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RESEARCH OF CUTTING RESISTANCES DURING TURNING

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ABSTRACT
In this paper are given experimental researching results derived during the treatment steel X12 Cr Ni 18.8.Turning has been made on a universal lathe PERVOMAJSKA NILES TVP -250 by using coated plates CNMG 12048 made in Sweden. The measuring has been done with a dynamometer TYPE FS1 whereas a researching method was used a method of statistics with three factors.
Keywords: chip, lathe, resistances and dynamometer

1. INTRODUCTION
For realization of the processing with cutting it is necessary that the cutting tool to act into the processing piece of the material. During this act because of the plastic deformation of the chip, cutting of the chip of the processing piece of the material, friction in the front surface of the cutting tool and chip, as well as the friction of the front surface of the cutting tool and the processing surface, appear, cutting resistances [2].
The development of the measurement technique made it possible very quickly to achieve the values of the cutting resistances. Cutting resistances are mechanical sizes where the piece of processing metal acts into the cutting tool in order to resist the cutting. The size and direction of this force is depended from the material processing, mechanical, physical and structural properties, processing regime elements, metal cutting tool geometry, machine characteristics, technological conditions etc.

2. CONDITIONS FOR EXPERIMENT REALIZATION
Metal cutting Instrument: The research is done with cutting plates CNMG M3 120408 SEKO made in Sweden. Cutting plates are settled on the holder PCLNR 20 x20 made in Uzhica´s Prvi Partizan, which gives the cutting edge, this geometry $\chi = 90^0, \gamma = -6^0, \lambda = -6^0$ and $r = 0.8mm$
Research material: The experiment is realized with steel X12 CrNi 18.8 according to DIN with these dimensions dxL 100 x 400mm.
Machine: The turning is processed in the lathe "PRVOMAJSKA" NILES TVP 250, with rotation numbers 16-2240 rotations/min, 18 scales, and feed 0,02 –1.2 mm/ rot. 48 scales Figure 2.1.
Measure device: The measure of the cutting resistance is processed by three elements inductive dynamometer type FS1, where is done as well the calibration Figure 2.2 [1].
Processing parameters: The turning is done without utilizing cool means changing the cutting speed(V), cutting feed (s) and cutting depth (a) although as a scientific method is used the method with many factors ($2^3 + 4$), table. 2.1.

Figure 2.1 Machine NILES TVP 250

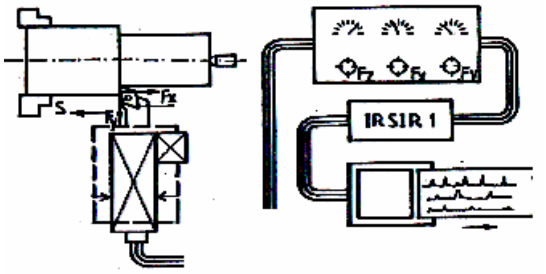

Figure 2.2. Scheme of measurement device

Table 2. 1 Conditions for experiment realization.

CHARACTERISTICS OF THE FACTORS					
Num.	Symbol	Level code	Maximum 1	Average 0	Minimum -1
1	V (m/min)	X_1	120.00	84.858	60.000
2	S(mm/rot)	X_2	0.200	0.141	0.100
3	a (mm)	X_3	2.000	1.414	1.000

3. ANALYSES OF THE RESEARCH RESULTS

Chosen plan and the derived research results are shown in table 3.1 [1]. The processing of data is done utilizing automatic computer system [1]. Differences of cutting resistances in the function of processing regime is shown through mathematical model without reciprocal act and without factors valuation that are important as shown in table 3.1-3.3. Graphic interpretation of mathematical models 3.1-3.3 is shown in figure 3.1-3.3.

Table 3. 1. Derived results during experiment realization

Nr rend.	V (m/min)	S (mm/rot)	a (mm)	X12 CrNi 18.8		
				Ft (N)	Fa (N)	Fr (N)
1	2	3	4	5	6	7
1	60	0.1	1	560	490	264
2	120	0.1	1	490	455	231
3	60	0.2	1	910	630	230
4	120	0.2	1	560	560	297
5	60	0.1	2	805	665	264
6	120	0.1	2	770	665	220
7	60	0.2	2	1400	945	330
8	120	0.2	2	1365	875	330
9	84.853	0.141	1.414	840	630	264
10	84.853	0.141	1.414	915	665	280
11	84.853	0.141	1.414	875	700	297
12	84.853	0.141	1.414	910	665	264

For analyse the cutting regime is used through mathematical model without reciprocal act and without factors valuation that are important. This is done with the intention that during research to participate all variable independent sizes (v,s,a) that makes possible qualitative determination of the change of cutting resistance.

Mathematical models analyse 3.1, 3.2 and 3.3 as well as their graphic interpretation, shown in fig. 3.1-3.3 helps us to make the following conclusions:

- In derived mathematics models is seen that with the increase of cutting speed the resistances reduce because of material temperature increase which influence in reduction of friction force and persistence effect.

