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EXPERIMENTAL RESEARCH ON INCREASING THE QUALITY OF THE SURFACES PROCESSED BY ELECTRIC EROSION

Assoc.Prof.Dr.Eng. Mihail Titu
Lucian Blaga University of Sibiu
Sibiu
Romania

Prof.Dr.Eng. Constantin Oprean
Lucian Blaga University of Sibiu
Sibiu
Romania

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ABSTRACT
Initially promoted due to certain necessities of the military and space equipment industry, nonconventional processing facilities and technologies, because of their effectiveness, rapidly spread in the developed industries of the western countries and as well in our country. The dimensional processing procedure by electric erosion might be characterised as the most widely spread concentrated energies processing procedure. The present paper deals with experimental research conducted in the "Lucian Blaga" University of Sibiu, Romania, on increasing the quality of the surfaces processed by classic and with magnetic actuation electric erosion with shape copying. The paper contains experimental programmes that lead to the conclusion that the actuation of the process by a magnetic field or by joint exterior magnetic fields leads to a significant improvement of the quality of the surfaces processed by the aforementioned processing procedure. Moreover, one can conclude that the electric erosion processing leads to higher productivity, a lower wear level of the transfer object, and as well to a higher processing precision.

1. INTRODUCTION

Initially promoted due to certain necessities of the military and space equipment industry, nonconventional processing facilities and technologies, because of their effectiveness, rapidly spread in the developed industries of the western countries and as well in our country.
The electric erosion dimensional processing procedure can be characterised as the most widely spread concentrated energies processing procedure.
Various types of actuation of the aforementioned process have been tested so far, such as the magnetic actuation by exterior overlapped fields.

2. RESEARCHES AND EXPERIMENTAL DATA

Starting from the need of acquiring more information on the process of material sampling in the electric erosion dimensional processing with or without exterior magnetic actuation, compared with the active experimental programmes designed so far, certain experimental researches have been conducted during which the processing of certain couples of material with various features has been modelled. [2]

Thus, the statistic experimental analysis of the classic experiments package refers to the processing of the K30 sintered hard alloys, using transfer objects made of materials such as electrolytic copper, OL37 steel, graphite.
The objective has been to perform the experimental statistic modelling and optimisation of certain objective functions of the following types: the processing productivity, the wear of the transfer object, the relative wear, and especially, the quality of the processed surface.
The following independent variables have been taken into account: the magnetic field strength, the electric field strength, the impulse time and the downtime.
The last two types of independent variables have been considered as constant during the process of material sampling and equal to certain technologically significant values. [2] The following table presents the experimental data (Table 1 and 2):

TABLE 1. EXPERIMENTAL DATA

„STATISTIC DATA SYSTEM 2000”							
	Input data (independent variables) - physical values -			Objective functions - physical values -			
	H [A·spire]	logH [A·spire]	I [A]	Q_p [mm^3/min]	Q_e [mm^3/min]	γ [%]	Ra [μm]
1.	0	1.00000	5.0	1.1093	0.8654	78.0131	5.0
2.	800	2.90309	10.0	3.5666	0.7323	20.5321	3.8
3.	3200	3.50515	12.5	9.2524	0.9402	10.1616	2.6
4.	16000	4.20412	17.5	6.8740	1.2810	18.6354	4.0
5.	32000	4.50515	17.0	5.3675	1.8230	33.9637	4.2

The statistic experimental analysis, modelling and optimisation of the abovementioned objective functions and especially of the mean square deviation of the Ra roughness profile, have been performed by means of the “STATISTIC DATA SYSTEM 2000” software package. [2]

