ELECTRICAL EROSION WITH MASSIVE ELECTRODE - A NONCONVENTIONAL PROCESSING PROCESS OF GREAT FUTURE

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ABSTRACT: As electric erosion is characterized by the lack of mechanical pressure on the object which ensures the macroscopic localization of the erosive agent, this can reduce its size gradually theoretically without any restrictions. From a practical point of view, the inferior dimensional limits, which direct the electric erosion processing especially toward micro-processing, can be identified. Micro-processing, as component part of micro- and nanotechnologies, has progressed over the last few years beyond all recognition. Being developed as a necessity of finding a technological solution for the obvious trend of cost-effective product miniaturization, the micro-processing field comprises all conventional and nonconventional processing procedures that can be applied to the processing of microsystem components. The more and more rapid development of micro and nanotechniques will cause the processing method through electrical erosion to face new requirements, new challenges that can be relatively easily met with the help of this processing method.
KEYWORDS: electrical erosion, singular discharges, precision, nanotechnologies, manufacturing processes, quality

1. PREAMBLE

Each technological method need to complete a technological process that represents an independent component which must, however, meet the precise requirements impose to the process equal system. The systemic approach tends to become a general method of thinking, pertaining to all sciences, yet having a particularly efficient impact on technological sciences. The essential character of the systemic approach consists in its preference for the whole over the component parts, on the one hand, and in the special attention it pays to the study of the constantly changing possible connections between the components of the system, on the other hand. Although the concept of system may currently refer to a single technological entity, the technological process tends to be regarded as a whole. In this way, each technological method is subordinated to the technological process and meets certain generalized requirements, without disrupting the functioning of the other methods. This approach regards the technology of dimensional processing through electrical erosion as a progressive one, which will result in identifying the possibilities of ensuring its systemic character. The concept of technological system originates in the more general concept of system, being defined as a structured group of interconnected means of production, whose functions are subordinated to the main purpose and whose components must be adjusted to the required general conditions. [6], [12]

2. PRO AND CONS

The integration of the electrical erosion processing into technological lines or flexible manufacturing systems has come true. However, this has brought about the development of new concepts regarding the methods of applying it, the ability to adjust automatically to certain evolving tasks being indispensable. [2]

This trend that has already been initiated by electrical erosion processing refers to bringing together all the improvements made in the many fields of human knowledge that contribute to processing. [7]

The main limitation of the method refers to the low productivity of the processing, and this has made it impossible to compare it with most of the conventional processing methods. [1]

It is obvious that this adjustment involves the presence of the processing computer, all the more necessary to electrical erosion processing as this method "excels" in the broad random values of the adjusting parameters. These facts have brought about the improvement of self-adaptive operations of the technological systems of electrical erosion processing and the preference for the larger use of systems able to do away with the operator's intervention almost completely, even when the operations to be performed are extremely diverse, from technological design, design of the manufacturing preparation (electrode-tools, electrode-tool storehouses, devices for fastening the processed object, etc.) to interphasic control and final operations. [10]

When the electrical erosion processing started to be applied in industry, it had a great number of advantages that brought about its continuous development; however, certain limitations resulted in its “technological isolation”. [5]

Since the development of these microsystems is a certainty of the future, the methods applied to obtaining micro-dimensional mechanical systems (such as micro-sensors, hydraulic microsystems, micro-switches, optical micro-marks, capillary microsystems, etc.) must keep up with the evolution of electronic microsystems or suitable software. This problem should be approached from at least three points of view: making marks that are typical of mechanical systems; manufacturing tools that can process certain micro-marks (micro-forming, microinjection and so on); making marks that are typical of electronic microsystems (made of silicon, germanium, etc.).

Once the technological system of processing has been improved by focusing on the increase in the quantity of removed material, the gap between the productivity of the electrical erosion processing and the productivity of other conventional methods is constantly decreasing.

