THE OUT-OF-ROUNDNESS ANALYSIS OF INNER CYLINDRICAL SURFACE PROCESSED BY GRINDING

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Abstract: The inner cylindrical surfaces are most often used as technological base for piece surfaces processing. Processing of these surfaces by grinding of parts used in machine manufacturing is mainly used as final technological operation. In the paper presented experimental researches were done to establish the effect of technological parameters on out-of-roundness and their influence on mining operation in the machined parts. In experiments were used three types of steel 1 C 45, 41Cr4 and X6CrMo17 and half finished product processed was bushing type. As tools were used abrasive three 66A25I5V217, 50A25LV217 and 21C4025V217 different abrasive nature, grit and hardness. It was used a 2^4 full factorial experimental plan. For all materials processed were obtained the mathematical models of out-of-roundness. Choosing the factors studied patterns respectively, were performed judiciously, appropriate research conducted on the influences on out-of-roundness, the inner cylindrical surface treatment by grinding.
Key words: grinding, cylindrical, significant factors, interactions

1. INTRODUCTION

Processing by grinding the surfaces of metal parts used in machine manufacturing is mainly used as final technological operation, [1]. The inner cylindrical surfaces most often are used as technological base for surfaces processing of the work piece and must satisfy dimensional accuracy conditions, shape and mutual position, and higher prescriptions on their smoothing, [2, 3, 4, 9]. The severe technical conditions imposed on those surfaces are found out the out-of-roundness, [5, 6]. In the paper presented experimental researches were done to establish the effect of technological parameters on out-of-roundness and their influence on the operation of the service of processed parts.

2. EXPERIMENTAL CONDITIONS

The experimental tests were performed under the following conditions:
-machine-tool: interior grinding machine RI80
-material of half finish product: it was used three types of steel, namely 1 C 45, 41Cr4 (SR EN 10083 to 1.2) and X6CrMo17 (SR EN 10088-2);
-half finish product: bush type D_{ext}=52mm, d_{int}=25mm and L=24.5mm. Before each grinding operation was processed by turning bush ensuring dimensional accuracy of 0.1mm, surface roughness Ra=(0.16 to 3.2)μm and out-of-roundness between (0.04 to 0.1)mm.
-tools used: abrasive discs with dimensions of 20x25x6 (D x B x d)mm in three types of abrasive material: 66A25I5V217, 50A25LV217 and 21C4025V217 different abrasive nature, grit and hardness;
-cutting regime parameters and each of them limits are shown in table 1.
-for measuring the out-of-roundness was used the Abbe apparatus, the diameter of each sample was measured with three different sections.
To cover the entire range of variation of parameters established in table 1, the number of experiments was sized using 2^4 full factorial experiment methods.

Table 1. The values of cutting regime parameters

Factor level	Factor			
	v_a [m/s]	v_p [m/min]	v_{sl} [m/min]	S_t [mm/c.d.]
1	15.69	18.05	2	0.005
2	32.97	72.22	5	0.025

3. EXPERIMENTAL RESULTS

The values of out-of-roundness Ac, are presented in table 2 (for 1 C 45), table 3 (for 41Cr4) and table 4 (for X6CrMo17). Using data from the above tables were plotted graphs variation of out-of-roundness Ac for experimental conditions (figures 1-3).
From the above figures it can mention the following. It showed a relatively small influence on the size of the type of abrasive out-of-roundness, for processed surfaces and a most significant influence of material parts. The best results, the lower values of out-of-roundness, were obtained using abrasive 21C40L5V217.

Table 2. The values of out-of-roundness, for 1 C 45 material samples

No.	Factors level				Abrasive material		
	v_a	v_p	v_{sl}	S_t	66A25I5V217	50A25L5V217	21C40L5V217
					The out-of-roundness, A_c, [mm]		
1	1	1	1	1	0.008	0.007	0.006
2	1	1	1	2	0.014	0.014	0.012
3	1	1	2	1	0.009	0.009	0.010
4	1	1	2	2	0.015	0.016	0.015
5	1	2	1	1	0.011	0.011	0.011
6	1	2	1	2	0.018	0.019	0.017
7	1	2	2	1	0.015	0.015	0.016
8	1	2	2	2	0.021	0.022	0.021
9	2	1	1	1	0.009	0.008	0.007
10	2	1	1	2	0.015	0.015	0.013
11	2	1	2	1	0.010	0.010	0.010
12	2	1	2	2	0.016	0.017	0.015
13	2	2	1	1	0.014	0.013	0.013
14	2	2	1	2	0.020	0.020	0.021
15	2	2	2	1	0.018	0.017	0.018
16	2	2	2	2	0.024	0.023	0.022