This reduction phenomenon of cutting resistance occurs after friction forces predomination and persistence effect.
- Cutting feed and depth influence directly in increasing of cutting resistance.

Table 3. 1. Review of derived mathematical models

Review of mathematical models		
Type of mathematical model	Form of mathematical model	
Without reciprocal act and without factors valuation that are important	$Ft = 4940{,}937 \cdot v^{-0.102} \cdot s^{0.775} \cdot a^{0.624}$	3.1
	$Fa = 1771{,}632 \cdot v^{-0.097} \cdot s^{0.391} \cdot a^{0.5544}$	3.2
	$Fr = 1182{,}914 \cdot v^{-0.152} \cdot s^{0.398} \cdot a^{0.0204}$	3.3
Without reciprocal act and with factors valuation that are important	$Ft = 3138{,}410 \cdot \cdot s^{0.775} \cdot a^{0.624}$	3.4
	$Fa = 1151{,}741 \cdot s^{0.391} \cdot a^{0.554}$	3.5
	$Fr = 606{,}765 \cdot \cdot s^{0.398}$	3.6
With reciprocal act and without factors valuation that are important	$Ft = 2201{,}843 \cdot v^{-0.0637} \cdot s^{0.245} \cdot a^{1.224} \exp(0.1113 \cdot \ln v \cdot \ln s -$ $- 0.052 \cdot \ln v \cdot \ln a + 0.5641 \cdot \ln s \cdot \ln a - 0.103 \cdot \ln v \cdot \ln s \cdot \ln a)$	3.7
	$Fa = 1771.632 \cdot v^{-0.316} \cdot s^{0.734} \cdot a^{1.231} \exp(-0.0909 \cdot \ln v \cdot \ln s -$ $- 0.076 \cdot \ln v \cdot \ln a + 0.671 \cdot \ln s \cdot \ln a - 0.0996 \cdot \ln v \cdot \ln s \cdot \ln a)$	3.8
	$Fr = 1182.914 \cdot v^{-0.0576} \cdot s^{0.0818} \cdot a^{3.9484} \exp(0.0586 \cdot \ln v \cdot \ln s +$ $+ 1.895 \cdot \ln s \cdot \ln a + 0.46287 \cdot \ln v \cdot \ln s \cdot \ln a)$	3.9
With reciprocal act and with factors valuation that are important	$Ft = 3138{,}410 \cdot \cdot s^{0.775} \cdot a^{0.624}$	3.10
	$Fa = 1151{,}741 \cdot s^{0.391} \cdot a^{0.554}$	3.11
	$Fr = 606{,}765 \cdot \cdot s^{0.398}$	3.12

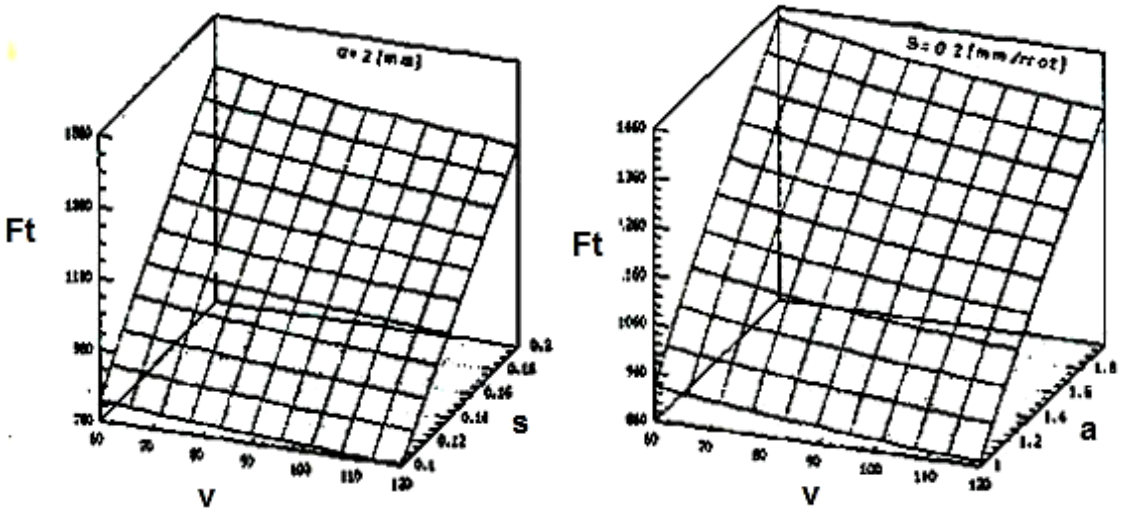

Figure 3.1. Graphic interpretation of mathematical models 3.1

- By analyzing graphic interpretation of mathematical models 3.3 it is noticed that radial resistance there isn't any evident increase and this occur for the reason of metal cutting tool geometry.

