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RESEARCH OF FLANK WEAR IN TURNING OF STAINLESS STEEL

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ABSTRACT

The estimation of the reliability of the metal cutting tools represents a complex issue which depends on a number of factors: the process of cutting, geometric complexity, dynamic and thermal tensions.
In this work are given the researched results of cutting tool flank wear P-30, during the turning of Stainless Steel X12CrNi18.8.
The experiment is realized with the lathe machine IK62, whereas the wear measurement V_B is done by microscope type JLC680148. For data process is used a statistic method with three factors.
Key words: Cutting, turning, flak wear.

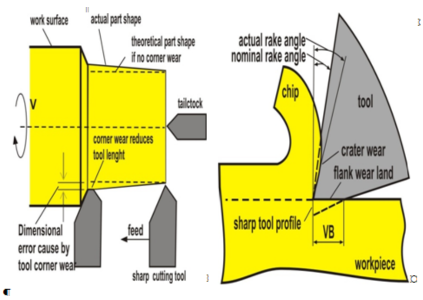
1. INTRODUCTION

The knowledge of mechanism of metal- cutting tool wear in the function of cutting regimens, geometry of metal-cutting tool, metal cutting tool and work piece material, time of processing and emulsion has a significant role during the projection of technological process [1,2,3].
The process of flank wear is a result of reaction of different forms of energy such as: mechanical energy, chemical, electric, magnetic and temperature.
The assessment of flank wear obtuseness of metal-cutting tool is done through these indicators:

- ❖ Technological indicators, which determine the change of quality manufacturing, mainly the accuracy of dimensions, form and position and as well as parameters of the profile roughness of processed surface, fig. 1.
- ❖ Geometric indicators, which describe stereo metric characteristics of metal-cutting tool, fig. 2.
- ❖ Energy indicators, which pertain to the change of energy relations in decohosation process, which means that the increase of cutting forces requires greater cutting power, which results in the increase of temperature in the cutting process and oscillations of the machine-clamping tool-metal cutting tool- processed particle system.

Type of the processing for ex.: the same material can have a good processing during the clean processing and it can have poor processing during the rough processing, has also a significant role.
Consumption of metal-cutting tool is hard process, it is attended by high physical-chemical changes of cutting surface and blade of metal-cutting tool which frictions with chip and the surface of processed piece in dry or wet condition. It changes the geometry and form of metal-cutting tool which are closely

linked with cutting forces, temperature, plastic deformation and surface roughness. Consumption process of metal-cutting tool blades can be followed with many following parameters which are divided in: direct and indirect consumption parameters. Direct parameters are: linear parameters one-dimensional, surface two-dimensional and voluminous three-dimensional parameters. During the cutting process, special attention should be paid to the way of clamping of work piece as in the character of consumption of cutting blades from the hard metal it effects the of the machine – clamping tool-metal cutting tool-processed particle system. The processing was realized with a clamping of work piece with new cutting blade, without emulsion with changing of v,s,a parameters tab. 1. A criterion for consumption measure was taken 1km cycle round cutting longitude, by increasing cutting regimes until the first consumption VB value was obtained.



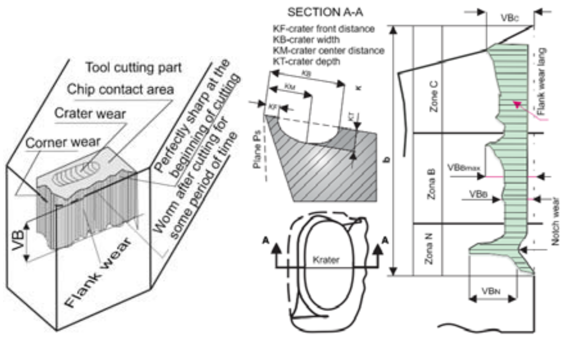


Figure 1. The way of work piece clamping and position of metal-cutting tool against work piece

Figure 2. Geometric indicators of metal-cutting tool consumption

2. CONDITIONS DURING THE EXPERIMENT

2.1. Tool-Cutting plate from the hard metal P30, SINTAL-ZAGREG, ISO SNMM120404, enforced in the body with sign, ISO PSDNN2525P12, outcome 25mm, with cutting geometry: $\chi=75^0$, $\chi_1=15^0$, $\gamma=-6^0$, $\alpha=6^0$,$\lambda= -6^0$, $r_\varepsilon=0.4$ mm, $b_f=0.2$ mm, $\gamma_f=-20^0$ [4].