Table 3. The values of out-of-roundness, for 41Cr4 material samples

No.	Factors level				Abrasive material		
	v_a	v_p	v_{sl}	S_t	66A25I5V217	50A25L5V217	21C40L5V217
					The out-of-roundness, A_c, [mm]		
1	1	1	1	1	0.009	0.008	0.006
2	1	1	1	2	0.014	0.013	0.012
3	1	1	2	1	0.010	0.011	0.010
4	1	1	2	2	0.016	0.016	0.016
5	1	2	1	1	0.012	0.013	0.011
6	1	2	1	2	0.018	0.018	0.017
7	1	2	2	1	0.015	0.017	0.015
8	1	2	2	2	0.020	0.023	0.021
9	2	1	1	1	0.007	0.007	0.005
10	2	1	1	2	0.013	0.012	0.011
11	2	1	2	1	0.008	0.009	0.008
12	2	1	2	2	0.014	0.014	0.014
13	2	2	1	1	0.011	0.013	0.010
14	2	2	1	2	0.017	0.017	0.017
15	2	2	2	1	0.015	0.016	0.015
16	2	2	2	2	0.020	0.022	0.020

Table 4. The values of out-of-roundness, for X6CrMo17 material samples

Nr. crt.	Factors level				Abrasive material		
	v_a	v_p	v_{sl}	S_t	66A25I5V217	50A25L5V217	21C40L5V217
					The out-of-roundness, A_c, [mm]		
1	1	1	1	1	0.007	0.007	0.006
2	1	1	1	2	0.011	0.013	0.011
3	1	1	2	1	0.010	0.010	0.009
4	1	1	2	2	0.015	0.017	0.015
5	1	2	1	1	0.010	0.010	0.010
6	1	2	1	2	0.015	0.016	0.015
7	1	2	2	1	0.015	0.015	0.015
8	1	2	2	2	0.020	0.021	0.020

9	2	1	1	1	0.005	0.004	0.004
10	2	1	1	2	0.010	0.011	0.009
11	2	1	2	1	0.007	0.008	0.007
12	2	1	2	2	0.012	0.014	0.012
13	2	2	1	1	0.010	0.010	0.010
14	2	2	1	2	0.015	0.016	0.014
15	2	2	2	1	0.014	0.014	0.014
16	2	2	2	2	0.019	0.020	0.019

