Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium, Volume 21, No. 1, ISSN 1726-9679
ISBN 978-3-901509-73-5, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2010
Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird
Annals of DAAAM International

ASPECTS REGARDING THE ECONOMIC MANAGEMENT OF THE NONCONVENTIONAL PROCESSING TECHNOLOGIES

KARNYANSZKY, T[iberiu] M[arius] & MEDINSCHI, S[ilvia]

Abstract: *Since their discovery in the XX century, the nonconventional processing technologies offer alternatives to the classics techniques. They are currently applied on a large category of materials, difficult to process by regular techniques. The use of computer management increases the accuracy of results, reduces the processing time and improves the final product quality. Thus, an economic calculus can be used to prove under which concrete conditions is preferable to apply new methods, comparing to the common ones. We present software designed to assist the human operator at the debiting by complex electric-electrochemical erosion (EEC); it uses an experimental database, proposes an optimization method and allows calculating the price and the time of the debiting through EEC operation.*
Key words: *non-technological processing, economic calculus*

1. INTRODUCTION. PROBLEM STATEMENT

The continuous developments of science and technology as well as the extraordinary progress of the scientific research have always led to new methods and procedures for solving the practical-applicative problems determined by the permanent human need of improving live. Some of these methods are classic, traditional, used for a long time, and some are represented by different techniques, called nonconventional technologies. Such o technology is defined as non-classic (nontraditional), currently not used and having a new character comparing to the already used procedures. Most of the times, the beginnings of the application of these new methods are related to the top industry, such as the military, aeronautic or spatial industry. The EEC is among these methods, having major advantages, such as ([Karnyanszky & Nanu, 2001]):

- the simple building of the tool, using simple and low-cost production technologies and materials;
- the possibility of processing materials with special physical and mechanical properties (hardness, mechanical resistance, melting temperature, refractivity etc.);
- a high usage coefficient of the processing material;
- the possibility of using tools at more successive without operations on its surface;
- simple, automated technological systems which allow optimal processing in most of the dimensional processing operations;
- the processing productivity is 2-5 times higher than that of the classical methods, with 1-3 higher equipment costs, but at half energy consumption and a better quality of the outcome product.

2. THE TECHNOLOGICAL PROBLEM

Regarding the technological processing, the system is considered as being made up of the subsystems: processing object (PO), transfer object (TO) and working media (WM) ([Herman, 2004]). Some of the influence factors are grouped in electric measures (tension U, current I, current density j, the structure of the circuit), mechanical measures (pressure p, relative speed v_r), measures depending on TO (shape, sizes, material), measures depending on WM (washing type and mode), measures depending on the technical system (command and control system, mechanic systems, the system for electrolyte, the electric supply system), measures depending on the processing type, measures depending on the human operator, measures depending on the environment.

A computer based data system offers a documented support for making the decisions regarding the study of the technologic processes, the analysis and interpretation of the experimental data and their checking and modeling. In order to elaborate the program, similar concepts were used in the literature regarding the running of electric erosion process ([Herman et al., 2003]), and of the electro-chemic erosion one ([Herman & Herman, 1999], [Herman, 2004]).

3. THE ECONOMIC PROBLEM

The processing through EEC expenses expressed by the following indicators ([Herman et all, 2003]):

- TO cost: represents expenses with TO used during the processing:

$$C_{TO} = K_{TO} \cdot Q_{TO} \cdot C_{TOM} \text{ [lei/min]} \quad (1)$$

in which:
K_{TO} represents a coefficient in the cost of other expenses
C_{TOM} represents the specific cost of the TO material [lei/mm^3]

- WL cost: represents the expenses with the working liquid (WL) used during the processing:

$$C_{WL} = K_{WL} \cdot Q_{WL} \cdot C_{WLM} \text{ [lei/min]} \quad (2)$$

in which:
K_{WL} represents a coefficient depending on the time between the two changes of WL
Q_{WL} represents the WL volume consumed during the processing [l/min]
C_{WLM} represents the specific cost of the WL material [lei/l]

- the energy cost: represents the expenses on the electric power used during the processing:

$$C_{EE} = K_{EE} \cdot (N_{TO}+N_{WL}+N_p) \cdot C_{EEM} \text{ [lei/min]} \quad (3)$$

in which:
K_{EE} represents a coefficient depending on the processing conditions
N_{TO} represents the consumed energy with the TO movement [kW]
N_{WL} represents the energy consumed with the WL circulation [kW]
N_p represents the energy consumed with the process [kW]
C_{EEM} represents the specific energy cost [lei/kW]

4. THE IMPLEMENTATION PROBLEM

A very easy method to determine the costs of processing through EEC is represented by the use of the computer and of dedicated programs (Temur et al., 1999). Considering the fact that nowadays, for managing a great amount of data, it is preferred the usage of databases, we have created a relational database, which contains:

- PO - data concerning the processed object;
- COMPOSITE – data concerning the composition of the PO;
- TO - data concerning the used tool;

- MACHINE - data concerning the technological equipment;
- WL - data concerning the work liquid;
- OUTCOME - data concerning the results of the performed experiments;
- CLASSIC - data concerning the PO processing through classic methods ([***, 1996]).

Starting form this mode of organizing data, we created a universal and interactive data system that prepares processing through EEC experiments (yet, the chosen method is not restrictive, the system can be applied to every technological process, with the corresponding modification of the data content). It selects the experimental data, models and simulates the developing processes, optimizes and permits the leading of a processing process.

