DEPENDENCE OF POWER RUGOSITY TO X40CrMoV5-1 STEEL YIELDING THROUGH COMPLEX EROSION BY INTRODUCING THE ELECTROLYTE THROUGH THE TRANSFER OBJECT

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ABSTRACT: *Ruggedness represents the imprints/traces left on the work surface after the processing and it consists of deviation of the 3rd degre and deviation of the 4th degre. They are microunevenness, which depend on the cinematic of the processing and have a temporal character, consisting of striations or scratches and snatches. In this paper in order to establish the mathematical pattern of the dependence of processing ruggedness on the induced power within the workspace $R_a=f(P)$ polynomial functions of the 1st, 2nd and 3rd degrees and exponential functions were used.*

Keywords: : complex erosion, induced power, steel, ruggedness

The state of machine part surfaces obtained after processing can be defined by the characteristics that express the geometric and the physico-chemical state of the surface:

- the geometric state of the surface expresses the geometric deviation of the real part as compared to the geometric piece. There can be: undulation and rugosity.
- the physico-chemical state of the surface expresses the physical, chemical and mechanical properties of a pellicle from the surface layer of the film, as compared to the rest of the material.

The rugosity is quantitatively expressed by the following indicators:

- deviation of R_a profiles defined as the median value of effect profile ordinates compared to the average line of real profile;
- dimensiunilor de contact între limitele admise la asamblare, preciziei dimensionale etc.
- height of R_z irregularities defined as the average distance between the highest 5 peak points and 5 lowest bottom points of real profile;
- the maximum depth of R_{max} irregularities defined as the greatest distance between the actual profile and average line. If for singular pieces rugosity has no particular importance for the parts assembled, where the surfaces get in contact, it is important because of resistance to wear of surfaces, resistance to fatigue and corrosion, durability, appearance, maintaining the ratio of contact dimensions between the limits admitted to the assembly, dimensional accuracy etc.

1. Mathematical patterns

The great number of factors which may influence the processing through complex erosion makes that the first stage in modeling process to be the pre-modeling, that is choosing from among the multitude of factors, only those that have a decisive importance upon the processing phenomenon.

A conclusion in the specialized literature is important: there is no previous importance of influential factors, each factor is more or less important depending on the concrete context of the respective tehnological processing: the same factor may be decisive in one case and totally insignificant in another. That is why in order to obtain a general pattern the problem is approached statically, depending on the frequency in which the respective factors appear in different cases. After having established these factors, the framing a factorial experiment follows on the basis of which the experiments, which are to be done, are determined in order to avoid a great too many attemps.

On the basis of these results the framing of the mathematical pattern may be accomplished using interpolation methods through different techniques. In order to establish the mathematical pattern of the dependence of the surface quality (ruggedness) depending on the electrical parameters, mechanical parameters etc. it was experimented the discharging of some samples of weakly alloyed steel X40CrMoV5-1.

The tests were realized with samples having the diameter of 20 mm, using as a transfer object (OT) plates of stell S235JRG1 and brass CW614n, having the diameter of 200 mm and thickness of 1 mm and they results are presented in table 1 and graphics 1 obtained through processing the dates with the help of computer.

Table 1. Results in disharging through complex erosion

OT out of S235JRG1				OT out of CW614N			
Step rectifier	U [V]	I [A]	R_a [μm]	Treapta redresor	U [V]	I [A]	R_a [μm]
I	16	30	4.8	I	16	35	9.8
	18	35	5.1		20	50	12.8
	20	40	5.4		25	70	14.3
II	14	25	2.8	II	20	60	12.3
	16	35	3.3		24	100	14.8
	20	50	4.8		30	125	15.3
III	20	80	12.3	III	25	125	10.6
	25	120	14.3		30	150	15.8
	35	200	16.8		35	200	18.5
IV	25	120	11.8				
	30	150	14.8				
	35	200	-				

