ELECTRIC FACTORS INFLUENCING THE COMPLEX EROSION PROCESSING BY INTRODUCING THE ELECTROLYTE THROUGH THE TRANSFER OBJECT

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Abstract: *The electric and electrochemical complex erosion processing is influenced by a great number of factors acting in tight interdependence and mutually influencing one another for achieving the stability of the processing process and achieving the final technological characteristics.The values taking part in developing the fundamental phenomena of the mechanism of complex erosion prevailing and contributes to the definition of technological characteristics, are factors.The paper presents the U potential difference and electric strength I as determining factors of the complex erosion process as well as other factors deriving from them: the current density, the power of the supply source.*

Keywords: potential difference, electric strength, current density, transfer object, processing object.

1. THE U POTENTIAL DIFFERENCE

It is the factor determining the stability of the processing process and the most often used in managing the automated adjustment systems.

The usual values of the U difference are between 10 – 30 V, and the control is made by modifying the nature of the electric circuit or through the supply source.

These values of the difference develop both anodic dissolution processes (AD) as well as impulse electric discharge (IED). When **overcoming the maximum difference**, between the OT transfer object and the OP processing object it becomes possible to the electric arc quasi stationary electric discharge which causes the instability of the process, with a final negative result upon the technological characteristics: productivity decrease; processing precision decrease; roughness increase; increase of the thermally influenced area; increase of the OT wear.

The U potential difference is influenced by: the nature of the electric circuit; the OP and OT material; the pressure in the SL working space; the supply source; and in turn, it influences the stability of the process and the following technological parameters: the productivity of the Q_{OP} processing; the processing precision; the roughness of the OT surface; the thermally influenced area, the OT wear.

For example, the influence of the U tension upon the Q_{OP} material prevailing productivity, in the case of OT arc cutting, by introducing the LL working fluid through the OT is presented in figure 1. We notice an increase of the productivity in direct proportion to the increase of the voltage.

2. THE INTENSITY OF THE CURRENT

Together with the voltage, the intensity of the current I is a determining factor of the EEC process.

The intensity of the current depends on the external characteristic of the supply source, which is relatively rigid and makes the voltage decrease not significantly when the intensity increases.

The increase of the I intensity is due to the increase of the pressure in the SL working space, followed by:

- The increase of the IED number so that a higher current be distributed in more simultaneous DEI. In this case, the power of discharge on every impulse remains constant and therefore the OP roughness does not suffer;
- The IED number remains constant, in which case the power of individual discharge increases, leading to some higher currents (in diameter and depth) and thus to the alteration of the processing results. It is the possibility that has proven to be correct based on the results of the experimental research.

For example, the influence of the I intensity upon the productivity of the Q_{OP} processing, in the case of OT disk cutting by introducing the LL through the OT, is presented in figure 2. We notice the increase of Q_{OP} in direct proportion with the I increase. The favourable result of the Q_{OP} increase is compensated by the alteration of other technological characteristics, as presented in figure 3, where we observe the increase of the deviation and of the profile height, in direct proportion with the I increase.

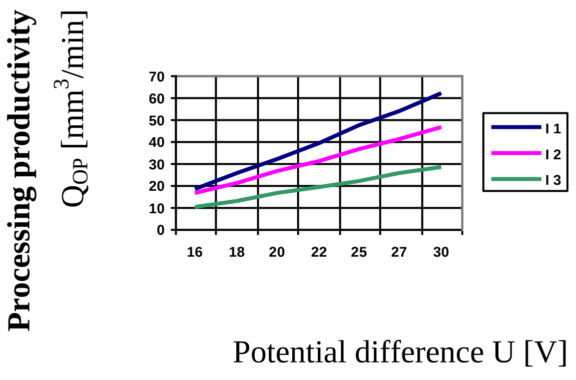

Fig. 1: *The influence of the U difference on the Q_{OP} processing productivity, for the values of the I current I_1 = 40 A; I_2 = 30 A; I_3 = 20 A*

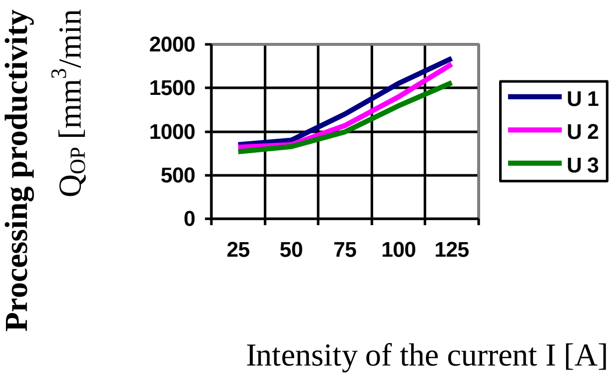

Fig. 2*: The influence of the intensity of the I current on the Q_{OP} processing productivity for the values of the voltage U_1 – 28V; U_2 – 24 V; U_3 = 20V.*

The intensity of the I current is influenced by: the type of the supply source, the type of washing with the LL work fluid; the type of processing; the structure of the electric circuit; the pressure between OP and OT; OP and OT and in its turn, influence technological parameters; the productivity of the process; the quality of the processed surface; the roughness of the OP surface.

