CONTRIBUTIONS REGARDING SHAPING SOME TECHNOLOGICAL PARAMETERS AT THE DIMENSIONAL PROCESSING THROUGH ELECTRIC EROSION

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ABSTRACT: Electric erosion is one of the most wide spread methods of processing the metal materials nowadays. It is further presented a real experiment for the modeling of the most important technological parameters for dimensinal processing through electric erosion with and without exterior activation. The scientific paper presents an experimental research focused in final on the obtained experimental data processing. We can talk about modeling and subsequent about the optimization of the process parameters considering the actual situation. Modeling and optimization process presented can lead to increased quality of the processed surface, to an increase in productivity and a decrese in volume wear of the transfer object used.
KEY WORDS: electric erosion, magnetic field, modeling and optimization process, experimental research.

1. INTRODUCTION IN THE PROCEDURE OF PROCESSING THROUGH ELECTRIC EROSION

Processing through electric erosion is a dimensional processing method of metal materials to which removing the material surplus is done based on the erosive effects of the electric discharges in impulse, repeatedly induced between the object to be processed (O.P.) and an electrode called object of transfer (O.T.). [7]

2. GENERAL THEORETICAL CONSIDERATIONS

In the context of the contemporary technical-scientific revolution, in which our country is deeply involved, special attention is given to quality rising, diversifying and perfecting materials production.

The special tasks put before our industry in the current stage can be solved integrally and at a high quality level only through a scientific approach and an optimal management of the technological processes. By applying science as productive force, people's work is heading more and more toward the reasoning and decision making activity, the work of action being taken gradually by machines and automatic equipments. [3]

For the reasoning and decision making activity in the management of a process, science puts at the disposal the necessary means under the form of models – physical and mathematical – capable of reacting to any change of the work conditions.

Because the research on physical models presents certain important disadvantages, such as long duration of the research with a high consumption of intellectual work as well as the impossibility of enclosing economic factors, the current tendency in the technological processes management is the wider and wider use of the mathematical models. [5]

They reproduce the researched process with the help of some functional relations and allow the finding of the optimal action conditions in a much shorter period of time and with much lower material expenses than in the case of using physical models. [7]

The experiment has always served as a means of knowing the surrounding reality, being a verification criterion of hypothesis and theories. [6]

For a long time it was believed that *choosing* ***the experiment strategy*** and doing it are determined by the experience and intuition of the experimenter, mathematics being used only when processing results. [9]

The experiment is programmed according to a determined, previously established plan, optimal from the point of view of the factors modification algorithm, it's making ensuring a complex.

For this last version one usually turns to factor experiments in which all independent variables with significant influence on the researched system are simultaneously varied, on determined levels.

3. EXPERIMENTING STRATEGIES IN THE FIELD OF ENGINEERING

The primal objective of any experiment is the mathematical shaping of the influence factors' action on the objective function of the system (object, phenomena, process) considered in its principle form:

$$y = f(x_1 , x_2 , ... , x_k) \quad (1)$$

In the empirical shaping, it is usually priory accepted a certain shape of the mathematical model which is considered to best approximate the real model, following that the development of the research to supply the necessary data for determining the coefficients (continuances) of the adopted model's shape. [9]

The objectives aimed by shaping are: the study and analysis of the researched system with the help of the model for obtaining more complete data and new laws related to it.

Emphasizing the action mechanisms of the factors on the researched system; verifying the hypothesis related to the internal interactions of the system; prediction of the system's state and behavior; system's calculation and designing; system optimization in relation with different criteria; system management in space and time. [8]

4. APPLICATION REGARDING SHAPING SOME TECHNOLOGICAL PARAMETERS AT THE DIMENSIONAL PROCESSING THROUGH ELECTRIC EROSION

There has been designed and realized a factorial experiment based on independent variables and objective functions from table 1. So, there were taken into account the following variables:

- t_p - pause time [μs];
- t_i - impulse time [μs];
- I - intensity of the magnetic field [A];
- H - intensity of the magnetic field (which activated the process) [A.spiră].

Objective functions that have been analyzed were:

- Q_p [mm^3/min] - processing productivity;
- Q_e [mm^3/min] - volumetric wear;
- γ [%] - relative wear;
- Ra [μm] - average arithmetic departure of the rigor profile.

