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To cite this article: I I Khafizov *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **570** 012050

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Application of the method of electroerosion treatment to improve the quality of the treated surface

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Abstract. Intensive use of electrical discharge machining is currently determined by the very dynamic development of domestic engineering. The use of electrical discharge machining helps us to achieve the desired results, namely high machining accuracy, low surface roughness and low dependence of performance on the mechanical properties of the processed materials. Thus, the study of processes and tools of electrical discharge machining to improve the quality of machined parts is one of the urgent tasks.

A high degree of sophistication and performance of the manufactured machine tools and the significant results of machining materials in a modern production has allowed to solve a variety of complex tasks.

But the rapid progress of aviation, nuclear and electronic technology, tool production and instrumentation has necessitated the use of materials, machining of which can be made only with great difficulty or practically impossible. These include materials with very high hardness (diamond, magnetic alloy, hardened steel), brittleness (ceramics, quartz, glass, ferrites), viscosity (stainless and heat-resistant steel), as well as materials with magnetic properties. Particular difficulties arise in the shaping of such materials when they need to get grooves, narrow slits, cavities and blind holes of complex shape.

The modern stage of development of materials science is characterized by the emergence of new materials with unique properties. Which, in turn, require new processing technologies to ensure high quality of the treated surfaces. An illustrative example of the state of materials science can be called the aircraft industry, where new materials appear in the first place, and then find application in other industries, including engineering and medicine.

Accordingly, the need for effective machining of complex shapes of materials difficult to cut predetermined the emergence of a number of new methods. These include electrophysical and electrochemical processing methods. The important and necessary methods include electrical discharge machining [1].

The process of electroerosion treatment is the destruction of a metal or other conductive material as a result of local exposure to short-term electrical discharges between two electrodes, one of which is an electrode tool, and the other – the workpiece. Under the influence of high temperatures in the discharge zone there is heating, melting and partial evaporation of the metal.

Modern wire EDM machining is widely used in various industries: Aeronautics, machine tools etc. But even more the spread she received in high-tech fields of engineering, namely the engine.



Continuous improvement of one of the main indicators of the quality level of engines - specific thrust - is provided, including the use of low-strength, curvilinear-shaped parts and structural elements. With the help cutting process such the surface very difficult, and in some cases and impossible.

On the details of high-tech products there are surfaces located in hard-to-reach places, which can be processed only with the use of EDM operations. In the designs of aerospace engineering parts, titanium and aluminum alloys are most often used in all their diversity. Because of their lightness and strength, they have become indispensable materials of particularly important parts, which are subject to the most stringent requirements, both for the quality of the material and the quality of their processing. By means of electroerosion processing it is possible to carry out easily processing of these alloys with the greatest productivity.

Consider the similarities and differences of electroerosion and electrochemical processing on copying and stitching machines. The similarity is in the kinematic-geometrical scheme of geometry generation:

- 1) use an electrode tool with a similar design of the working part;
- 2) the electrode tool is fed in relation to the workpiece;
- 3) processing is carried out at small gaps between the tool and the workpiece;
- 4) there is no significant force impact on the workpiece;
- 5) removal of metal from the workpiece occurs most intensively in places with a smaller interelectrode gap.

Table 1 shows a comparison of the characteristics of electrical discharge machining electrochemical machining.

Table 1-Differences between electroerosion treatment and electrochemical treatment

No	Indicator of difference	Electroerosion treatment	Electrochemical treatment
1	The main difference between the methods is the physical mechanism of metal removal	This is the process of dimensional destruction of the material under the action of an unsteady electric discharge in a liquid dielectric	It is based on high-speed dimensional anodic dissolution of metal under the action of high-density electrolysis current.
2	Different performance of the equipment	More slowly	Anodic dissolution is faster by an order of magnitude
3	Ensuring accuracy	Accuracy is easier to ensure	It is more difficult to ensure accuracy. Careful protection of untreated areas is required.
4	The presence of a defective layer on the treated surface..	There is, but quite insignificant	During electrochemical treatment there is no defective layer.
5	Dissolution of the workpiece at different temperatures	The temperature does not affect the electroerosion treatment	The temperature affects the electrochemical treatment.
6	The presence or absence of wear of the electrode-tool	The wear of the electrode tool in the area of 3-10%	No electrode-tool wear. The electrode-tool is made of cheaper and easily processed material

In our opinion, the main advantages of electrical discharge machining, compared with other types of treatments, include:

- high quality of the received surfaces which do not demand further finishing treatments;
- you can treat the surface with high hardness;
- do not deform thin-walled parts due to lack of mechanical load;
- no noise.

And of course it is worth considering improving the performance and efficiency of electrical discharge machining. For example, the introduction of the electroerosion method in the production allowed "Severnaya Torgovaya Kompaniya" LLC to increase the productivity of processing deep

holes of small diameter by 3.5 times, cutting Windows by 2 times and processing composite parts, such as forming molds, by 8.3 times, reducing the cost price by 22, 48 and 82%, respectively [2].

The following factors affect the performance of electrical discharge machining:

- modes of electrical discharge machining (process parameters);
- physical and mechanical properties of tool and product materials;
- physical and chemical properties of dielectric fluid.

Thus, to increase productivity, it is necessary to choose the optimal combination of the above factors, allowing to increase the share of useful pulse energy, its power and pulse repetition rate [3].

For example, the performance of electrical discharge machining can be improved by using multi-circuit processing schemes, when one product is processed by several electrode tools isolated from each other (in sections). Each section is connected to the pulse generator autonomously. In this scheme, electrical discharge machining can be carried out several electrical discharges simultaneously. The use of multi-circuit processing scheme helps to increase productivity, but not in proportion to the number of circuits, as these circuits operate from a single supply regulator and in case of violation of the electrical discharge process in one of the circuits, the process stops in all circuits [4].

Electroerosion treatment does not exclude machining, but complements it, taking its specific place, corresponding to its features, namely: the possibility of processing conductive materials with any physical and mechanical properties and display the shape of the tool in the product.

From all this, it can be concluded that electrical discharge machining is important and has the right to be widely used in production as the basis of technologies for forming complex profiles.

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