3. THE j CURRENT DENSITY

It is an important factor in the EEC processing and represents the intensity of the current I [A] which goes through the contact surface S [cm^2] between OT and OP:

$$j = \frac{A}{S} \qquad [\text{A/cm}^2] \qquad \textbf{(1)}$$

In strong relation with I, the j current density controls the contribution of the elementary fundamental processes, from SL:

- When j is **low,** the electro-chemical phenomenon prevails. The weight of impulse discharges is low (and if U is low, they cannot form) and we result a good result of processing from the point of view of geometric and state parameters of the surfaces but the Q_{OP} is also low.
- When j is **high,** the electric erosion provides material sampling, through thermal effect, which increases Q_{OP}, but the quality characteristics decrease (geometrical and state parameters of the surface).
- When j is very **high,** the material sampling becomes uncontrolled, short-circuits appear (if U is low) or electric discharges in stationary arc (if U is high), which through the previously mentioned thermal effect leads to the degradation of OT and OP through weight and volume alteration.

For example, the influence of the current density (j) on Q_{OP}, in the case of EEC cutting, with the introduction of LL through OT is presented in figure 4.

The current density (j) depends on the following factors: the type of supply source and structure of the electric circuit; U voltage; I current intensity, and influences technological parameters through the weight of fundamental processes in the SL working space; processing productivity, the quality of the surfaces (geometrical and state characteristics of the surface).

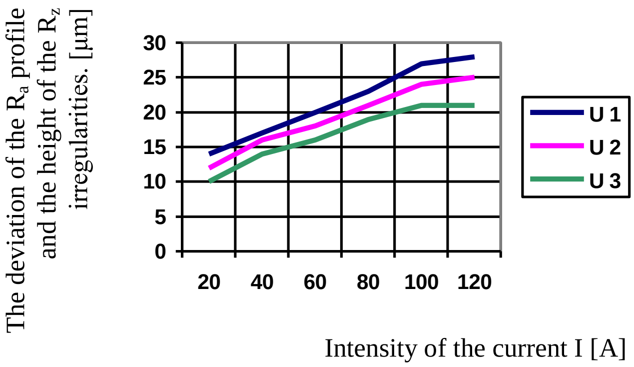

Fig. 3: *The influence of the I current intensity on the R_z irregularities height for the values of the voltage: U1 = 28 V; U2 = 24V; U3 = 20 V.*

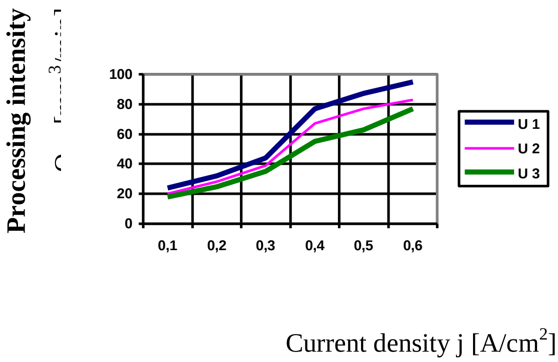

Fig. 4: *The influence of the j current density on the productivity of the Q_{OP} processing for the values of the voltage U1 = 28 V; U2 = 24 V; U3 = 20 V.*

4. THE POWER OF THE SUPPLY SURFACE, P [W]

Power (is an electric influence factor which defines its involvement through the two elements it is made of: U and I. therefore, at the I increase, we notice an increase of the Q_{OP} (the decrease of the processing time t_p) until a threshold is reached above which the process becomes unstable due to the too high current density (j), which leads to the appearance of the electric arc (figure 5).

Power P has a powerful influence upon the OT wear, in the sense that at a low power, the wear is high, because the abrasive effect is very obvious, and in the case of high powers, DEI turns into electric arc. A representation of the OT wear dependence is given in figure 6.

The power induced by SL is used both for electric discharges sampling as well as for anodic dissolution.

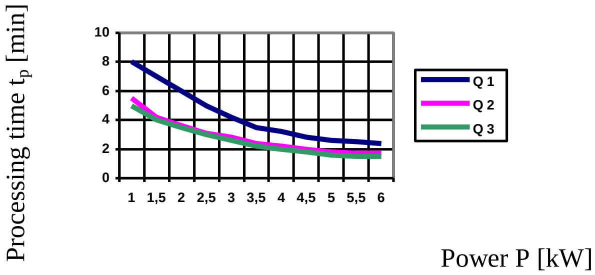

Fig. 5: *The influence of the induced power in SL on the cutting time t_p for the values of the Q_1 = 30 l/min; Q_2 = 25 l/min*

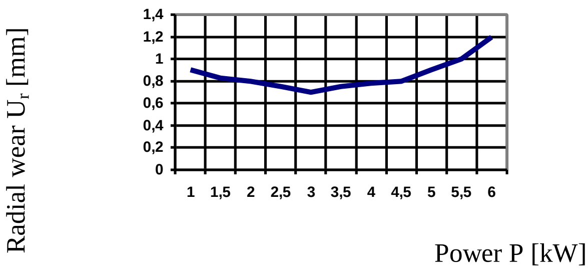

Fig. 6: *The influence of the power induced in SL upon the radial wear U_r*

5. CONCLUSIONS

The factors influencing the EEC processing, act in strong interdependence and mutually influence one another. They can be grouped in **determining influence factors** for other factors and **determined influence factors** by others. This complexity of factors and their mutual influences prove the complex character of the EEC process and it is an explanation for the complexity of the patterns necessary for the theoretical analysis of the processing. In conclusion, due to the special character of the processing process through EEC, the fundamental phenomena developed in SL depend on an entire range of parameters and factors acting at the same time and in a dynamic interdependence.

In accordance with the variation of these parameters and factors, the results of the processing are influenced at the same time, namely:

- The global erosive effect;
- The weight of the elementary processes;
- The stability of the processing process;
- The global technological characteristics.

In conclusion, the main processes taking place within the EEC processing develop inside the system limited by OP, OT and LL.

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