INFLUENCE OF DIFFERENT FACTORS ABOVE INTENSITY PROCESS OF ELECTROEROZION

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The practical application of electro erosion process it is stopped from different causes. So, in the dimensional processing it is necessary to mention constant dimensional value and the form of tool electrode (cathode) constant; for the formation of deposition layers of compact materials it is necessary to reduce to the minimum the erosion of the cathode component and to increase to the possible maximum the erosion of the anode electrode transferring the eroded material to the surface of the processed component, and avoiding erosion both in the tool electrode and of the component in the superficial thermal treatment and chemical-thermal of components in machine building. The wide diversity of practical application of electro erosion requires an ample analysis of the influence of different factors, both of electric and non – electric nature, on the intensity of this phenomenon.

Erosion is studied after a solitary electric discharge on the surface of the tested component. A wolfram bar with 6 mm diameter and with the working end sharpened that has the form of semi-sphere was used as counter – electrode. The test bar served as the anode and in cases of interstices bigger that 0,5 mm, the multiple reflection of torches took place, all this complicating the picture of electro-erosion.

Table 1. The energy discharged on anode and cathode in correlation with the dimension of the interstice [1]

Inter stice mm	It is connected like	The warm ^{o}C	The energy for a impulse
1	Anode	0,8	0,44
	Chatode	0,6	0,33
0,5	Anode	0,7	0,39
	Chatode	0,5	0,28
0,25	Anode	0,6	0,33
	Chatode	0,3	0,17
0,1	Anode	0,5	0,28

The investigation was made under the following conditions: *C=320 µ F,* *U_C=300* V, *τ_i=200 µ s,* dielectric environment – air [1] .

The result led us to the conclusion that according to the intensity and character of electroersion, metals may be divided into three groups:

I group – wolfram, rhenium and its alloys (for them it is characteristic that on the action of plasma the discharges in conditions wrote earlier there is no smelt. The surface of the test tube in the place of plasma action it is subdue electronic processing or ionic the structure of the material it is the same.

II group – copper, nickel, iron etc. The erosion is the cause of the smelt and possible of vaporization or the prevalence of small drops.

III group – zinc, lead, tin where an evident zone of smelt appear and appear a crater.

By oscilloscope we can say that, for all tested metals the parameters of electric discharge in impulse were constant (the quantity of energy, the character of the discharge and the duration of impulse).

It is demonstrated that, there is no explication for such an erosion for wolfram, because the energy of discharge gets a little to the surface of the tested pieces (it is a low temperature and the metal doesn't smelt).

The energy from the battery of the condenser *W_C*, it is spent on the discharge to warm the environment (air), to warm the electrodes, radiation (light, sound and distortion), when the tension on interstitial is approximately 20…30 *V* and usually it should be to warm the condenser 160…400 *V*.

To appreciate the released energy on electrodes a hole has made in their body to put in a mercury thermometer and the medium increase of their temperature during ten impulses has measured.

The table clearly shows that in all cases the cathode is warmed less than the anode. This makes it clear that the phenomenon of erosion for cathode electrodes differs from that of anode electrodes. The quantity of released energy in the interstice depends on its dimension. The brightness of the interstices increases when its value is higher, whiles for *0,1 mm* value the brightness of interstice is low. This makes

the size interstice one of the important parameters of the processing. Table 2 contains information about the released energy on the electrode during a solitary discharge when the size of the interstice 0,5 mm for several materials.

As far as the size of the interstice, it has been experimentally demonstrated [5,6,8] that the intensity of the erosion including the one of forming the deposition layer are square functions. Of the interstice in conformity with results presented in table 2, metals may be divided again into three groups: I-st group - wolfram and aluminum ; II-nd group-Zn, Pb, Sn, III-nd group-the other metals.

Table 2. Energy released during on discharge on the electrode.