It goes without saying that these subsystems, appropriate for technological systems of processing through electrical erosion, will be improved as well, once particular components have been improved. Hence, new alternatives for automatic advance servomechanisms and new conceptions regarding the actual conditions of the erosive interstice will be put into practice. The mechanical block of technological systems of processing through electrical erosion will undergo changes and improvements, too. The foreseeable directions are those determined by the need to increase the rigidity of mechanical blocks with a view to increasing processing accuracy, and by the reduction of their own weight and the use of novel materials able to facilitate the meeting of requirements and cut-price costs. More attention will be paid to tubs, in the sense of ease of access to the area meant for fastening the processed objects. Naturally, once the degree of automation of the technological systems of processing through electrical erosion has increased, more attention will have to be paid to automating the technological stage of fastening the processed object. This implies the possibility to automatically clear the working desk (automatic opening of the tub, automatic withdrawal of the tub, etc.), on the one hand, and the use of auxiliary fastening systems adjusted to automation conditions. [8], [9]

3. FUTURE SOUNDS GOOD

The application of micro-processing through electrical erosion, still in its experimental days, offers new perspectives to the development of this fascinating and promising field of mechatronic systems. If we consider only the technological system of processing through electrical erosion, we can single out several distinct lines to be followed so that this method can have the status it deserves due to the favorable possibilities it offers. Here is an outline of these lines:

- The systems that automatically adjust the erosive interstice (automatic advance) will rely more and more on “intelligent” automation systems, able to adjust themselves in real time to intentional or imposed modifications, necessary for the correct operating of the technological system. High pretensions regarding processing accuracy, together with those related to processing dimensions (micro or macro-processing), require that these systems should be provided with increased accuracy, capable of meeting these divergent prerequisites. However, self-adjustment to actual conditions will not be able to solve completely the problem of the freedom of the processing from the operator’s actions, unless control systems of the whole technological process are continually improved. In the case of electrical erosion, this requirement is essential, as this processing method is marked by a large number of random parameters, but not also by usually complex shapes to be processed. While developing continuous adaptive control systems, we should also develop systems of interfacing the former with centralized control systems; [1]

- Improving generators of impulses by putting the accent on some characteristics directed at certain applications. This method of improvement is suitable for technological systems that have a precise destination, for series or mass production, and results from the need to reduce the cost price of the system. Furthermore, the level of automation must increase considerably, human intervention being merely qualitative, adaptive, focused on solving only exceptions or the random deviations from the programme. At the same time, there arises the need to maximize the technological possibilities of the systems of electrical erosion processing, with a view to meeting the numerous technological requirements of the processing. This need brings about the pretension of amplifying the offers for system input, with a direct impact on technological characteristics. Among others, we could highlight the requirement to increase the frequency of impulse electric discharges with a view to improving the quality of the processed surfaces, or to put an accent on multichannel processing that offers improved processing conditions resulting in productivity increase, better processing accuracy, etc. In this respect too, automation pretensions are more and more significant. The operator will have to be relieved not only of the physical activity that relies on physiological factors but also of the psychological activity that can cause breakdowns, which is inconceivable when it comes to high-cost and time-consuming processing such as electrical erosion. [1]

The number of dimensional limitations of this processing method will be lower and lower, by providing components of the technological system capable of meeting these challenges. One of the major limitations of electrical erosion processing refers to the difficulty of manufacturing electrode-tools. On the one hand, this limitation will determine the identification and development of possibilities to include the systems of manufacturing electrode-tools into technological lines or into flexible, automatic lines that involve electrical erosion processing. This requires the presence of technological systems of processing electrode-tools which will assist one or more technological systems of processing through electrical erosion able to produce automatically – in real time – the designed needed electrodes. On the other hand, the already discernible tendency to simplify the constructive and dimensional shape of electrode-tools by applying controlled additional movements corresponding to the processed object will evolve.

When technological systems of processing through electrical erosion are interpolated, the fastening of the processed objects on the desks of the electrical erosion processing machines will have to be the one used within the global processing system, which requires increased flexibility of these systems.

