THE PARAMETERS AND FACTORS OF THE PROCESS OF WORKING THROUGH COMPLEX EROSION AND THEIR INFLUENCE UPON THE PROCESSING

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ABSTRACT:

The paper presents the main parameters and factors which characterise the process of working through complex erosion, as well as the dependency of the working productivity taking into account these parameters. The working through complex erosion is a complex process, driven and strongly influenced by a series of parameters and factors which work simultaneously and others interdependently. The parameters influence the weight of the elementary processes, whereas the factors influence the development of these processes.

KEYWORDS: erosion, tension, current density, the advance velocity

The theoretical and experimental study of the processing through complex electrical erosion, realized up to now, reveals the existence of a complex process driven and strongly influenced by a series of parameters and factors which activates simultaneously, and some of them interdependently. Their characteristics determine the proportion of participation at the drawing of material of one of the specific elementary processes, determining the global erosive effect and finally the characteristics of the processing. The parameters and factors presented in figure no. 1 are considered representative for the dimensional processing through complex electric erosion.

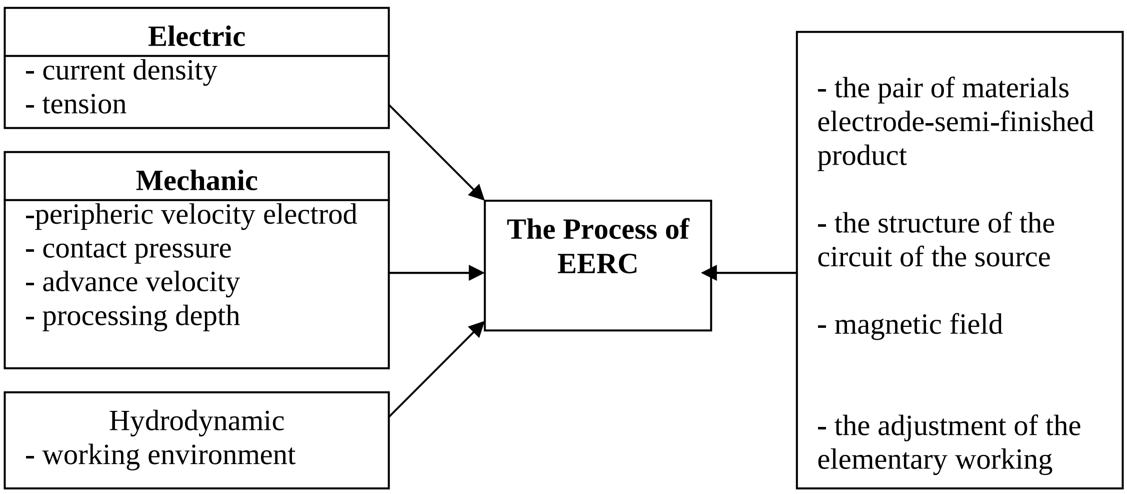

Fig.1. The Parameters and Factors of the Process of Working through Complex Erosion

The characteristic parameters for the proceeding are different such as: electric – defined through the intensity of the electric current, as well as the current density and the tension of the process; mechanic – represented by the external velocity of the electrode- tool and the depth of processing or advance in some studies, or in others, fusing the last two parameters, through the light of the pressing force between the electrode and the semi-finished product, as well as the contact pressure; hydrodynamic, represented by the working environment.

The parameters influence the share of the elementary processes and the factors determine the unfolding of these processes.

The tension corresponding to the working area is a parameter whose size influences the stability of the process of processing. In the domain of low tensions (8…12 V), the quantity of energy emitted is reduced (approximately 2…5%in the energy of discharge in the electric resort) and it is due to Joule- Lenz of heating.

In the domain of medium tensions (12…22V), breaking the contacts will determine the emergence of the un- stationary resort with well- marked thermal effects. It is estimated that in this domain, the balance of the elementary processes is achieved, which ensures the stability of that process, as well as the unfolding of the effect energy and the evacuation of the erosive products. This domain is considered the optimum one and leads to a surface processed with the lowest value of parameters of ruggedness and depth of the modified layer, at a minimum consumption of energy.

In the domain of high tensions (22…32V), the share of the discharges in un- stationary resort, accompanied by well- marked thermal effects, is high. The temperature of the connection bridges is close or overcomes the smelting temperature, so that the material smelts and sometimes is vaporized in an exploding way.

The electric current is the determinative parameter of the process, being a relative size, which depends on the size of the active surface that takes part in the process of processing. Thus the specific size $j = \frac{I}{S}$, as the density of the current represents the main parameter of the process.

For low densities of the electric current ($j<20A/mm^2$), if the tension in the working area is low, then the processing takes place on the account of the electrochemical process. Processed superior qualities will be obtained, high dimensional precisions, well marked minimizing of the modified layer, as well as of the thermally influenced area (ZIT) and almost a total elimination of the micro-fissures, instead a lowering of the productivity is to be observ

For high densities of current ($j>20\ A/mm^2$) and corresponding tensions, the processing is preponderantly realized due to the electric discharges in impulse, generated at the level of the tops of micro-asperities, the share of the erosive process being determined by the effects of the thermal process. In this case, productivity increases, but with negative effects upon the quality of the processed surface, upon the dimensional precision, upon the thermally influenced area ZIT and the modified layer. In case of an exaggerated increase of the current density, either in the presence of low tensions, or high tensions, the process of erosion degenerates causing the emergence of short-circuit at low tensions or electric discharges in stationary resort.