TABLE 2. STANDARD COEFFICIENTS

„STATISTIC DATA SYSTEM 2000”				
Input data	Standard Coefficients (standard error)			
Independent variables	Q_p [mm^3/min]	Q_e [mm^3/min]	γ [%]	Ra [μm]
Constant	-53.345649	2.569552	239.230407	18.698145
logH	-50.920148	-0.26375	16.368397	11.23564
I	23.841872	-0.372058	-42.601894	-5.699587
$LogH^2$	4.890852	0.218944	4.089187	-1.078823
I^2	-0.749005	0.008038	1.253383	0.185719
	R-SQ = 1.0000 SE = 0.000006 = 0.0000034 MAE = 0.0000078 = 0.0000002 DurbWat = 1.706 = 0.000	R-SQ = 1.0000 SE = 0.00000070 = 0.0000002 MAE = 0.0000066 = 0.0000005 DurbWat = 2.646 = 1.706	R-SQ = 1.0000 SE = 0.0000049 = 0.0000051 MAE = 0.000003 = 0.0000006 DurbWat = 2.984 = 2.646	Hazard-SQ = 1.0000 SE = 0.000005 = 0.0000046 MAE = 0.000008 = 0.0000022 DurbWat = 2.777 = 2.984

The experimental results, presented in the tables above, have been quantified by means of the plane variation curves of the statistically optimised abovementioned objective functions. The first experimental package has antithetically presented the electrolytic couple used for the manufacturing of the transfer object and a set of samples made of K30 sintered hard alloy. The second classic experimental programme has been completed by using graphite transfer objects and samples made of K30 carbide.

In both cases, the dimensional processing without magnetic actuation is difficult, in fact almost impossible to perform. [2]
Suggestive graphical representations of the first experimental programme of the Ra objective function are presented in figure 1. [2]
The processing of hard sintered K30 diagrams is preferable as sampling procedure when the transfer object is made of graphite.
In this situation, the designed experimental programme led to the conclusion that the processing productivity maximum was obtained for a value of the magnetic field strength H[AS] of 2250 AS, the relative wear minimum was obtained for a magnetic field strength H[AS] of 1900 AS, while a very good quality of the processed surface was obtained for a magnetic field strength H [AS] of approximately 2800 AS. [2]

3. CONCLUSIONS

Taking into account all the conclusions drawn after running all the classic experimental programmes, led and completed by means of the Package of Programmes titled „STATISTIC DATA SYSTEM 2000", [2, 3], the results were validated by means of certain active experimental programmes and it was concluded that the actuation of the dimensional processing procedure by electric erosion leads to a substantial increase in productivity, helps to reduce the wear of the transfer object, all these added to an improvement of the processing precision and of the processed surface quality.

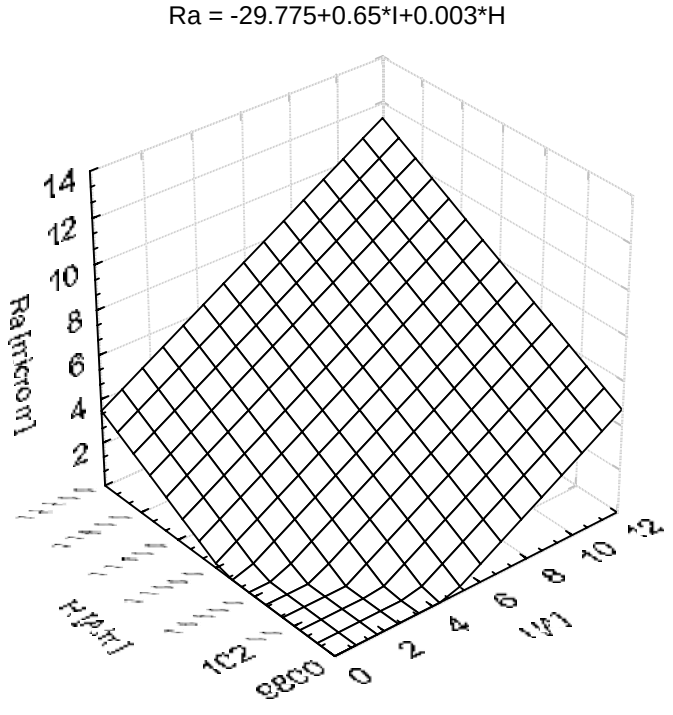

FIGURE 1. THE EVOLUTION OF THE R_a PARAMETER

The regressive modelling and optimisation o the aforementioned objective function Ra leads to experimental results, which attest once more that, especially in the processing of sintered hard alloys, the overlapping of magnetic fields with the aforementioned processing procedure leads to a widening of the range of applicability of the analysed procedure with considerable good and very good results.

4. REFERENCES

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