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THE RESISTANCE OF TOOLS WITH CIRCULAR CUTTING EDGE

Melkonov G., Hlazunov Y.

СТІЙКІСТЬ ІНСТРУМЕНТІВ З КРУГОВОЮ РІЖУЧОЮ КРОМКОЮ

Мелконов Г.Л. Глазунов Я.І.

The process of controlling the resistance of the cup cutter during a certain time of work. Proposed technological indicators are criteria for tool wear. Designed by experimental research methodology. The results of the conducted stochastic tests. According to the research done findings. With increased tool life and this is an opportunity to speed up cutting. Increased cutting speed favorably affected the performance and cost of the operation. Built a graph of the dependence of wear on the rear surface on time.
Keywords: *cup cutter durability, types wear, operation time, technological parameters.*

Introduction. The basis for the choice of installation modes cutting is the requirements for quality of the treated surface, as well as to durability of any cutting tool and cup in particular. The durability of the cutting tool is ability to maintain performance cutting blade for a certain period of time. Tool life significantly affects economic processing figures - productivity and cost of operation.

Analysis of literature data and goal statement. Analysis of literary sources [1, 2] showed that using circular tools rotating edge leads to significant increase the period of resistance and as a result process productivity increase processing. The basis of such changes is the replacement friction sliding on rolling friction between processed workpiece, chips and tool. The results of the research, the above authors, was that cup tool life increased in dozens or more times.

Along with increased tool life and due to this, it was possible to increase cutting speed. Increase cutting speed had a positive effect on performance and cost of operation. Productivity has increased and the cost of the operation has decreased. At the heart of the increase the durability of the cup tool lies increase the length of the cutting blade. Rotation tool promotes active heat sink tool surface temperatures.

Recent studies indicate that generally accepted power dependencies between tool life, cutting conditions, cutting tool geometry and other parameters due to expansion nomenclature of the processed materials and development of machine park are unsuitable. Therefore, there was a problem establishing new up-to-date dependency requirements.

Based on the foregoing, you can formulate the purpose of this article - the definition the period of resistance of the cutting tool of the cup cutter from the time of his work - the period of resistance.

Methods of conducting experimental research. Experimental methods research provides a rationale chosen direction of experimental research program specific experiments, assessment of accuracy and reliability the data obtained, the empirical conclusion tool life versus time work. Given the above, it is necessary set the following conditions cutting conditions during the experiment willpermanent [5 – 8].

The result of this work are the following cutting conditions: $V = 100m/min$,

$S = 0{,}4mm/rev, t = 0{,}4mm.$

One of the important parameters affecting the machining process is the angle crossing the axes of the workpiece and tool $r = 37^o$.

As a workpiece was adopted shaft drive shaft pump. Cardan the shaft is a non-rigid part $(L > 10d)$ and simultaneously performing a responsible role in pump design. Because it is very important to make in accordance with the requirements of the drawing. For the manufacture of the propeller shaft was used billet with a diameter of 45 mm and a length of 410 mm of steel marks 40X. Drawing finished parts propeller shaft shown in Figure 1.

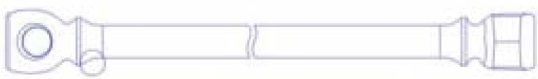

Fig. 1. Drawing of the drive shaft

Harvest the propeller shaft processed cup tool representing carbide plate marks T15K10, with 32mm cutting tool outer diameter, 10mm thick with a side tilt angle (back) surface. This tool has been used. exclusively on the finishing operation (Fig.2).

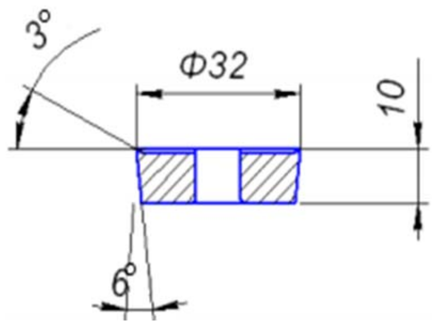

Fig. 2. Carbide round plate

Durability of the cup tool controlled by two parameters: diameter carbide plate over the cutting blade and belt wear on the back surface. Controlled parameters are shown in Figure. 3

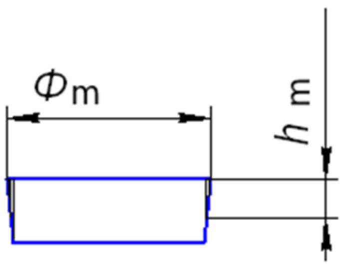

Fig. 3. The scheme of wear carbide cup plate

As a measuring tool used caliper with hourly indicator, with the price of division of 0.1mm and instrumental microscope BMI-1 with accuracy divisions to 0,005mm.

