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RESEARCH OF SURFACE ROUGHNESS AVERAGE OF STEEL C45 DURING TURNING

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***Abstract**: In this work are presented results on the research of surface average roughness during turning. The turning is performed on the machined steel C45, applying the methods of planning of poly-factorial experiments, using as cutting tool the ceramic inserts MC2 of the company Hertell. The measurements are carried out by means of profile graph meter model Talasurf 6 of company Taylor Hobson.*
***Key words**: roughness, cutting tool, turning, cutting speed.*

1. INTRODUCTION

In all manufacturing methods, besides the dimensions and geometrical tolerances of products, a satisfactory surface roughness quality is of great importance. Besides other parameters, the desired productivity, tool life and resistance against the outer effects of operating machine tool types are dependent on the surface quality as well. Surface operations realized in various manufacturing systems are affected by the process parameters directly or indirectly. Process parameters chosen with non-accordance cause losses such as rapid tool wear and tool fracture besides the economic losses including spoiled workpieces or reduced surface quality. The first study on surface roughness was performed in Germany in 1931.
In machining, surface quality is one of the most commonly specified customer requirements in which the major indication of surface quality on machined parts is surface roughness. Surface roughness is mainly a result of process parameters such as tool geometry (nose radius, edge geometry, rake angle, etc.) and cutting conditions (feed rate, cutting speed, depth of cut, etc.) (Milton, 2005).
The surface parameter used to evaluate surface roughness, in this study, is the average roughness Ra. This parameter is also known as the arithmetic mean roughness value, arithmetic average (AA) or centerline average (CLA). Ra is recognized universally as the most common international parameter of roughness (ISO 4287, 1997 standard). The average roughness (Ra) is the area between the roughness profile and its center line, or the integral of the absolute value of the roughness profile height over the evaluation length (Fig. 1). Therefore, the Ra is specified by the following equation.

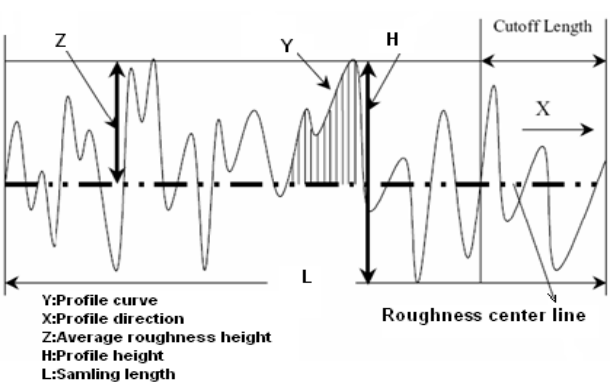

Fig. 1. Surface roughness profile

$$Ra = \frac{1}{L}\int_0^L |Y(x)| dx^o \qquad (1)$$

When evaluated from digital data, the integral is normally approximated by the trapezoidal rule:

$$Ra = \frac{1}{n}\sum_{i=1}^{n}\int_0^L |Y_i|^o \qquad (2)$$

Where *Ra* is the arithmetic average deviation from the mean line, *L* is sampling length and *Y* represents the ordinate of the profile curve.
By using the theory of experimental planification with many factors are obtained the mathematic models of the surface average roughness. The obtained results are presented in this work.

2. CONDITIONS FOR EXPERIMENT REALIZATION

Machine: The experiments for measurement of roughness parameters of the surface process are realized by numeric lathe model MD 5S GILDEMEISTER P = 1.85 – 25 kW with rotating nr.fields n=100–4000 rev/min and feed 0.001–39.99 mm/rev