Afterwards it followed the establishing of the mathematic pattern of the dependence $R_a=f(P)$, for which I attempted the representation through polynomial of the 1st, 2nd and 3rd degree and trough exponential functions, taking into account the expressions:

(1) $R_{a1} = a_0 + a_1 \cdot P$ [μm]

(2) $R_{a2} = a_0 + a_1 \cdot P + a_2 \cdot P^2$ [μm]

(3) $R_{a3} = a_0 + a_1 \cdot P + a_2 \cdot P^2 + a_3 \cdot P^3$ [μm]

(4) $R_{a4} = e^{a0 + a1 \cdot P}$ [μm]

(5) $R_{a5} = e^{a0 + a1 \cdot P + a2 \cdot P2}$ [μm]

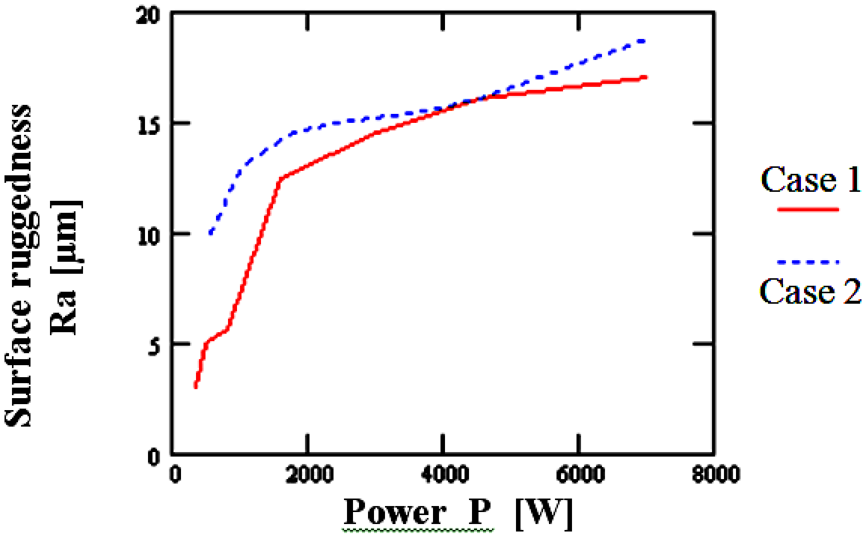

Fig. 1. The dependence of the surface ruggedness on the induced power within the workspace (case 1 = OT out of S235JRG1, case 2 = OT out of CW614N)

In order to determine the coefficients out of the ten functions I realized a polynomial interpolation through the method of the smallest squares using the computer.

After the calculuis has been done, I obtained the fallowing results, for the dependency $R_a=f(P)$:

- In the case of processing OT out of S235JRG1 (figure 2)

(6) $R_{a1} = 4.8764 + 1.918 \cdot 10^{-3} \cdot P$ [µm]

(7) $R_{a2} = 1.9569 + 5.801 \cdot 10^{-3} \cdot P - 5.2964 \cdot 10^{-7} \cdot P^2$ [µm]

(8) $R_{a3} = - 0.2952 + 0.0134 \cdot P - 2.9108 \cdot 10^{-6} \cdot P^2 + 1.6062 \cdot 10^{-10} \cdot P^3$ [µm]

(9) $R_{a4} = e^{1.6093 + 2.3127 \cdot 10-4 \cdot P}$ [µm]

(10) $R_{a5} = e^{1.2003 + 6.975 \cdot 10-4 \cdot P - 6.09 \cdot 10-8 \cdot P2}$ [µm]