4. CONCLUSION

Derived mathematical models analyses as a result of experimental research make us possible to give the following conclusions
- The difference of cutting resistance in the function of cutting parameters can be shown with gradual function.

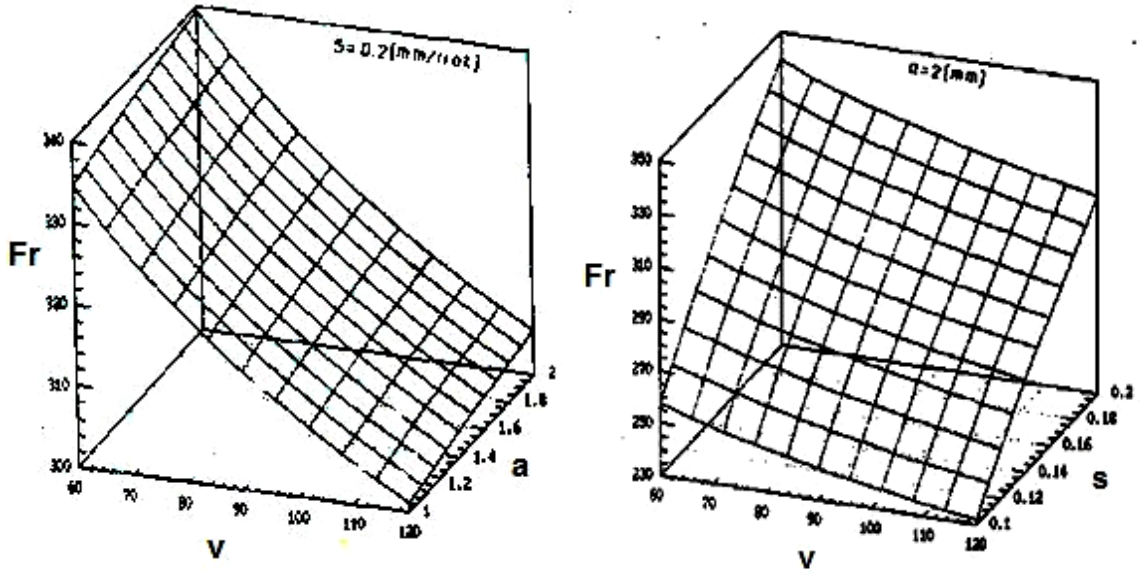

Figure 3.2. Graphic interpretation of mathematical models 3.2

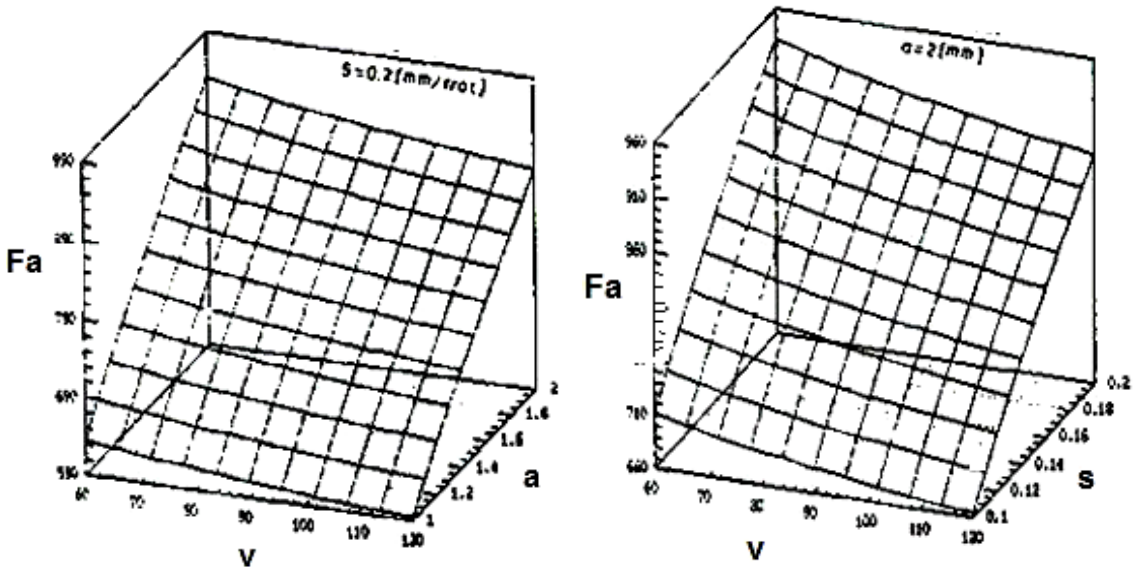

Figure 3.3. Graphic interpretation of mathematical models 3.3

- Direct influence in cutting resistance have cutting feed and cutting depth, wherein with the increase of clearance angle $\aleph = 95^0$ radial resistance has not an evident increase.
- With the increase of cutting speed the cutting resistances reduce.
- Research results show the possibility of achieving the exploited characteristics utilized for cutting resistances whatever can influence evidently in machine ability of cutting material.

5. REFERENCES

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