Table 1. "Factor programs" – Central composed factor experiment

Variables independent of the process and the functions objective-physical values								
No.	t_p [μs]	t_i [μs]	I [A]	H [A·spiră]	Q_p [mm^3/min]	Q_e [mm^3/min]	γ [%]	Ra [μm]
1.	12	24.0	4	3200	3.2281	0.3342	10.35	4.0
2.	48	24.0	4	3200	4.1666	0.6166	14.80	5.2
3.	12	95.0	4	3200	7.7223	0.3193	4.13	5.2
…								
25.	30	59.5	6	9600	30.4586	0.8735	2.87	3.8
26.	30	59.5	6	9600	31.8905	0.9143	2.87	3.7

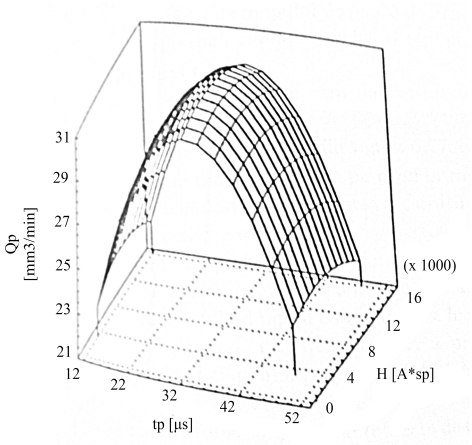

Figure 1.

Plane and spatial graphics have been drawn for all mentioned objective functions. Next we will present some graphics, which are more representative.

The evolution of the processing productivity is different namely; it is according to the nature of the type of cleaning used, to the type of the transfer object's material and according to the experimental program used (according to the work regime used).

One can see that (Fig. 1) the processing productivity has a maxim for an intensity of the magnetic field H=8500 AS when the break time is t_ps.m = 24.

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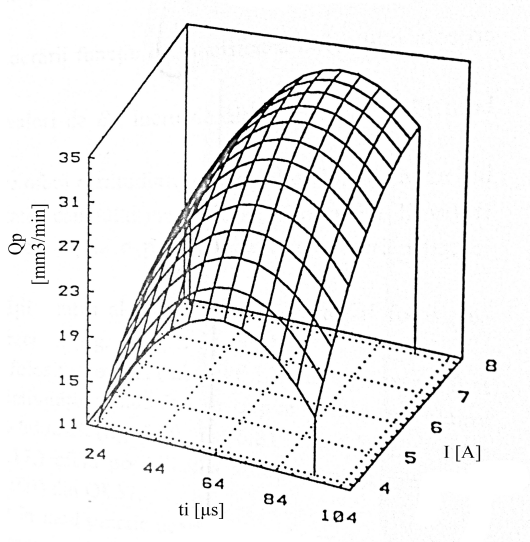

Figure 2.

The variation of the productivity is of course according to the intensity of the electric current and the values taken by the impulse time (Fig. 2).

The evolution of the processing productivity in the case of using the first experiments package (Table 1) has been presented in figures 1…6.

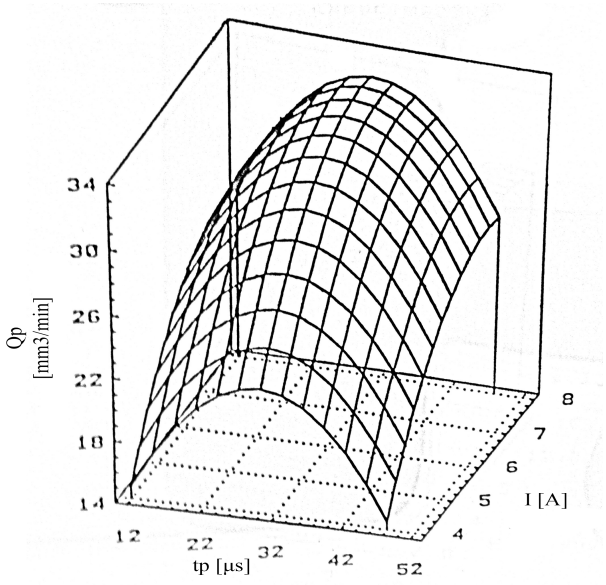

Figure 3.