Metal (anode)	Energy (call)
Wolfram	0,45
Țirconiu	0,37
Titanium	0,37
Steel	0,35
Itriu	0,32
Copper	0,39
	0,48
Magniu	0,30
Zinc	0,20
Plumb	0,29
Cositor	0,24

As the experiments were made in the open air, the oxidation processes played an important rale-E.g., for Mg. the released during the oxidation process could influence the results of the measurements. On the other hand, the vaporization of metals could play the role of energy consumer and lead to the decrease of the interstice resistance. It is through vaporization that we can explain the minimal energy that is released on electrodes for the II end group metals: Zn, Pb, Sn.

The attempts to state the vaporization process of the test component material were based on the methods of spectral analysis by energizing the NP3995 A in the air with a low tension spark for different electrode materials The results of the relative blackening of ΔS line are presented in Table 3.

According to the table 3 the metals again can be divided into three groups:

I group – Re and W; II group – Pb, Zn, Mg; III group – the others.

Transferring Al to the third group, and Mg to the one is due to their specific of oxidation. The drawing of the material in the interstice takes place simultaneously not only because of its vaporization but also due to oxides.

The energy that is released during the process of Al and Mg, oxidation, was not taken into account at the variation of energy in impulse electric discharges. However, A more qualitative result results was obtained for Wand Re, because these metals are not evaporated. This is important due to the fact that the same results are obtained both in an attempt of a single discharge, and when repeating it with 50 impulses one after the other for 0,5 sec. Wolfram weak erosion cannot by energy waste at vaporization and as a result of a smaller quantity of released energy at the surface of test bar. The obtained results correspond to the absorption of impulse energy of metals.

The results of the investigation were not enough to be able to elucidate the relativity small erosion of wolfram and thenium at impulse electric discharges at low tension on the interstice.

Let us examine the development of the process drawing the attention to the erosion of metals that are not easily melted. The specific power q as an average for the duration of the impulse related to the surface of action at the beginning of the action possesses the value of ~108 w/cm². Such a flux density for duration of action of about 10-4 is already sufficient for the process of erosion both through intensive evaporation and explosion vaporization, practically for all metals.

The critical density of the flux for the beginning of intensive evaporation at the material may be determined according to the relation:

$$q_c = \rho L \sqrt{a/\tau} \qquad (1)$$

in which **ρ** is density; **L** is latent heating of evaporation; a the coefficient of thermal conductibility of the electrode material; **τ** is the time of exposure.

In conformity with the executed calculation according to relation (1) the highest critical density of the flux is needed for wolfram and it constitutes $\approx 5 \cdot 106 \text{ w}/\text{cm}^2$.

The experimental results, conclude that not easily metals (wolfram and renium) are not destroyed at all, while in the other materials, with the exception of those that are easily melted, the erosion is to superficial melting and not evaporation.

The greatest part of the impulse energy is released in the interstice during the first phase of discharging (0…50). The power of impulses under the form of independent fluxed of electrons and ions

is active on the small surfaces. The relaxed processes of transmission energy from electrons and ions to the crystalline network ends which throughout period of about 10-7 s sufficient energy is introduced in the very thin superficial layer to start the explosive phenomena [7]. Because of the thin layer of the volume charge (<10-4 cm), the thickness of liquid phase layer on the surface of action should be very small. Experimental investigations show that its thickness is smaller than 1 μm.

In has been made clear that in spark, the discharges the vapor pressure on the surface of the metal is of [1].

The initial stage of discharging causes metal vaporization; it also increases the pressure in the interstice which leads to plasma canal dilation and a change of the character of surface erosion.

In one of his paper [2], the author of this article studied the formation of deposition from compact materials on components made of aluminium and its alloys dependent on melting temperature and proved that there is no obligatory correlation for this function (see Picture 1).
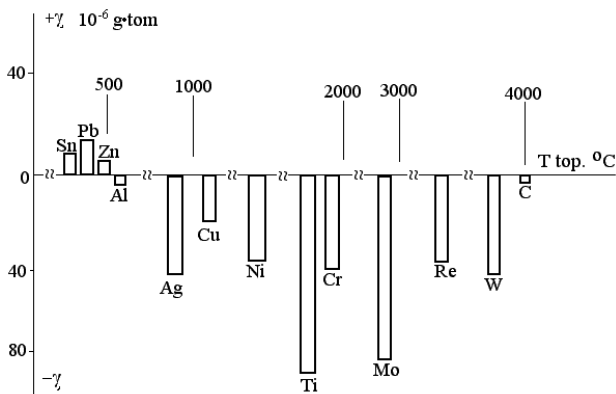
Picture 1. Histogram of mass variation of Al cathode depending on the melting temperature of the anode material. The discharging energy 0,3 J, specific time of processing 1min/cm^2 [2].

