation of the tool [1].

The features of heavy loaded cutting tool operation, large dispersion of processing parameters on heavy machines, a variety of factors affecting the operation process require an integrated approach for determining rational design parameters of cutting tools, in particular, plate thickness affecting the operational strength of the tool [2].

Purpose – improving the efficiency of metal working on heavy machine tools by automating the choice of tool design and cutting modes.

The variety of design options for assembly tools complicates the task of justifying the effectiveness of using a particular constructive solution. To develop recommendations for the design of the instrument, comparative laboratory and operational tests were used using breakdown methods, long-term tests, and expert evaluations. As a result, a system of tables has been developed that provides recommendations for the preferred choice of tool design depending on the conditions of their operation [3, 4] and the cutting regimes that are first time associated with a particular tool design. However, the use of these

recommendations requires a sufficiently high qualification of the technologist in making decisions, complicating the search for necessary information. For the implementation of CAD TP, a tool and cutting modes selection block with the use of a computer was developed (Fig. 1).

To automate the technological preparation of machining, a program has been developed in the free application development environment of SharpDevelop in C#. The interface of the main menu of the program is a series of buttons that allow you to open windows of the necessary user parameters. The interface of the tool design selection programs and cutting modes for selecting input data is a series of ComboBox and RadioButton elements. Introduction of input data is successive. In the event that the option of choosing is only one the choice is automatic. At each stage of the input data selection, the corresponding variables are assigned specific values. After selecting all the necessary initial data, according to the values of the variables, the result is displayed on the user's screen.

Input parameters for selecting the design of prefabricated tools are: operation, a group of materials to be processed, the nature of machining and allowance, and the depth of cutting. Further, depending on the type of machine (medium or heavy) and the size of the part, the type of plate, its fastening scheme, the shape of the plate in the plan, the material of the cutting part, the thickness of the plate depending on the required strength, the shape of the front surface of the plate, geometric parameters are selected. The mode selection block contains the selection of feed, cutting speed and correction factors to them, depending on the changed cutting conditions. Next is the durability period and the tool flow elements.

The developed program can be used to implement CAD TP for machining parts on medium and heavy machine tools.

In the basis of design calculations, as a rule, the average values of the loads on the tool are built without taking into account the degree of their dispersion. A feature of the carbide-tipped tool on heavy machines is a large proportion of chipping and breakage of the cutting part. Table 1 shows the results of a statistical analysis of the structure of failures of incisors for machines of different sizes.

Statistical processing of these conditions collected at the base enterprise of NKMZ CJSC, cutting forces during turning with carbide-tipped tools showed that their distribution does not contradict the logarithmically normal law. The density of the distribution of the random variable Pz (y):

$$f(y) = (1/y\sigma)\Phi_0[(lg\, y - lg\, y_0)/\sigma], \quad (1)$$

where σ, y_0 - are the parameters of the distribution law.