The results of the research. Harvest of shaft designed for finishing, set on lathe model 16K20. One end clamped in the chuck of the machine, the second end pursed center tailstock. Cup cutter installed in lathe centers under is equal to 37°. Cutting modes installed in accordance with a technique equal to $V = 100m/min$; $S = 0{,}4mm/rev, T = 0.4\ mm$. To fair operation consumed $t = 126\ min$. Stocking rotation at a speed of 100 m/min has been reported, a cup cutter was fed into the cutting zone and made finishing treatment.

After the completion of the finishing operation, the part was removed from machine, and in its place was set new stocking. After each part processing measurements were taken of the cutting blade of the cup cutter for wear and results were recorded table 1.

Measurements were taken cutting diameter tool and chamfer width on the back surface. Measurements were taken and medium values were taken. values.

Given the fact that in this work the goal was to determine the time during which the cup cutter will save performance analysis of the table showed that the smallest wear of the cup in diameter and in the back the surface will be in the range of time $T = 100\ min - 300\ min$. Over $300min$ is coming catastrophic wear. Wear criterion cup cutter is quality machined surfaces - roughness, cutting forces and cutting temperature.

Table 1

Results of measurements of wear of cup cutting tool on diameter of the cutting edge and wear facets on rear surface

№	T_{min}	$\emptyset_m$, mm	$\emptyset - \emptyset_m$,mm	h_m,mm	R_a and R_z, µm	P_y,N	Q□
1	10	32	-	-	R_a =1,6	800	300
2	20	31,97	0,03	0,1	R_a =1,6	800	300
3	40	31,94	0,06	0,2	R_a =1,6	800	300
4	60	31,9	0,1	0,3	R_a =1,6	800	310
5	80	31,7	0,3	0,37	R_a =1,6	810	310
6	100	31,58	0,42	0,42	R_a =1,7	810	320
7	120	31,52	0,48	0,5	R_a =1,79	850	330
8	140	31,47	0,53	0,56	R_a =1,82	870	370
9	160	31,4	0,6	0,61	R_a =1,88	900	390
10	180	31,3	0,7	0,68	R_a =2	930	415
11	200	31,3	0,7	0,71	R_a =2,5	980	447
12	220	31,25	0,75	0,75	R_a =2,5	1050	493
13	240	31,1	0,9	0,8	R_z =15	1120	515
14	260	30,97	0,9	0,85	R_z =18	1190	534
15	280	30,93	0,9	0,89	R_z =20	1200	600
16	300	30,9	0,9	1	R_Z =25	1280	620
17	320	31	1	1,3	R_z =30	1350	643
18	340	29	3	1,7	R_z =38	1410	670
19	360	28	4	2	R_z =51	1600	713

The result of the experiments found to achieve chamfer wear by back surface $h_{wear} = 0.85mm - 1mm$ adversely affected the height microroughness of the treated surface. Of analysis of table 1 and figure 4 shows that surface roughness in the initial period of the shaft turning was 1.6μm in the time interval from 20 to 200 min. processing height of asperities remained practically unchanged and amounted to $R_a = 2$μm.

According to the results of research built a graph of wear back surface on working time.

The measurement results of the wear of the bowl cutter diameter cutting tool and chamfering on the back surface.

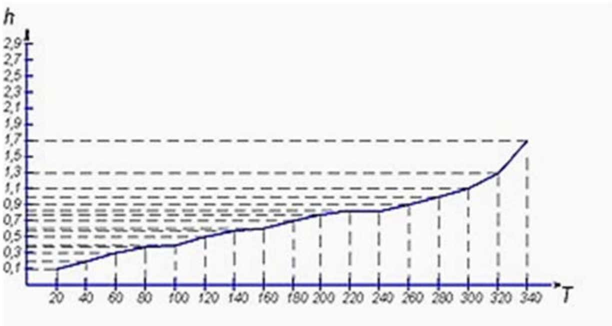

Fig. 4. A graph of the wear of the cup wear h from work time T

With further processing height microscopic irregularities increased from R_a =2μm to R_a=20μm. After working the cup incisors, processing of shafts, 300min came catastrophic wear. Chamfer size on the back the surface has a life span of $h_m = 1{,}7 - 2mm$, which led to catastrophic wear. Height microscopic irregularities reached R_z= 51μm. A similar picture was observed when study of the dependence of cutting force and temperature from temporary wear of the cup cutter.