This is due to electrode processes and energy redistribution among electrodes and the interstice. In their paper [7] the authors demonstrate that, when the impulsive electronic fields activate the interstice, the character of the erosion is considerably influenced which is a proof that electro-dynamic processes in the interstice play an important role in erosion.

Picture 2. Experiment scheme in the study of electrode erosion in the magnetic field.
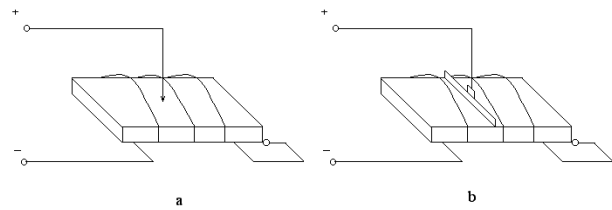
Picture 2. The experience scheme of the erosion research in magnetic field.

The superposition of the magnetic field on the interstice greatly influences the electric process and those in the discharge plasma [9].When alloys are made by contact breaking great changes have been noticed in the process of layer formation irrespective of the relatively small value of the interstice. This happers due to plasma canal dilatation. This interstices are large and distinct electrode spots types I and II are formed on the surface of electrodes, the magnetic field influences the dynamic of their development the speed of moving and interaction with the processed surface [4,7].

The latter present a special interest both for dimensional processing and for deposition layer formation. Evidently, varying the size of the interstice and the intensity of magnetic induction in the magnetic fields can change the technological processing.

In the paper [4] the made some investigations on the influence of the impulsive magnetic field upon electro-erosion processes for S = 0,5…2,5 mm, condenser battery tension being Uc = 160, 240, 320, 400, 480 V. The investigations were made both for solitary discharging and for a series of discharges. The speed of electrode movement was 60 mm/□min, the frequency of impulses being 10…15 Hz.

The impulsive magnetic field was created by a bobbin connected in series in the discharging contour [picture 2]. The bobbin contains 10…15 whirl. Thus, it has possible to state that as a result of the impulsive magnetic field the plasma canal is dilated, and its action is directed towards the force lines. The diameters of erosion and of thermal treatment spots increased by 25…40□. The quantity of erupted material on the electrodes surface increased too.

It is worth mentioning that impulse duration influences the intensity of the electro-erosion processes. The author of [3] mentions that when high tension impulses are applied on the interstice the so-called "cathode discharges" take place; when low tension impulses are applied "anode discharges", take place, each of them causing vivid

cathode and anode erosion. As to the influence of the impulse duration upon the character of electric erosion it is worth mentioning that short duration discharges are "anodic" while those of long duration are "cathode".

The investigation made by the author of paper [6] about the electro erosion intensity as a function of the coefficient of accumulating electrode material heat both for anodes and cathodes proved that this may be expressed by the relation:

$$\Delta \gamma = b^{-n}$$
$$b = \sqrt{c\rho\lambda} \qquad \qquad (2)$$

in which c is the specific thermal capacity, P is density, is thermal conductibility of electrode material and – function exponent determined experimentally.

CONCLUSIONS:

- the coefficient of warmth accumulation influences the erosion intensity of electrodes;

-to execute tool- electrodes at deposition layer formation from powders aiming at avoiding the participation of this material in the formation of the cover it is worth utilizing materials with a high coefficient of heat accumulation;

-the electric discharge duration in the impulse is decisive for the preferential erosion of anode or cathode;

-the use of short duration electric discharges is recommended both for dimensional processing and for formation of depository layers from compact materials.

-the supplementary application of electric or magnetic fields upon the interstice causes the amplification of electrode erosion and depository layer formation.

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