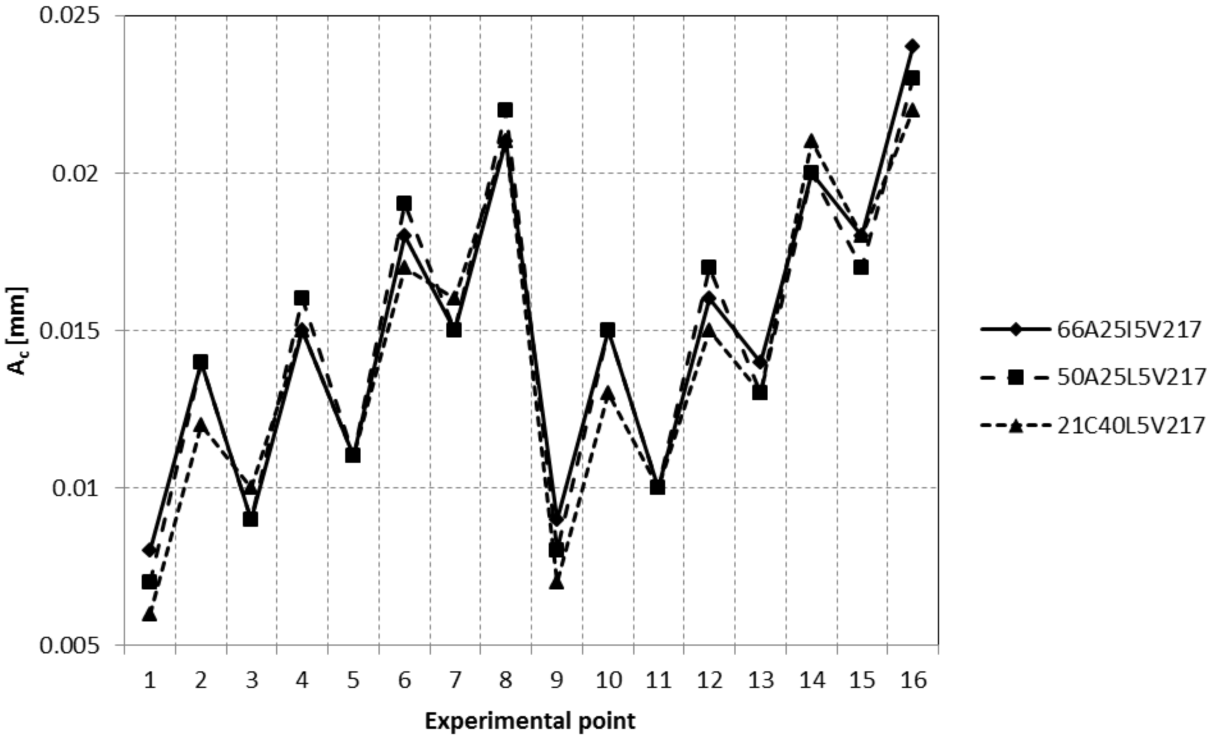


Fig.1. The out-of-roundness, A_c, of interior surfaces of 1 C 45 steel rectified with three types of abrasive material

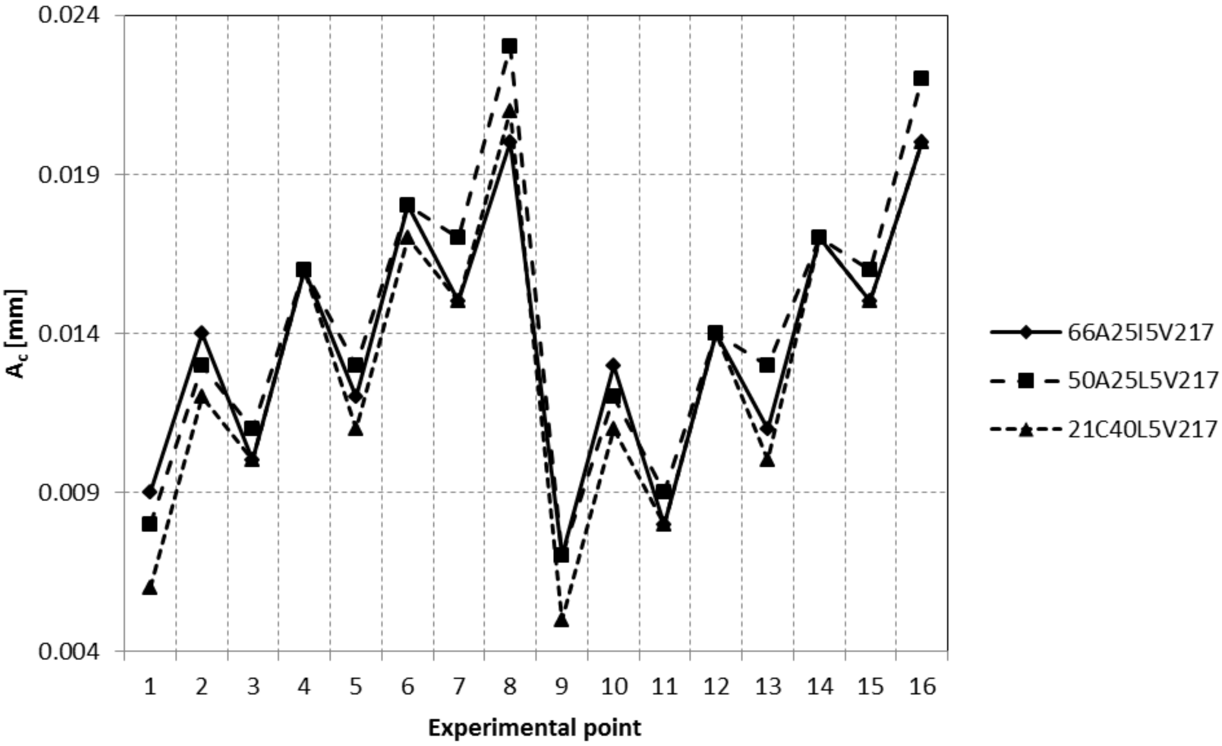


Fig.2. The out-of-roundness, A_c, of interior surfaces of 41Cr4 steel rectified with three types of abrasive material