The program is structured on the following menus:

- Initialization, allows the erasing of all information in the data base, respectively form the tables (files) WL, Machine, PO, TO, Outcome, Composite, Classic.
- Modification, allows the adding, the conversion or the erasing of the data in the tables WL, Machine, PO, TO, Composite, Classic.
- Planning, allows the creating of the program matrix for a factorial experiment;
- Processing, allows the introduction, modification or erasing of the data regarding experiments, their statistic analysis, the modeling and simulation.
- Optimizing, allows the determining the optimal conditions for the developing of a processing operation;
- Listing, allows the obtaining of lists with information from the data base.

The Input data option of the menu allows the experimental data input into the database. A special designed screen is used in order to put the experimental data in the database.

The Economic calculus of the EEC processing costs is done through a specific option, which needs the selection of the desired experiment, while the result is obtained as in Figure 1, by comparing the results of the EEC processing to the standard one, as presented in [Nanu, 2003].

For the comparative determining of the processing results of the processing through EEC and through conventional methods, the program permits to find in the data base the processing time through EEC (from the table RESULT) and through classic methods (from the table CLASIC) and their comparative presentation, resorting to the option Comparative calculus.

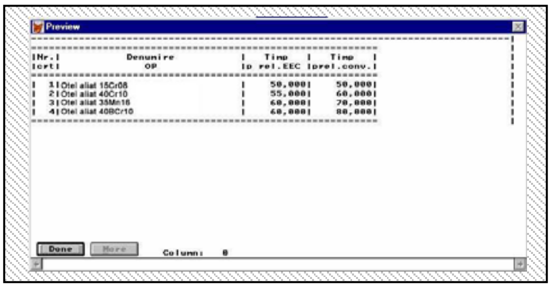

Fig. 1. The Economic calculus option

5. THE RESULTS

The main goal of our study is to determine the optimal debiting conditions of the materials which accept the processing through EEC. Regarding this, the data system permits the selection of the work conditions, and then it presents a selection from the data bases containing data on similar experiments and the results of the optimizing process. It must be mentioned that, if in the database there are no data on the similar experiments, the program emits a warning message and the optimization is finished without success.

Providing the elaboration and utilization of the materials with superior mechanic and thermal characteristics is more and more frequent, the increase of the applicability of the nonconventional technologies, in general, and of the processing through EEC, particularly. It has become a strong necessity, because:

- the processing machines through EEC used today are limited both numerically and as operation types;
- the production diversification, the increase of the quantity of materials with special features or of the special type products have changed the managing of the production, which permit the progress of the theoretical research and practical applications of the nonconventional technologies;
- the updating of the existing machines and the adapting of the automatic systems can be usually an efficient solution;
- the usage of computer applications to improve the performances of the machines usually represents a much cheaper solution, than the acquiring of machines with automatic integrated systems;
- the presented system permits the comparative calculus of the results of the processing through classic methods;
- the above principles give the extension possibility of the mathematic models and of those for determining other parameters, in the circumstances of the existence of data in the database or other similar technologic processes.

6. CONCLUSIONS AND FURTHER RESEARCH

Due to these facts this study has a contribution to the improvement of the technical and economic management of the processing through EEC (but this is not exclusive), to the obtaining of better results and, therefore, to the adjustment of this nonconventional technology to the present growing competing conditions:

- the created data system contains data bases of the experimental results which can be easily brought up-to-date with new data;
- the data system allows the economic calculus of the debiting process through EEC;
- the system gathers around 1.300 pieces of data concerning the processing of 50 materials which accept the processing through EEC (alloyed steal, stainless, carbide, cast iron etc.)

7. REFERENCES

Herman, R.I.E. (coord.) (2004). *Tratat de tehnologii neconvenţionale, Vol. V – Prelucrarea prin eroziune complexă electrică-electrochimică*, Ed. ArtPress, ISBN: 973-7836-02-2, Timişoara

Nanu, A. (2003). Tratat de tehnologii neconvenţionale. Vol. I. Tehnologiile neconvenţionale la început de mileniu, Ed. Augusta, ISBN: 973-695-071-9, Timişoara

Herman, R.; Herman, M. (1999). Consideraţii privind un sistem generalizat de acţiune tehnologică în procesul de prelucrarea prin eroziune electrică complexă, *Revista de tehnologii neconvenţionale*, Vol. 2/1999, 41-46, ISSN: 1454-3087

Herman, R.; Herman, M.; Botiş, M. (2003). Performances Index for Processing by Electrical Complex Erosion (ECE), *Revista de tehnologii neconvenţionale*, Vol. 2/2003, 66-68, ISSN: 1454-3087

Karnyanszky, T.M.; Nanu, A. (2001). Study about the Complex Electric Erosion Processing Modeling, *Revista de tehnologii neconvenţionale*, Vol. 2/2001, 7-10, ISSN: 1454-3087

Temur, R.; Ivan, M.; Sîrbu, F. (1999). Utilizarea microcalculatorului pentru controlul procesului de prelucrare prin eroziune electrochimică*, Tehnologii neconvenţionale*, Vol. 2/1999, 40-44, ISSN: 1454-3087

*** (1996). *Normative unificate pe M.I.C.M. pentru prelucrări de debitare a metalelor pe maşini-unelte specifice*, Oficiul de Informare Documentară pentru Industria Construcţiilor de Maşini, Bucureşti, 1996