The variation of the volume usage is different than that of the processing productivity respectively, one can see that the response curve of this object function is allocated differently from a spatial point of view.

A minimal usage of the transfer object is obtained for value of the magnetic field's intensity H[AS] of approximately 4000 AS for certain situations of a technological nature and of approximately 14000 AS for other situations of technological nature with the very important highlighting that the values can differ according to the analyzed variables.

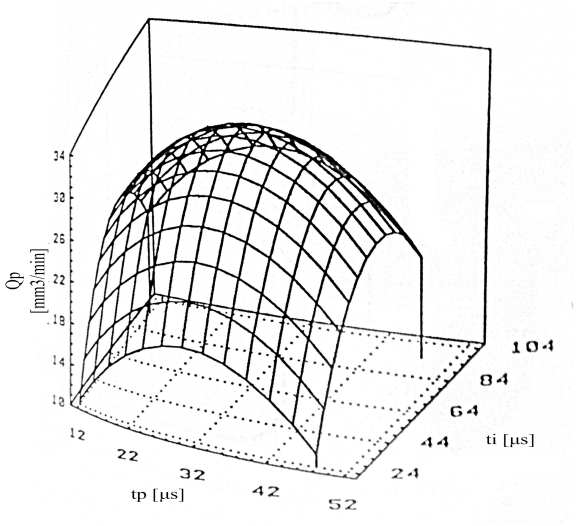

Figure 4.

The relative wear expresses as it is known a percentage report and it represents a very important object function for characterizing the process.

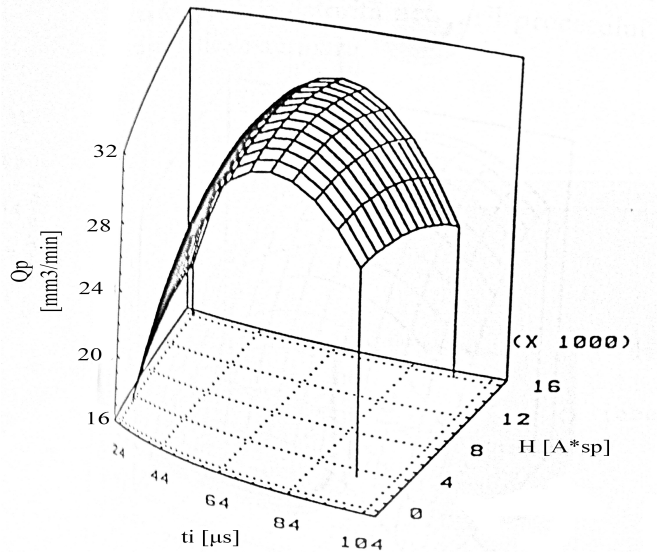

Figure 5.

A relatively minimum wear is obtained for values of the magnetic field's intensity H[AS] of approximately 4000 AS for certain situations of a technological nature, of approximately 8000 AS for other situations of a technological nature and of approximately 12000 AS for particular cases, highlighting that the values can differ according to the analyzed variables.

The average arithmetic departure of the rigor profile varies in a parabolic manner, a minimum usually existing around the value of the magnetic field's intensity H [AS] of 14000 AS, a relatively high value but which can vary downwards according to the adopted work regime.

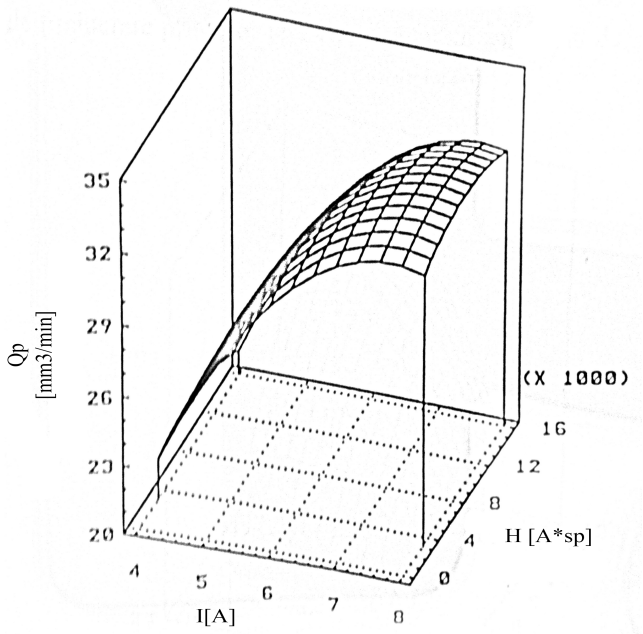

Figure 6.