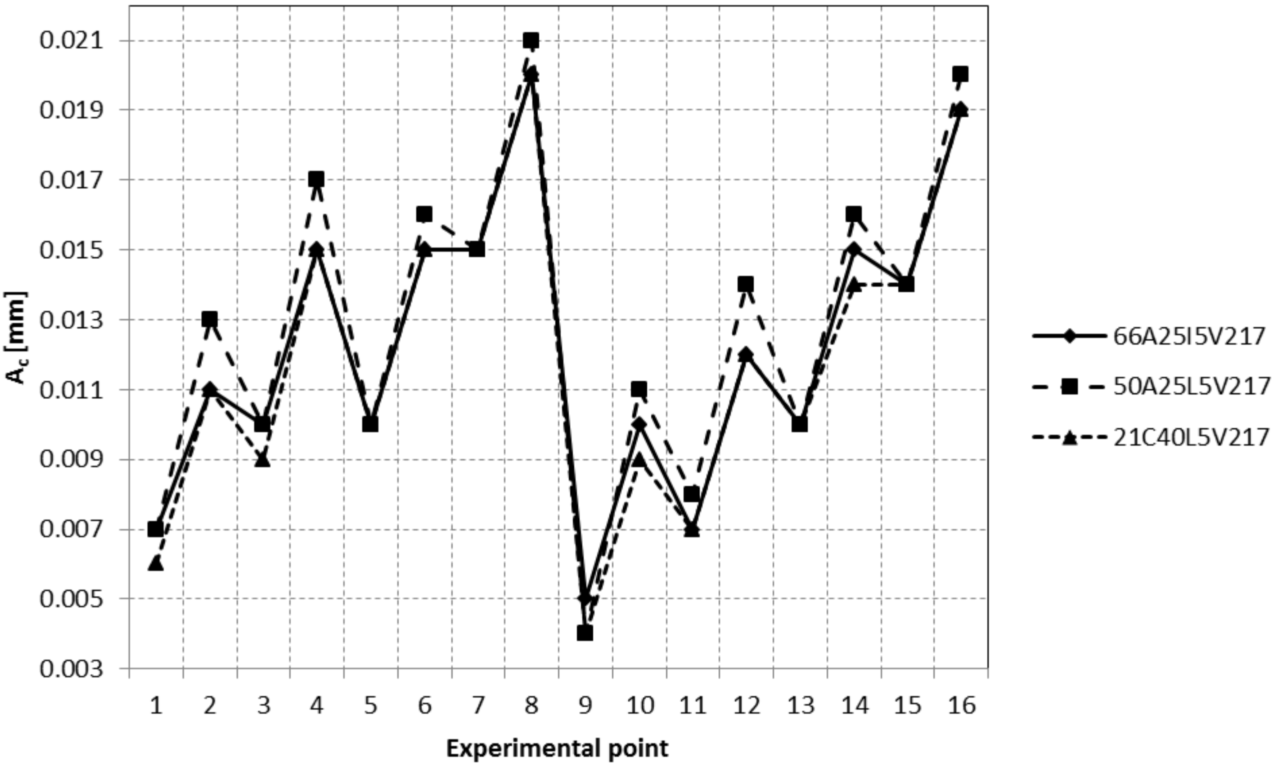


Fig.3. The out-of-roundness, A_c, of interior surfaces of X6CrMo17 steel rectified with three types of abrasive material

The way how the abrasive influence of roundness deviation may be related to how its characteristics, especially the hardness and grain size determines deployment abrasion process, especially dynamic phenomena, namely forces and vibrations. Processed material influence on out-of-roundness can be explained by the association with how the mechanical characteristics of the material, namely hardness and stiffness determines also dynamic phenomena or forces, elastic deformations and vibrations from the grinding process.