2.2. Machine-Horizontal Lathe IK62, with these characteristics: P=10kW, n=12.5÷2000 rot/min, and feed s=0.035÷2.08mm/rev.

2.3. Researching material–Steel X12CrNi18.8 in the cylinder shape with dimensions Φ68X750/Φ38.5X750mm, Rm=550÷750N/mm^2.

2.4 Apparatus for roughness measurement–Duplex Microscope CARL SEISS type STOLLBERG/ERCGEBTYPS15A/GA6Og

2.5. Experimental researching plan – based on the rating number of the rotations of the machine, consulted literature, professional experience, chemical composition, mechanic features of processed piece and metal cutting tool are defined cutting conditions: v, s, a Tab.1.

Table.1. Conditions for experiment realization

CHARACTERISTICS OF INDPENDENT VARIOUS SIZES					
Nr	Note	Level Code	Maximal 1	Average 0	Minimal -1
1	v [m/min]	X_1	213.00	146.000	106.000
2	s [mm/rev]	X_2	0.097	0.0685	0.0485
3	a [mm]	X_3	1.500	0.866	0.500

Table 2. Derived results during experiment realization

Nr	REAL PLAN OF MATRICA			REZULTS	
	v [m/min]	s [mm/rev]	a [mm]	V_B [μm]	lnV_B
1	106	0.0485	0.500	57.740	4.055
2	213	0.0485	0.500	104.982	4.653
3	106	0.0970	0.500	86.856	4.464
4	213	0.0970	0.500	154.398	5.039
5	106	0.0485	1.500	80.449	4.387
6	213	0.0485	1.500	136.272	4.914
7	106	0.0970	1.500	112.402	4.722
8	213	0.0970	1.500	186.895	5.230
9	146	0.0685	0.866	103.315	4.637
10	146	0.0685	0.866	103.315	4.637
11	146	0.0685	0.866	103.315	4.637
12	146	0.0685	0.866	103.315	4.637