Metal cutting tool: The cutting inserts: SNGN 120708 - 120712-120720 from mixed ceramic (Al_2O_3 + TiC) of HERTELL company are used.
Also, the tool holder is used CSRNR 25x25 M12H3 that the cutting edge obtains these values: $\chi = 75^o$, $\chi_1 = 15^o$, $\gamma = -6^o$, $\alpha = 6^o$, $\lambda = -6^o$, $r_\varepsilon = 0.8 - 1.2 - 2.0.mm$ $\gamma_f = -20^o$ $b_f = 0.2.mm$
Measure device: Measurement of parameters of the roughness on the processed surface is done with the computer measurement equipment Talasurf 6 of Taylor Hobson company.
Research material: The rings are made of machined steel C45 (pursuant to DIN) in normal state with strength in limits of 185-200 HB with dimensions Ǿ 170 x 80 x 25 mm (Salihu et al, 2001).
Processing parameters: The research process is realized with the change of *v, s, a* and *r* presented in Tab. 1 using the plan with many factors of the first row ($2^4 + 4$).

CHARACTERISTICS OF INDIPENDENT DIFFERENT SIZES					
Nr	Note	Level Code	Maximal 1	average 0	Minima l -1
1	v (m/min)	X1	700,000	458,258	300,000
2	s (mm/rev)	X2	0.400	0,283	0,200
3	a (mm)	X3	1,600	0,894	0,500
4	r (mm)	X4	2,000	1,265	0,800

Tab. 1. Characteristics of the factor

3. ANALYSE OF THE RESEARCH RESULTS

Chosen plan and results obtained are shown in tab. 2. Basing in the obtained results, and the processing of data in computer there are presented of roughness average. After processing the data there are obtained the mathematic models 3.(Stankov,1982) Graphic interpretation is shown in fig. 2 (Salihu, 2001).

·	REAL PLAN OF MATRIX				REZULTS
Nr Rend.	v (m/min)	s (mm/rev)	a (mm)	r (mm)	Ra (μm)
1	300.000	0.200	0.500	0.800	2.520
2	700.000	0.200	0.500	0.800	1.420
3	300.000	0.400	0.500	0.800	7.410
4	700.000	0.400	0.500	0.800	5.580
5	300.000	0.200	1.600	0.800	2.110
6	700.000	0.200	1.600	0.800	1.330
7	300.000	0.400	1.600	0.800	5.790
8	700.000	0.400	1.600	0.800	7.140
9	300.000	0.200	0.500	2.000	0.850
10	700.000	0.200	0.500	2.000	0.860
11	300.000	0.400	0.500	2.000	2.690
12	700.000	0.400	0.500	2.000	2.090
13	300.000	0.200	1.600	2.000	0.910
14	700.000	0.200	1.600	2.000	0.790
15	300.000	0.400	1.600	2.000	2.240
16	700.000	0.400	1.600	2.000	2.380
17	458.258	0.283	0.894	1.265	2.170
18	458,258	0.283	0.894	1.265	2.250
19	458.258	0.283	0.894	1.265	2.080
20	458.258	0.283	0.894	1.265	2.430

Tab. 2. Derived results during experiment realization

$$Ra = 80.658 \cdot v^{-0.2110} \cdot s^{1.656} \cdot a^{-0.0336} \cdot r^{-0.954} \cdots\cdots (3)$$

The increase of height parameters of roughness surface with the increase of cutting feed *s* is as a result of conditions with which is realized the transformation process of cutting layer in a chip. Therefore with the increase of cutting feed *s* is increased the thickness of cutting layer. The contact and friction surface between the chip and front surface, the cutting force of average temperature and conditions of heat all of these influence in technological effects of processed surface.

With the increase of depth of cutting *a* there is a small increase of average roughness because of conditions in which the process of plastic deformation is realized in the formation zone of the chip in the zone of the surface layer creation as well because of the presence of elastic deformations of the system that is as result of cutting force (Aleksander, 1976). The influence of nose radius *r* is in combination with the cutting feed *s* and then is a result of geometrical –cinematic review of the nose radius r of cutting plane in the processed surface.

4. CONCLUSION

The analyses of the mathematic models obtained make us possible to conclude:

-The change of the roughness average in the function of cutting parameters can be represented in step function,

-With the increase of cutting speed it is reduced the roughness average,

-The increase of cutting depth has lower influence in the increase of Ra,

-Larger influence in the roughness average has the feed and the nose radius r.