4. MATHEMATICAL MODELING OF EXPERIMENTAL DATA

The experimental results recovery is by establishing mathematical models of technological factors influence on out-of-roundness of the interior surfaces processed by grinding [7, 8]. In case of X6CrMo17 steel processed with 66A25I5V217 abrasive disk the mathematical model of Ac parameter is presented in relation (1).

$$
\begin{aligned}
A_c = {} & 0{,}014810 + \begin{bmatrix} -0{,}000937 & 0{,}000937 \end{bmatrix} \cdot \begin{bmatrix} A_{v_a} \end{bmatrix} + \begin{bmatrix} -0{,}0028212 & 0{,}0028212 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + \begin{bmatrix} -0{,}001187 & 0{,}001187 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \\
& + \begin{bmatrix} -0{,}003062 & 0{,}003062 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + {}^t\begin{bmatrix} A_{v_a} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + {}^t\begin{bmatrix} A_{v_a} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000062 & -0{,}000062 \\ -0{,}000062 & 0{,}000062 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \\
& + {}^t\begin{bmatrix} A_{v_a} \end{bmatrix} \cdot \begin{bmatrix} -0{,}000062 & 0{,}000062 \\ 0{,}000062 & -0{,}000062 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + {}^t\begin{bmatrix} A_{v_p} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000687 & -0{,}000687 \\ -0{,}000687 & 0{,}000687 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \\
& + {}^t\begin{bmatrix} A_{v_p} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000062 & -0{,}000062 \\ -0{,}000062 & 0{,}000062 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + {}^t\begin{bmatrix} A_{v_{sl}} \end{bmatrix} \cdot \begin{bmatrix} -0{,}000062 & 0{,}000062 \\ 0{,}000062 & -0{,}000062 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix}
\end{aligned} \tag{1}
$$

For equation (1) were calculated the theoretical responses values Ac on the points of experimental plan and then were determined the residues values corresponding. The results are shown in table 5. The results obtained of variance analysis for model analysed are shown in table 6.

Table 5. The measured values of roundness deviation, Ac, values of theoretical answers respective A_c ~ and residues, for X6CrMo17, grinded with 66A25I5V217 abrasive material

	v_a	v_p	v_{sl}	S_t	A_c [mm]	A_c~ [mm]	r [mm]
1	1	1	1	1	0.007	0.00663	0.000375
2	1	1	1	2	0.013	0.01313	-0.000125
3	1	1	2	1	0.010	0.001038	-0.000375

4	1	1	2	2	0.017	0.01688	0.000125
5	1	2	1	1	0.010	0.01013	-0.000125
6	1	2	1	2	0.016	0.01613	-0.000125
7	1	2	2	1	0.015	0.01488	0.000125
8	1	2	2	2	0.021	0.02088	0.000125
9	2	1	1	1	0.004	0.00438	-0.000375
10	2	1	1	2	0.011	0.01088	0.000125
11	2	1	2	1	0.008	0.00763	0.000375
12	2	1	2	2	0.014	0.01413	-0.000125
13	2	2	1	1	0.010	0.00988	0.000125
14	2	2	1	2	0.016	0.01588	0.000125
15	2	2	2	1	0.014	0.01413	-0.000125
16	2	2	2	2	0.020	0.02013	-0.000125

Table 6. The variance analysis of for Ac parameter model for X6CrMo17 steel grinding with 66A25I5V217 abrasive

Factor (interaction)	Variance	F_{max}	F_T	Signification
ν_a	0.000009	60	6.61	S
ν_p	0.00009025	601.667		S
ν_{sl}	0.000064	426.667		S
S_t	0.00015625	1041.67		S
ν_{a}- ν_p	0.000004	26.6667		S
ν_{a}- ν_{sl}	0.00000025	1.66667		N
ν_{a}- S_t	0	0		N
ν_{p}- ν_{sl}	0.000001	6.66667		S
ν_{p}- S_t	$2.5x10^{-7}$	1.66667		N
ν_{sl}- S_t	$2.0463\ x10^{-34}$	$1.4x10^{-27}$		N
Residual variation, V_R		0.00000015		

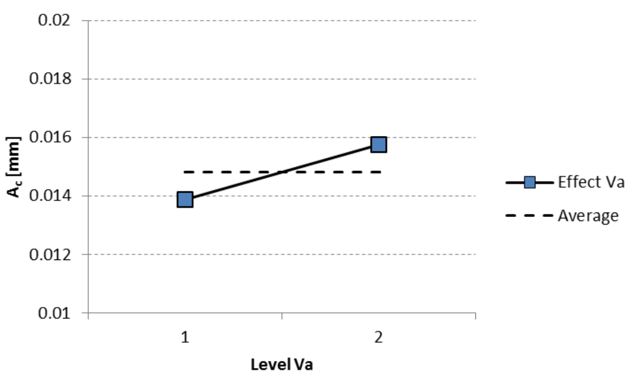
Data recorded in the tables above show a good approximation relatively of the theoretical values responses Ac in the experimental points in relation with measured values Ac, corresponding residues are small compared with the measured values.