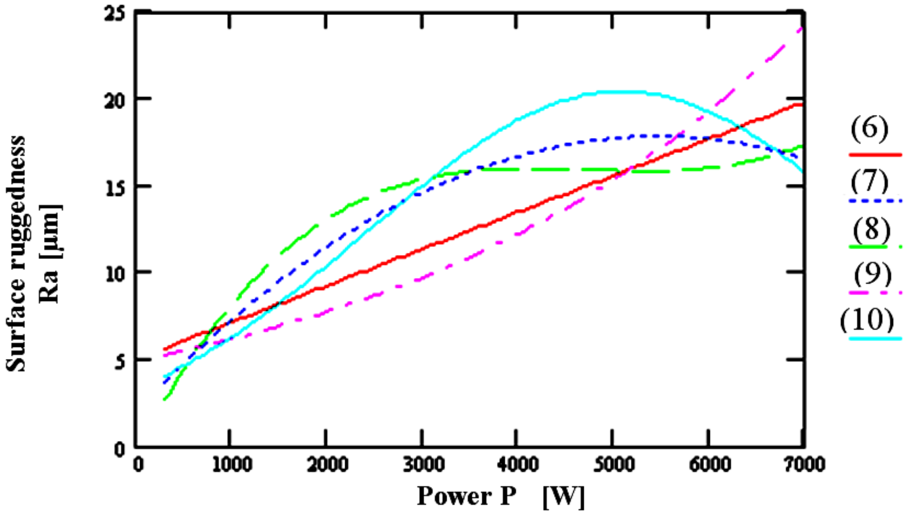

Fig. 2. Representation of interpolation functions R_a=f(P) in the case of discharging OT out of S235JRG1

- In the case of processing OT out of CW614N (figure 3)

(11) $$R_{a1} = 10.9856 + 0.9978\cdot10^{-3}\cdot P \quad [\mu m]$$

(12) $$R_{a2} = 10.2986 + 2.0521\cdot10^{-3}\cdot P - 0.9697\cdot10^{-7}\cdot P^2 \quad [\mu m]$$

(13) $$R_{a3} = 7.295+6.3859\cdot10^{-3}\cdot P - 1.5904\cdot10^{-6}\cdot P^2 + 1.2858\cdot10^{-10}\cdot P^3 \quad [\mu m]$$

(14) $$R_{a4} = e^{2.3987 + 7.6182\cdot10\text{-}5\cdot P} \quad [\mu m]$$

(15) $$R_{a5} = e^{2.2938 + 1.7185\cdot10\text{-}4\cdot P - 1.1978\cdot10\text{-}8\cdot P2} \quad [\mu m]$$

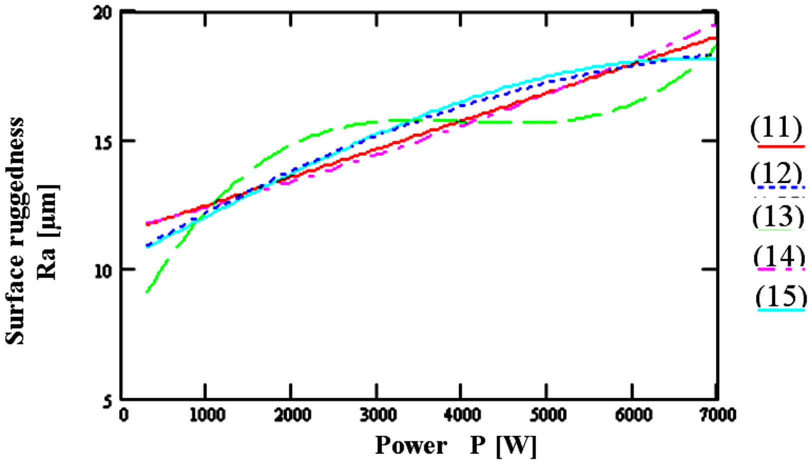

Fig. 3. Representation of interpolation functions R_a=f(P) in the case of discharging OT out of CW614N

2. Conclusions

On the basis of the data presented in this paper many conclusions may by drawn:

- the deterioration of the surface is the more obvious, as the induced power in the workspace increases;
- the ruggeddness is lower if tensions U used;
- the ruggedness is lower if the transfer object OT is made of steel, for the same value of induced power, than in the case of the transfer object made of brass.

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