Recent research has revealed the possibility to process certain small cavities by means of cylindrical electrode-tools, made of wolfram, whose movement can be controlled so that they can scan the whole surface that generates the cavity to be processed. At present, these attempts have yielded promising results, even if they are applied only to micro-processing. The field that has stimulated the development of the above-mentioned micro-processing is that of mechatronic microsystems, a field which is constantly evolving. The demand for operations that are cost-effective, safe, and that observe quality prescriptions and manage to surpass certain limitations has brought about the replacement of certain methods (the electron jet, chemical erosion, micro-engraving and so on) with the method of electrical erosion processing adapted to micro-processing.

Dielectrical liquids and their recirculation systems will be also subjected to continuous improvement, as a result of technological necessities or necessities related to maximizing or minimizing certain technological characteristics. [10] It has already been proved that synthetic dielectric liquids are better from the point of view of the technological results obtained than natural ones. This will make it possible to identify controlled processing of the liquids so that one or more technological characteristics could be highlighted. Some properties may even be changed automatically so that for the same technological system and within the same process, the dielectric liquid can favor the increase in productivity at one technological stage and act upon the increase of the processing accuracy at another stage. The systems of recirculating the dielectrical liquid will undergo a process of improvement envisaged by the same technological improvement requirements that can be identified in the case of the whole technological system of processing through electrical erosion. To maximize certain characteristics by means of the system of recirculation of the dielectrical liquid, the work area - the erosive interstice will be supplied with a liquid that has a certain degree of impurity and that has the optimum temperature. [1], [14]

4. INSTEAD OF CONCLUSIONS

This brought about a better technology relation of the electrical erosion processing compared to the other processing methods. Another relation much insisted upon is that determined by the processing accuracy, placing the method of dimensional processing through electrical erosion among the methods that can be applied to finishing and superfinishing processing. This technological characteristic can very well be achieved by means of electrical erosion processing, both from the point of view of the quality of the surface resulted from the processing and from the point of view of all the parameters of dimension, shape and position accuracy. By correlating these qualities with the advantage given by electrical erosion that makes it possible for it to meet all accuracy requirements, electrical erosion becomes an efficient method.

Electrical erosion is the technological method of electrical erosion that will require the development of a lot of fields due to its possibilities to solve major material problems. It will be the one to bring about the development of micro-processing and nanotechnology and the one to stimulate the development of macro-technologies.

The technological possibilities, the flexibility and adaptability of the method are qualities that make it possible for this processing method to be greatly valued.

The future of electrical erosion processing is influenced not only by the vast possibilities of this processing method but also by the attention it still receives both from those directly interested in its industrial application and from researchers in the field, either well-known ones or those who have just begun to study it. [9]

We may assume that the development of electrical erosion processing will be determined by the evolution of systems controlled by computers, the improvements brought about to power and control electronics, the design and manufacture of new materials endowed with fine thermophysical features that can be used to make electrode tools capable of improving the processing accuracy (as well as other technological characteristics), the application of new automatic advance systems able to perform operations in improved real time and to ensure high steadiness of the system, the improvements to be brought about to mechanical blocks or dielectrical liquids and their recirculation systems, and so on. [4]

Another factor that will bring about improvements of the systems of dimensional processing through electrical erosion is the availability of new materials, endowed with special properties, which require alternative processing methods. We should point out that there have already been successful attempts of electroerosive processing of non-electroconductive materials. [11]

The answer to the question referring to the future of the method of processing through electrical erosion can easily be formulated.

The constant development both of techniques directly responsible for the results of the method and of related techniques make it possible for electrical erosion to be the leader in the use of processing methods by means of nonconventional technologies and one of the leaders at the level of all technological methods used in the global industry.

The more and more rapid development of micro and nanotechniques will cause the processing method through electrical erosion to face new requirements, new challenges that can be relatively easily met with the help of this processing method. [3]

Electrical erosion will be the method that will around which other processing methods will revolve. [13]

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