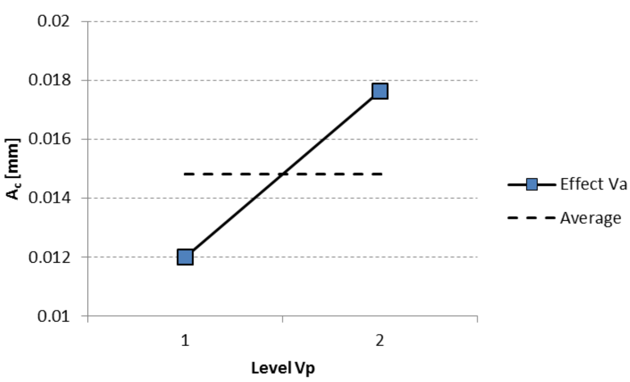
This proved a reduced influence of uncontrolled factors and accuracy of measurement carried out on the parameter under consideration.

Please note that in table 6 were marked with S factors and interactions between factors with significant effects in the model analyzed. Were marked with N interactions between factors, with significant effects.

The average effects of independent factors studied, on Ac parameter, so the out-of-roundness values are plotted in figure 4.

A similar analysis was performed for all steels and abrasive materials used. Keeping only the significant effects, mathematical models describing the influence of independent factors studied and interactions between them on out-of-roundness, for the three steels processed for the three types of abrasives used expressions are listed in relations (3)-(11).





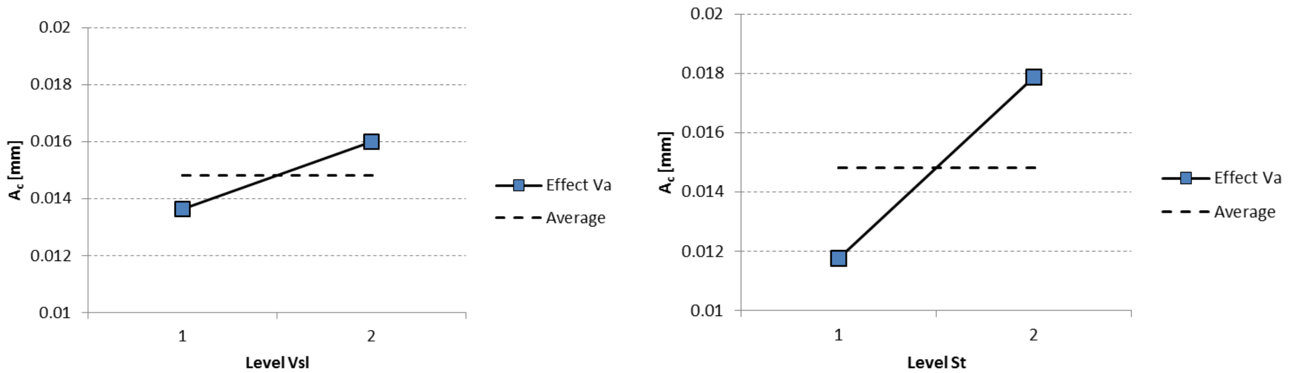


Fig.4. The effects of independent factors on out-of-roundness Ac for X6CrMo17steel grinding with 66A2515V217 abrasive

For 1 C 45 steel grinding with 66A25I5V217abrasive:

$$A_c = 0{,}014810 + \begin{bmatrix} -0{,}000937 & 0{,}000937 \end{bmatrix} \cdot \begin{bmatrix} A_{v_a} \end{bmatrix} + \begin{bmatrix} -0{,}0028212 & 0{,}0028212 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + \\ + \begin{bmatrix} -0{,}001187 & 0{,}001187 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \begin{bmatrix} -0{,}003062 & 0{,}003062 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + \\ + {}^t\begin{bmatrix} A_{v_a} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + {}^t\begin{bmatrix} A_{v_p} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000687 & -0{,}000687 \\ -0{,}000687 & 0{,}000687 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} \tag{3}$$

