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Influence of Cutting Regime Parameters on Edge Endurance of Lathe Tool

In mechanical industry, to increase productivity is very important to correctly establish the factors that influence the process dynamic. One of these factors is the features cutting regime. In practice, the technological process optimization depending by the value of the characteristics parameters. The paper purpose is to reveal the influence of operating speed and penetration speed over edge endurance of a lathe tool.

Keywords*: cutting, regime, parameters, endurance, tool*

1. Introduction

Because of mechanical and thermal stresses, which are manifested in cutting process, occurs party wear cutting tool. The wear consists in the progressive material loss by active part of tool, her geometry being modified (the attack α and release γ angle decrease). For this reason cutting capacity decreases and the accuracy and surface quality of machined surface diminishes [1].

The experimental researches about tools wear allow rational and economical use of tool. The present study object is a lathe tool with carbide sintered plate.

Of previous research it is already known that from this type of tool the wear process are manifested on both faces sitting and clearance, as is shown in Figure1.

Tacking in consideration the wear process type it is expected that curve wear to be like the one presented in Figure 1.

It is necessary to specify that the curve from Figure 2 corresponded to a lathe tool wear made from high-speed steel [2].

Usually the maximum width of the worn surfaces is located at the top of the tool or on sitting surface.

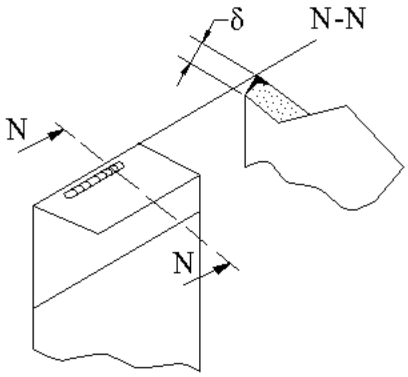

Figure 1. The wear of a carbide sintered plate

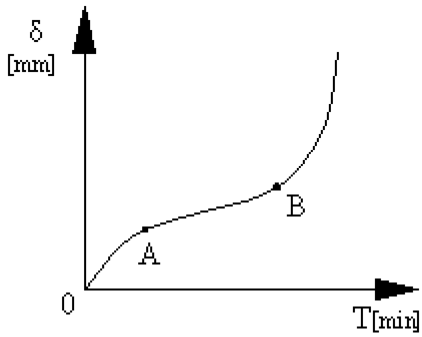

Figure 2. The wear curve for turning steel with high-speed steel lathe cut

The significance of curve segments from Figure 2 are:

- 0-A – is characteristic of the period elapsed from the start of cutting process until the moment when the wear process begins. Practical, in this period the active surface of carbide sintered plate is smoothed;
- A-B – are the curve segment that graphic describe the normal wear of tool;
- B$\longrightarrow$ - are the curve segment characteristic of catastrophic wear period.

In case of steel parts shaped, the calculus relation for wear is [4]:

$$\delta = C_{\delta} \cdot T^{0.7} \cdot v^{5.3} \cdot s^{3.2} \cdot t^{0.5} \ [mm] \tag{1}$$

where:

- C_{δ} - a constant depending by chipped material and by value of t and s;
- T – working time;
- t – depth of cut;
- v – rate of cutting;
- s – feed rate (penetration speed);

From relation (1) it is already known that the wear is proportional with cutting speed and feed rate, for experimental part remains to be determinate which from those two factors exert a greater influence.

The tool is worn when the wear on sitting side reaches a value equal to the optimum wear. The optimum wear represents the wear value that ensuring maximum total duration of use of tool.

To the processing of steel the optimum wear value is between 0.8÷1.0 mm.

Also, from relation (1) can be concluded that the most important factors that influence the wear size are cutting speed and feed rate (in the presented order). This conclusion can be drawn from order power of each one that reveals the share of influence.

Therefore the experimental part is concentrated to determining influence of these two factors over carbide sintered plate worn.

2. Experimental results

The experiments was made on tools - machines laboratory of U.E.M, on a lathe SN 500, using a lathe cut with carbide sintered plate having the code GC 4025 (after Corokey guide) and a bar stripe from OLC 45 with 80 mm diameter and 500 mm length [5].

To establish the influence of cutting speed over wear intensity it is necessary to raise least three characteristics curve. This curves corresponding to three different cutting speed values. For this first part of experiments, the other cutting regime parameters war maintained constant.

After every experiment cycle the worn plate was changed with a new one.

In Table 1 are shown the experimental parameters used and obtained for highlighting the influence of cutting speed over wear intensity.

Table 1

Crt.no	t [mm]	s [mm/rot]	n [rot/min]	v [m/min]	T [min]															
					1	2	3	4	6	8	10	12	15	20	25	30	35	40	45	50
					δ [mm]															
1	1.5	0.10	500	125	0.01	0.015	0.02	0.025	0.04	0.05	0.06	0.07	0.09	0.11	0.13	0.16	0.17	0.19	0.22	0.25
2			630	158	0.01	0.02	0.03	0.04	0.06	0.08	0.11	0.13	0.15	0.18	0.20	0.24	0.26	0.3	-	-
3			800	201	0.02	0.04	0.08	0.13	0.15	0.17	0.18	0.19	0.21	0.28	0.5	-	-	-	-	-

For the second part of experiment the initial parameters of tool and bar strip remain the same. The only difference being that feed rate was changed for each set of tests, the others regime cutting parameters being kept constant.