Contact pressure p = 1…. 10 Mpa, on whose value other parameters depend, too, especially the current density, is another important factor. The optimum value of pressure marks the limits of the contact bridges number between OT and OP, as well as the size of their section, an important role in preventing the short-circuit OT and OP having the passive film. If the pressure surpasses a certain limit, there is no balance between the quantities of film formed and removed, and thus the contact surface between the electrodes with tendencies towards short-circuits increases.

The advance velocity v_s = 1…100mm/s. For low advance velocities, the absorbed strength (transmitted in the working area) represents only 2/10…3/10 from the maximum strength of the transformer, because an alternation of the working conditions with one running idle and the resort is unstable and it often interrupts. The size of the advance leads to the increasing of discharging number and of current density, thus to an increased strength of absorbing, which produces favourable conditions for a spontaneous vaporization and splinter of smelted metal outside the working area, leading to a deterioration of the processed surface but to minimization the specific consumption of energy.

Processing depth t = 0,1…5 mm. The influence of the processing depth upon the absorbed strength and consequently upon the specific consumption of energy, is similar to that of the advance velocity.

The size of the processing depth and that of advance determine the surface on which the drawing of material takes place; they have to be chosen in such a way so that the surface perimeter on which the drawing of material should be minimum; the choice of the advance size depends on the processing depth.

The external velocity of the electrode v_e = 10…50 m/s; it is advisable that the electrode rotation should be done in the opposite direction comparatively to the semi-finished product.

The velocity ensures the balance of the elementary processes, determines and limits the effect the effect energy in the elementary area, with a determinative role both in establishing the contact duration and imparting the discharging character in un-stationary resort.

The low velocities determine the existence duration of the micro-contacts to increase and consequently a strong increase of the electric strength through Joule- Lenz effect takes place, of which a great part is lost through the dissipation in the bodies in contact mass, without any utility in the erosion process. In case of such velocities, the drawing of material is due especially to the long resort from the cathode to the anode, and the total erosion of the anode is reduced. The quality and productivity of the surface are inadequate.

In case of high velocities productivity increases, ruggedness lowers whereas the structural modifications in the superficial layer are reduced. Because of the working environment action (especially the aqueous one) the metallic contacts decrease once the velocity increases, so that if the velocity is too high the contacts are likely not to emerge any more.

Working environment: soluble solution of glass metal, compressed air, aqueous solution of kaolin, technological water with surpluses of sodium and potassium chlorides and technological water.

Presently, the industrial practice especially validates, on technical and economic grounds, as working environments, the compressed air and technological water. Three main lines of action concerning the working environments are inferred, such as: activation of the erosive phenomenon, confinement of the effect energy and the activation of the evacuation process.

The working environment has to be maintained at optimum temperatures of processing. The last researches throw a useful light on the heating of the working environment at temperatures of over 40 ^{0}C thus leading to substantial alteration concerning the conditions of unfolding the process. Cooling the action area of the electric resort as well as the rapid movement of the electrode lead to un-stabilization of the resort and minimizing of its column length.

The pair of materials electrode – semi-finished product: the electrode may be made of graphite, steel, yellow brass, aluminium, cast iron, copper, and the semi-finished product has to be electro- conductor material with smelting temperature lower than that of the electric resort.

The proceeding is efficient, economically speaking, concerning the thermal resistant materials, with high ohmic resistance or metals and alloys with high hardness and tenaciousness: allied steels, austenical and martensitical stainless, refractory etc.

The pair of materials electrode – semi-finished product represents an important factor in characterizing the material easiness of processing, being the line of generalizing in the process of processing through the complex electric erosion. The pair of materials electrode – semi-finished product may drive and optimize the characteristics of the processing, their thermal physical properties, giving them a different behaviour at processing: for instance, the ruggedness of the surfaces processed in sinterised carbide is lower and the productivity is higher than that already obtained in the same conditions in processing the rapid steel; using a copper electrode leads to a lower relative wearing (under20%) than in case of using a steel OLC 45 (OVER40%); also, the productivity at processing with a soft steel is somehow more reduced than in case of using a copper electrode.

The electric circuit structure of the supply source:

- transformers/ converters for welding;
- special transformers.

It influences the quantity of heating introduced in the process: the point is to transmit at the surface of the electrode – semi-finished product a great quantity of energy in a short period of time, able to produce the powerful heating of the micro-volumes in contact, without affecting the mass of the semi-finished product in depth. These conditions are ensured by the inductive structures and the characteristics relatively rigid of the supply source.

The magnetic field:

- internal – having a role in evacuation of the corrosive products and ensuring the stability of the process;
- external – perpendicular on the discharging channel axis and parallel with the semi-finished product axis;

It reduces the energy consumption, minimizes the electrode wearing, reduces the possibility of the metal drops to join the surface of the semi-finished product.

The automatic adjustment of the working area:

- it determines with high share the stability of the processing and represents an efficient means of driving and optimizing of the process;
- it correlates the electric and mechanic parameters, with a view to observe an objective function during the process: maximum productivity, specific minimum consumption of electric energy, ruggedness of the processed surfaces and minimum thermal influenced area ZIT;
- even in case of a partial correlation of the parameters, the automatic adjustment of the elementary working area has very important repercussions upon the technology of the process and in realizing the desired technological characteristics.

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