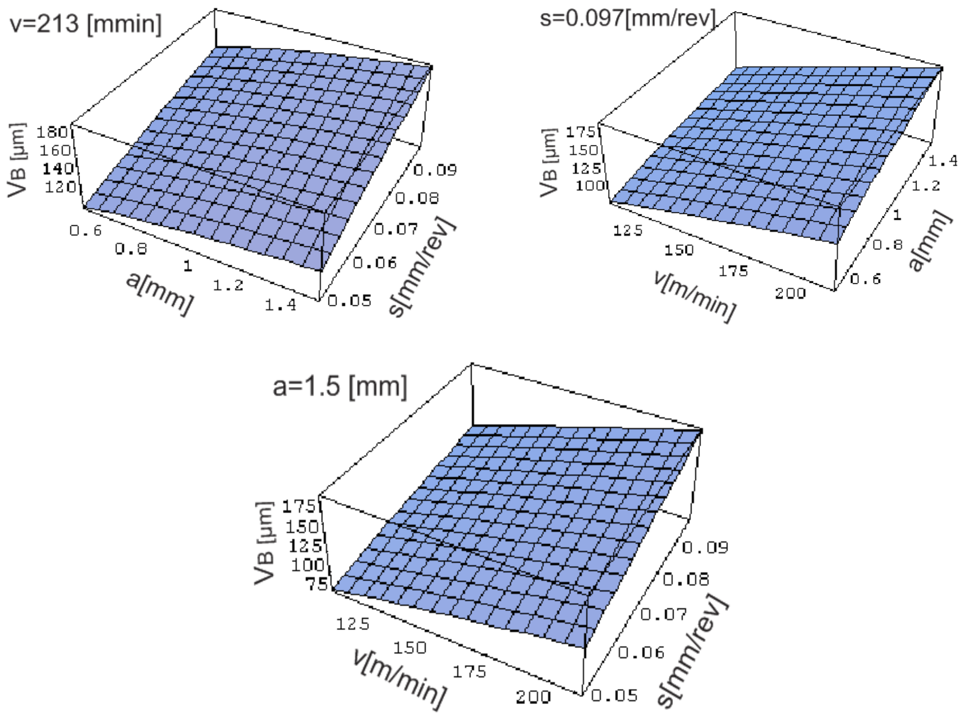


Fig. 3. Graphical interpretation of the mathematical models (1.1)

3. THE ANALYSIS OF OBTAINED RESULTS

Upon defining the inlet and outlet parameters, selection of appropriate method for measurement and measuring apparatus, selection of form of function for defining the scope of experiment, statistical processing of researched parameters and verification of mathematical models, the impact of obtained parameters (v, s, a) in consumption magnitude is defined [4,5,6].

During the research was conducted the change of consumption V_B in cutting blades from hard metal P30. For describing of this change was adopted the mathematical model of exponential form (1):

$$V_B = C \cdot v^x \cdot s^y \cdot a^z \qquad (1)$$

Consumption of metal-cutting tool is a complex process; it conducts in difficult conditions during cutting it is attended with physical-chemical changes of work piece surface and cutting blade, it changes the geometry of metal-cutting tool which frictions with chip and cutting surface in dry or wet condition. It is closely linked with chip plastic deformation, cutting forces, surface roughness and temperature while cutting. Mathematical model (1) indicates the impact of cutting regimes in the form and consumption magnitude V_B, increasing the cutting speed it changes the conditions in the cutting zone, the chip departs fast from the cutting zone, by this plastic deformations in the chip deformation zone and surface layer zone are reduced, which affects in reducing of non planes.
Processing of obtained results during the research as per experimental plan tab. 1&2, mathematical model (1) is:

$$V_B = 8.47159 \cdot v^{0.790} \cdot s^{0.522} \cdot a^{0.236} \tag{1.1}$$

From (1.1) it is clearly seen that in the consumption magnitude V_B, the cutting speed *(v)* and cutting feed *(s)* have a dominant impact, while the cutting depth *(a)* has a smaller impact.
Increasing the cutting speed *(v)* causes reducing of touching surface between the chip and front surface of cutting blade. By this the mechanical and heat impact shifts to the cutting blade by causing higher specific pressures and speed gradient. Friction coefficient between the chip and front surface, chip compression coefficient and cutting forces will be reduced.
Therefore, increasing the cutting speed *(v)* causes increasing of work from chip friction with front surface of metal-cutting tool. From this it turns out that the cutting speed *(v)* has a significant impact in consumption magnitude, as the high heat concentration in the cutting blade causes the change not only to mechanical attributes of cutting material but also to cutting tool. Increasing the cutting feed *(s)* causes increase of removed layer thickness (s sinχ), by this a higher energy is needed to transform it to the chip

4. CONCLUSION
Metal-cutting tool consumption is one of the most negative forms in cutting process; it is conducted in difficult conditions depending on cutting regimes and processing technology. Based on analysis of obtained results with experimental research tab. 2, mathematical model (1.1), and its graphical interpretation fig.3, we can conclude that:

- Change of consumption magnitude can be described with function of exponential form;
- Increasing the cutting speed, consumption of metal-cutting tool will be increase and metal-cutting tool durability will be reduced;
- Increasing of cutting feed and depth have less impact on consumption magnitude;
- Presented function might be applied for assigning of boundary fields, choosing of optimal cutting regimes for gaining the desired accuracy and useful economical relations.

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