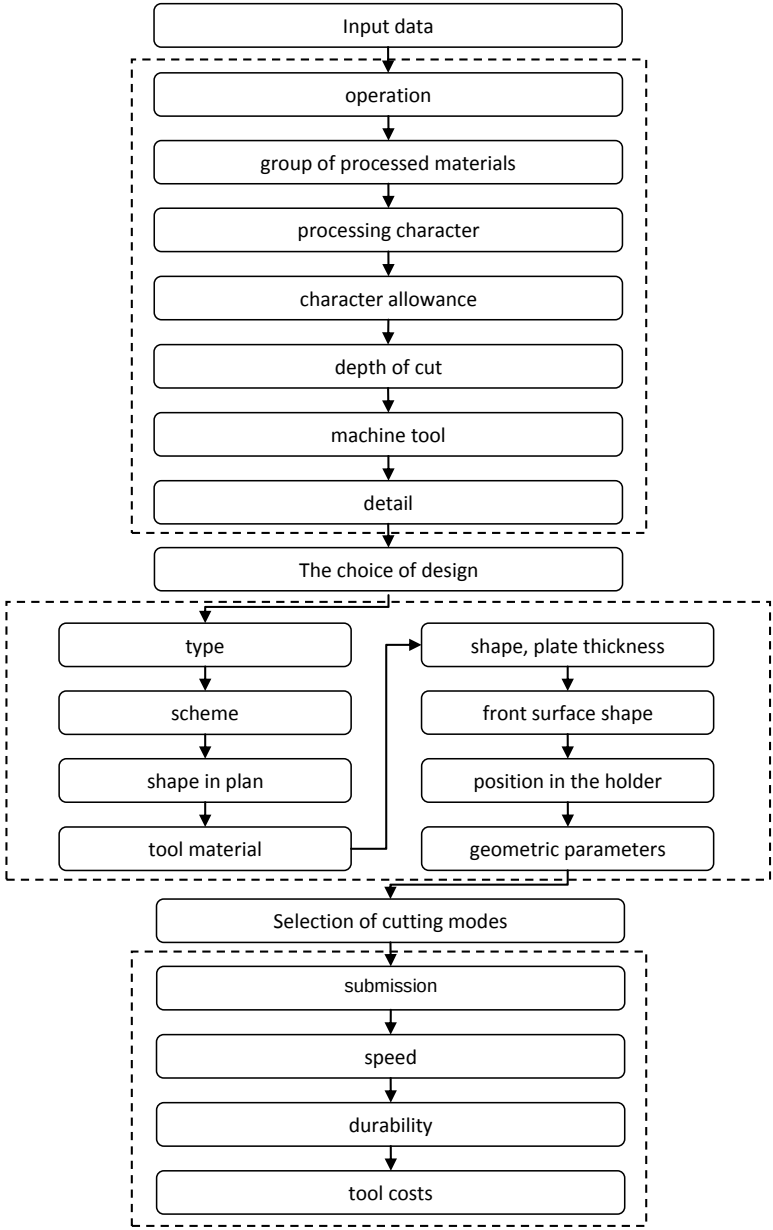

Figure 1 – Algorithm for selecting tool design and cutting modes

Table 1 – Structure of failures of carbide-tipped tools on heavy lathes

Type of failure	Basic machine parameter Ds, mm					
	1250	1600	2000	2500	3200	4000
	Failure rate, %					
Frazzle	56	60	55	57	52	48
Chipping	14	12	20	16	20	22
Breakage	30	28	25	27	28	30

On heavy machine tools, various modular assembly cutters are used. Calculations of strains in the cutter are made for a tool that has a height of H = 45 mm, on which rhombic many-sided disposable carbide-tipped plates of SECO firm of DNMG-150604 MF3 with a thickness of 4.76 mm are used. The most common cases of the average component of the cutting force with a probability of 0.8, equal to Pz = 32000N.

Using the COSMOS application of the SolidWorks program, the areas of plate breaking and strains distribution arising in it for different values of the cutting force component Pz are determined: for example, Pz = 32000H with a probability of 0.8, Pz = 80000H with a probability of 0.2, based on the distribution of the component cutting force Pz of heavy machine tools [2].

In the process of analysis of strains on the basis of the processed material, as well as the limitations and loads on the cutter, the movements, loads and strains are calculated. The tool material is destroyed when the strain reaches the limiting level.

The results of the calculation in COSMOSWorks are shown in Figures 2, 3.

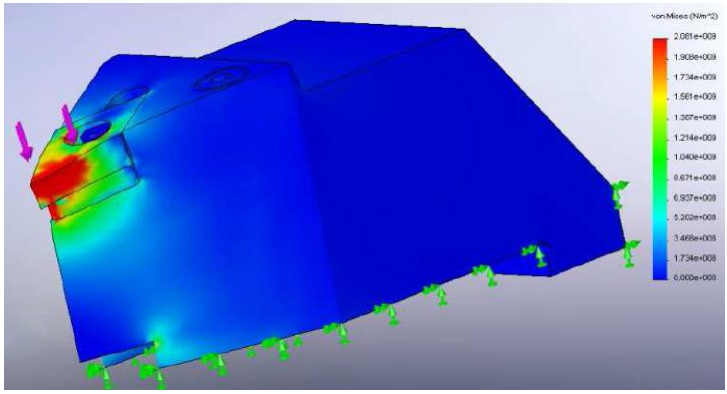

Figure 2 – The results of calculating the strains with cutting force Pz = 32 000 N

Figures 2, 3 show the strains distributions in the collection tool with its various loads. Thus, in the most common cases of the component of the cutting force Pz with a probability of 0.8, the strains values are minimal in comparison with the strains that occur in the less common cases of the component of the cutting

force Pz with a probability of 0.2. The obtained values of strains from the minimum and maximum loads showed that the thickness of the plate 4.76 mm and the design of the tool are suitable only for the conditions of loading the tool with a probability of 0.8. Loads that occur with a probability of 0.2 require a thicker plate - 6.35 mm.

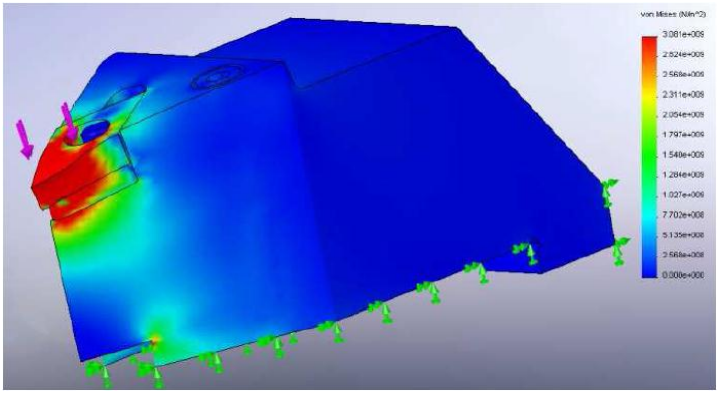

Figure. 3 – The results of calculating the strains with cutting force Pz = 80 000 N

Conclusions

1. Based on the strength studies carried out, rational design parameters of the assembly cutters, in particular, the thickness of the plate, are substantiated, which provides an increase in the efficiency of machining of parts with a carbide-tipped tool on heavy machine tools.

2. Programs have been developed for selecting the tool design and cutting modes in the free application development environment of SharpDevelop in C #, the use of which will automate the selection of the rational design of the assembly tool and for it - the machining modes for parts on heavy machine tools.

3. The application of the COSMOS application of the SolidWorks program allowed to determine the strains distribution in the tool design, which made it possible to substantiate the rational design parameters of the assembly cutters, in particular the plate thickness, which provides sufficient strength of the tool.

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