In Table 2 are shown the experimental parameters used for highlighting the influence of feed rate over intensity wear.

Table 2

Crt.no.	t [mm]	s [mm/rot]	n [rot/min]	v [m/min]	T [min]															
					1	2	3	4	6	8	10	12	15	20	25	30	35	40	45	50
					δ $[mm]$															
1	1.5	0.15	250	62.831	0.01	0.02	0.025	0.03	0.04	0.045	0.05	0.055	0.07	0.08	0.11	0.13	0.15	0.18	0.21	0.26
2		0.25			0.02	0.035	0.045	0.05	0.06	0.07	0.08	0.09	0.11	0.14	0.17	0.21	0.26	0.33	-	-
3		0.5			0.02	0.05	0.07	0.08	0.09	0.11	0.13	0.14	0.17	0.22	0.28	0.4	-	-	-	-

To measure the wear intensity (expressed by the value of δ) the working process was stopped to 1÷5 minutes and the measurement was made using a digital ruler namely QuaNix 8500 (Figure 3).

Figure 3. Digital ruler QuaNix 8500

The graphics result, based on experimental values presented in Table 1 and Table 2, are given in Figure 4 and Figure 5, as follows:

- Figure 4 – experimental curves with rate of cutting influence over wear intensity;

- Figure 5 – experimental curves with feed rate influence over wear intensity.

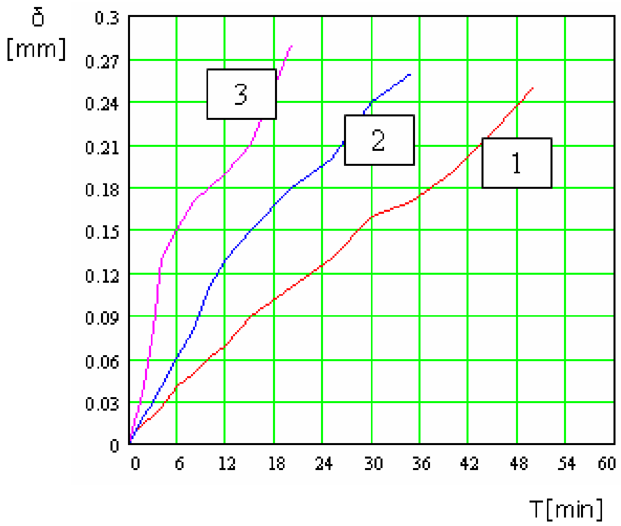

Figure 4. Experimental curves by rate of cutting influence over wear intensity

1- the experimental curve for v=125 [m/min]
2- the experimental curve for v=158 [m/min]
3- the experimental curve for v=201 [m/min]

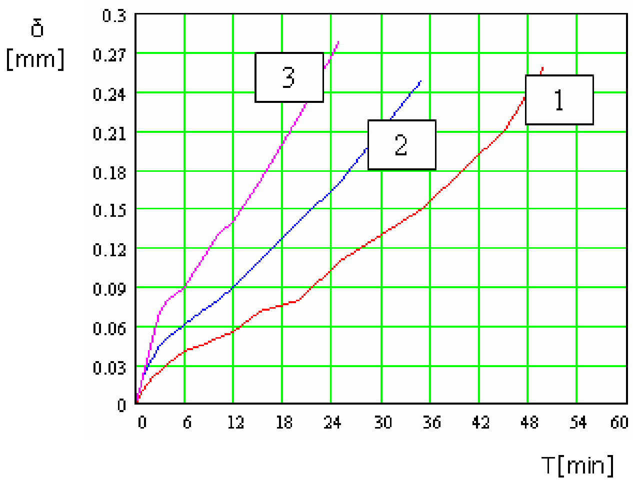

Figure 5. Experimental curves by feed read influence over wear intensity

4- the experimental curve for s=0.15 [mm/rot]
5- the experimental curve for s=0.25 [mm/rot]
6- the experimental curve for s=0.5 [mm/rot]

4. Conclusion

Based on graphics from Figures 4 and 5 can be concluded that:

- increasing working speed the lathe cut is damaged faster; so, to an increase of cutting speed with 75 m/min can be observed a decrease of lathe cut durability with 25 minutes;

- at increase of feed rate with 0.35 mm/rot is observed a decrease of lathe cut durability with about 25 minutes;

- growth rate of wear is bigger at speeds up work compared with the increase of the feed rate (higher wear values occur after a short time period).

Finally, can be concluded that, to at rough turning is recommended to increase productivity to growth the feed rate work and maintained the operating speed, as possible, at small values.

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