For 1 C 455 steel grinding with 50A25L5V217 abrasive:

$$A_c = 0{,}01475 + \begin{bmatrix} -0{,}000625 & 0{,}000625 \end{bmatrix} \cdot \begin{bmatrix} A_{v_a} \end{bmatrix} + \begin{bmatrix} -0{,}00275 & 0{,}00275 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + \\ + \begin{bmatrix} -0{,}001375 & 0{,}001375 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \begin{bmatrix} -0{,}0035 & 0{,}0035 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + \\ + {}^t\begin{bmatrix} A_{v_p} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000375 & -0{,}000375 \\ -0{,}000375 & 0{,}000375 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} \tag{4}$$

For 1 C 455 steel grinding with 21C40L5V217 abrasive:

$$A_c = 0{,}014188 + \begin{bmatrix} -0{,}000687 & 0{,}000687 \end{bmatrix} \cdot \begin{bmatrix} A_{v_a} \end{bmatrix} + \begin{bmatrix} -0{,}003187 & 0{,}003187 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + \\ + \begin{bmatrix} -0{,}001687 & 0{,}001687 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \begin{bmatrix} -0{,}002812 & 0{,}002812 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + \\ + {}^t\begin{bmatrix} A_{v_a} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + {}^t\begin{bmatrix} A_{v_{sl}} \end{bmatrix} \cdot \begin{bmatrix} 0{,}00925 & -0{,}00925 \\ -0{,}00925 & 0{,}00925 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} \tag{5}$$

For 41Cr4 steel grinding with 66A25I5V217 abrasive:

$$A_c = 0{,}013688 + \begin{bmatrix} 0{,}000562 & -0{,}000562 \end{bmatrix} \cdot \begin{bmatrix} A_{v_a} \end{bmatrix} + \begin{bmatrix} -0{,}002312 & 0{,}002312 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + \\ + \begin{bmatrix} -0{,}001062 & 0{,}001062 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \begin{bmatrix} -0{,}002812 & 0{,}002812 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + \\ + {}^t\begin{bmatrix} A_{v_p} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} \tag{6}$$

For 41Cr4 steel grinding with 50A25L5V217 abrasive:

$$A_c = 0{,}014313 + \begin{bmatrix} 0{,}000562 & -0{,}000562 \end{bmatrix} \cdot \begin{bmatrix} A_{v_a} \end{bmatrix} + \begin{bmatrix} -0{,}003062 & 0{,}003062 \end{bmatrix} \cdot \begin{bmatrix} A_{v_p} \end{bmatrix} + \\ + \begin{bmatrix} -0{,}001687 & 0{,}0016875 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} + \begin{bmatrix} -0{,}002562 & 0{,}0025625 \end{bmatrix} \cdot \begin{bmatrix} A_{S_t} \end{bmatrix} + \\ + {}^t\begin{bmatrix} A_{v_p} \end{bmatrix} \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot \begin{bmatrix} A_{v_{sl}} \end{bmatrix} \tag{7}$$

For 41Cr4 steel grinding with 21C40L5V217 abrasive:

$$A_c = 0{,}013000 + [0{,}000500 \;\; 0{,}000500] \cdot [A_{V_a}] + [-0{,}00275 \;\; 0{,}00275] \cdot [A_{V_p}] +$$
$$+ [-0{,}001875 \;\; 0{,}0016875] \cdot [A_{V_{sl}}] + [-0{,}003000 \;\; 0{,}003000] \cdot [A_{S_t}] + \quad (8)$$

For X6CrMo17 steel grinding with 66A25I5V217 abrasive:

$$A_c = 0{,}012188 + [0{,}000687 \;\; -0{,}000687] \cdot [A_{V_a}] + [-0{,}002562 \;\; 0{,}002562] \cdot [A_{V_p}] +$$
$$+ [-0{,}001812 \;\; 0{,}001812] \cdot [A_{V_{sl}}] + [-0{,}002437 \;\; 0{,}002437] \cdot [A_{S_t}] +$$
$$+ {}^t[A_{V_a}] \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot [A_{V_p}] + {}^t[A_{V_a}] \cdot \begin{bmatrix} 0{,}000312 & -0{,}000312 \\ -0{,}000312 & 0{,}000312 \end{bmatrix} \cdot [A_{V_{sl}}] + \quad (9)$$
$$+ {}^t[A_{V_p}] \cdot \begin{bmatrix} 0{,}000437 & -0{,}000437 \\ -0{,}000437 & 0{,}000437 \end{bmatrix} \cdot [A_{V_{sl}}]$$