5. FINAL CONCLUSIONS

Taking into consideration what was disclosed so far regarding the evolution of the processing productivity certain points of view can be asserted which are confirmed by the very favorable results obtained.

If one takes into consideration the connection of the object to be processed one can say that removing the material from its surface takes place through ionic bombardment.

With smaller impulse times the ion quantity in the ionized plasma channel is relatively low.

Lowering productivity to values of the magnetic field's intensity H [AS] which surpass certain values is caused by a cramping of the eroded particles in the work space.

From the analysis of the spatial graphics one can say that choosing the impulse times with s offers the best conditions of ms and namely of 420 ms, 95 m the values of 24 processing when a dimensional processing through electric erosion with magnetic activation is intended.

One can issue the hypothesis that the electric load from the active interstitial space are influenced by the magnetic field and are accelerated reaching the opposite surface faster thus hastening the material sampling.

If one refers to a particular situation of the processing with transfer objects from OL37 motivating productivity increasing can also be placed on the streamer.

Due to the assemblies of the magnetic fields it appears that the formation of positive streamers and the formation of several unloading decks take place, so an ease of starting the electric discharge in impulse at the dimensional processing through electric erosion with magnetic activation.

In the case of using the impulses with high intensity the current density surpasses the acceptable limits when the transfer object is from OL37.

Also, when it was processed with a transfer object made out of OL37 the instability of the process was considerably big thus being able to say that it was practically almost not possible to process.

By applying the assembly of magnetic fields it was not only the possibility to remove the material from the surface of the object to be process that was created but also substantial productivity increases.

For the study of the influence of the exterior magnetic field on the dimensional processing through electric erosion with magnetic activation establishing the volume modifications of the wear was also considered to be important.

The necessity of these studies has been determined by the fact that modifications of the volume wear have defining influences on the precision of the processing, as well as creating an opportunity on the verification of the magnetic field's influence on the electronic and ionic components of the discharge current.

The processing which took place on ELER 01 have pointed out the fact that at the dimensional processing through electric erosion with magnetic activation the volume wear decreases in comparison to the classic processing.

This decrease is caused by the angle, which appears between the field lines of electric nature and the magnetic fields line in the erosive interstitial space.

Taking into account the different directions of the two types of field lines, the change of trajectory which the electrically charged particles suffer at small durations of the impulse time will be smaller and on the surface of the object of transfer a larger number of particles will reach, a situation possible to explain due to the negative streamers which take form.

At bigger durations of the impulse time changing the trajectory of the electrically charged particles is

bigger the possibility existing that a certain number of electrons will leave the interstitial space.

The relative wear of the object of transfer characterizes in general the material removal phenomena at the surface of the elements in interaction at the dimensional processing through electric erosion with magnetic activation, through the fact that it expresses in percentages the quantity of material sampled at the surface of the object of transfer for sampling the volume unit at the surface of the object to be processed.

Since by applying certain exterior magnetic fields the quantity of sampled material at the object to be process, respectively at the object of transfer is changed implicitly, modifications of the relative wear will also occure.

Using the object of transfer made out of OL37 (in particular cases) has pointed out an obvious dependency of the relative wear according to the value of the magnetic field used.

Based on the studies and researches done one can conclude that the main technical-economic deficiencies of the most used unconventional dimensional processing procedure, namely the dimensional processing through electric erosion procedure, have been improved.

The present scientific paper opens new perspectives of the dimensional processing through electric erosion procedure.

The theoretical and experimental studies existing in the paper done by the author put at the disposal of trading companies, research institutions, as well as universities a research with an original content, sustainable and of actuality, which allows the implementation of a technology of activating the dimensional processing through electric erosion procedure, implementation which finally leads to the lowering of the processing costs.

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