The results of the research are of the interest to show the exploited characteristics in the surface lay by choosing the cutting parameters.

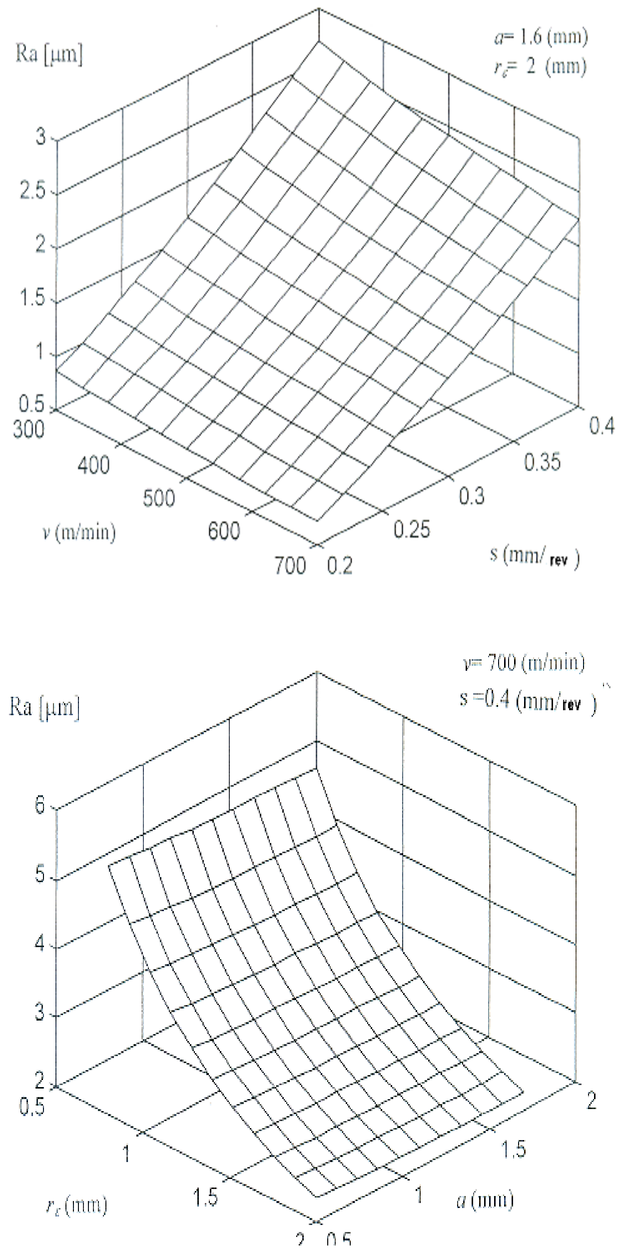

Fig. 3. Graphical interpretation of the mathematical models 3

5. REFERENCES

Salihu, A. (2001), *Research of machinobility of cutting material with increased speed* (*Hulumtimi i perpunueshmerise se materialit me prerje me shpejtesi te rritura)*, doctoral dissertation, Faculty of Mechanical Engineering, Prishtinë.

Salihu, A; Bunjaku, A; Qehaja, N. & Zeqiri, H. (2006). *Investigation of bearing ratio of the machined profile as a function of machining conditions*, Procededings of 17th International DAAAM Symp, Vol 17.No1, Katalinic, B. (Ed), pp, 357-358, ISBN 3-901509-57-7, DAAAM International Vienna, Vienna 8-11th November 2006.

Milton C Shav, (2005), *Metal cutting principles, second edition, Arizona State University*, ISBN 0-514206-3, Oxford New York.

Aleksander, B. (1976), *Mechanical technology*, volume 2, Faculty of Mechanicl Engineering, Tiranë.

Stankov, J. (1982), *Measurement technical basic, methods and experiments planification (Osnove merne tehnike, metode planiranja eksperimenata)*, Faculty of Mechanical Engineering, Novi Sad.