For X6CrMo17 steel grinding with 50A25L5V217 abrasive:

$$A_c = 0{,}012875 + [0{,}00075 \;\; -0{,}00075] \cdot [A_{V_a}] + [-0{,}002375 \;\; 0{,}002375] \cdot [A_{V_p}] +$$
$$+ [-0{,}002000 \;\; 0{,}002000] \cdot [A_{V_{sl}}] + [-0{,}003125 \;\; 0{,}003125] \cdot [A_{S_t}] + \quad (10)$$
$$+ {}^t[A_{V_a}] \cdot \begin{bmatrix} 0{,}000500 & -0{,}000500 \\ -0{,}000500 & 0{,}000500 \end{bmatrix} \cdot [A_{V_p}] + {}^t[A_{V_p}] \cdot \begin{bmatrix} 0{,}00025 & -0{,}00025 \\ -0{,}00025 & 0{,}00025 \end{bmatrix} \cdot [A_{V_{sl}}]$$

For X6CrMo17 steel grinding with 21C40L5V217 abrasive:

$$A_c = 0{,}011875 + [0{,}00075 \;\; -0{,}00075] \cdot [A_{V_a}] + [-0{,}00275 \;\; 0{,}00275] \cdot [A_{V_p}] +$$
$$+ [-0{,}002000 \;\; 0{,}002000] \cdot [A_{V_{sl}}] + [-0{,}002500 \;\; 0{,}002500] \cdot [A_{S_t}] + \quad (11)$$
$$+ {}^t[A_{V_a}] \cdot \begin{bmatrix} 0{,}000375 & -0{,}000375 \\ -0{,}000375 & 0{,}000375 \end{bmatrix} \cdot [A_{V_p}] + {}^t[A_{V_p}] \cdot \begin{bmatrix} 0{,}000375 & -0{,}000375 \\ -0{,}000375 & 0{,}000375 \end{bmatrix} \cdot [A_{V_{sl}}]$$

5. CONCLUSIONS

For all three types of steel being processed in experiments and for all three types of abrasives used in the study all the factors have significant effects on the parameters investigated, Ac.

The strongest effects are the factors Vp and St, which can be explained by the fact that the rotational speed is directly related to the undeformed chip thickness and transverse advance chipped determines the thickness of a single grain, and the number granules that take part simultaneously at cutting process. The two parameters of the grinding process and thus a strong influence on cutting forces, stresses, strains and elastic vibration.

An important effect was also for Vsl factor, this speed directly causing the longitudinally feed, which is related with the load on the abrasive grain. It was highlighted by the results achieved, a smaller significant effect of this factor on out-of-roundness, for steels with higher mechanical properties.

A lesser effect with different sign depending on the nature of steel processed was registered for Va factor. The explanation can be found in the fact that, in general, as shown by other studies mentioned in the literature, cutting speed, increasing its, determines, on the one hand, a decrease in the specific cutting energy, the cutting force and an increase in efforts to limit vibration and an increase in relative amplitude of low frequency vibrations.

The weight of the effects of each of the factors studied in mathematical models corresponding to the parameter Ac, vary depending on the type of steel processed and depending on the nature of the abrasive used.

To optimize the grinding process in terms of out-of-roundness, so to minimize the parameter Ac, the Vp, Vsl and St factors must be at first level, while the Va factor will be located at first level for 1 C 45 steel respectively at level 2 for the other two steels tested.

From the point of view of interactions with significant effects on out-of-roundness one can make the following comments. Interaction between Vp and Vsl factors that appear most often as having significant effect, the explanation may be related to the fact that the speed Vp is determined by the speed of the piece, the latter parameter with Vsl speed, causing the longitudinal feed Sl. The interaction between the factors and Vp and Va is also important to have a significant effect.

The explanation may be sought in the fact that the two speeds determine the value of another important parameter in the trials investigated or grinding report. For X6CrMo17 steel with 66A25I5V217abrasive grinding processed the interaction between Va and Vsl is above the materiality. For 1 C 45 steel with 21C40L5V217 abrasive grinding processed is also recognized as significant and the effect of interaction of Vsl and St.

Take into account all the above considering, it can make the claim that choice the studied factors and models as well was judiciously carried out, appropriate research conducted on the influences on out-of-roundness at the inner cylindrical surface processing by grinding.

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