Smallest cutting force values and temperatures were at T=220min, then an increase to T=320min was observed. With the expiration of the time more than 300min performance rose sharply and reached $P_y = 1600N$, $Q^o = 713^0$, it's the same evidence of catastrophic wear cup cutter. In the process of experimental research addiction changes in the roughness height of the treated surface cutting force and temperature wear Cup cutter diameter is not installed. Analyzing the conducted experimental research can be made the assumption that tool life C from the time T will be presented in general form: $C = f(T)$.

Having spent analysis of the table presented in fig. 1 and graphics built according to the table can be done the conclusion that the curve obeys the following law:

$$h_m = \sqrt{T} \tag{1}$$

that is, it will be a curve resembling hyperbole.

Conclusions. The main purpose of the experimental research is to establish the dependence of the resistance of the cup tool on the time of continuous operation.

The criterion for wear of the cup cutter was the appearance of a matte ribbon on the back surface. With the increase in the continuous operation of the cup cutter, the width of the matte ribbon increased.

The basis for the wear criteria of the cup cutter is a technological indicator - the height of asperities of the processed surface of the cardan shaft. The effect of the amount of wear on the cup tool on parameters such as cutting force and cutting temperature was also investigated.

It was established that over time from 0 to 220 min, the amount of wear on the back surface was minimal and amounted to h = 0.75mm, the height of asperities was R_a = 2.5μm, the cutting force varied within P_y = 800−980N cutting temperature $Q^0 = 300 - 500^0$.With the further operation of the cup cutter T=300min, the chamfer of wear reached h = 1mm; roughness height R_z = 25 μm; cutting force P_y=1280N and temperature in the cutting zone Q°= 620^0. With further exploitation the cup cutter had catastrophic wear at T > 320min and all experimental performance peaked R_a= 51μm; P_y = 1600N; Q°=713^0.

Further experimental studies were impractical because this would already be a zone of rough turning, and not a fair turning.

The derived empirical relationship (1) will allow determining the amount of wear on the back surface of the tool without additional experimental studies.

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Мелконов Г.Л., Глазунов Я.І. Стійкість інструментів з круговою ріжучою кромкою

Розглянуто процес контролю за стійкістю чашкового різця протягом певного часу роботи. Запропоновані технологічні показники є критеріями зносу інструменту. Розроблено методику проведення експериментальних досліджень. Представлені результати проведених стійкісних випробувань. За проведеним дослідженням зроблені висновки. З підвищенням стійкості інструменту і за рахунок цього з'явилася можливість підвищити швидкість різання. Підвищення швидкості різання сприятливо позначилося на продуктивності та вартості операції. Побудований графік залежності величини зносу за задньої поверхні від часу роботи.

***Ключові слова**: стійкість чашкового різця, види зносу, час роботи, технологічні параметри.*

Мелконов Г.Л., Глазунов Я.И. Стойкость инструментов с круговой режущей кромкой

Рассмотрен процесс контроля стойкости чашечного резца в течение определенного времени работы. Предложенные технологические показатели являются критериями износа инструмента. Разработана методика проведения экспериментальных исследований. Представлены результаты проведенных стойкостных испытаний. По проведенным исследованиям сделаны выводы. Повышение стойкости инструмента дает возможность повысить скорость резания. Повышение скорости резания благоприятно влияет на производительность и стоимость операции. Построен график зависимости величины износа по задней поверхности от времени работы.

***Ключевые слова:** устойчивость чашечного резца; виды износа; время работы; технологические параметры.*

Мелконов Григорій Леонідович. – к.т.н., доц., доцент кафедри машинобудування та прикладної механіки, Східноукраїнський національний університет імені Володимира Даля (м. Сєвєродонецьк) g.melkonov78@gmail.com

Глазунов Ярослав Ігорович – студент групи ММ-151, факультет інженерії, кафедра машинобудування та прикладної механіки, Східноукраїнський національний університет імені Володимира Даля (м. Сєвєродонецьк) Yaroslav7888@gmail.com

Рецензент: д.т.н., проф. ***Соколов В.І.***

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