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FEATURES OF ELECTROCHEMICAL MACHINING OF MAGNETIC - HARD MATERIALS

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ABSTRACT

This article describes the features of processing by an effective method of electrochemical grinding of parts made of hard-to-process metals and alloys. Ways to improve production, reduce costs, and improve product production efficiency are briefly described.

KEYWORDS: ***Electrochemical grinding, abrasive, electro erosive treatment, magnetic hard materials, diamond.***

INTRODUCTION

At the present stage of technology, one of the most important ways to solve the problem of processing parts made of hard-to-process metals and alloys is grinding with conductive diamond and abrasive wheels. This provides a significant increase in labor productivity, reducing costs and improving production efficiency while achieving high performance properties of the treated surfaces.

Electrochemical grinding with diamond or abrasive wheels on conductive metal bundles is a combined process in which the material is removed as a result of simultaneous processes: anodic dissolution, mechanical cutting with diamond or abrasive grains, and electro erosive phenomena “Figure -1”. In addition, as a result of the influence of electrolytes, an adsorption decrease in the strength of the processed material occurs due to a decrease in the interfacial surface energy. Due to the absence of continuous contact between the discrete contact surfaces of the part and the tool, as well as the protrusion of diamond or abrasive grains from the bundle, a gap filled with electrolyte is formed between them. In the gap, under the influence of an electric current, the surface of the part is anodic ally dissolved. Thus, the surface layer during electrochemical grinding is formed as a result of the electrochemical process and the mechanical work of the circle produced by the diamond or abrasive grains, which remove the products of anodic dissolution and cut off the material being processed, and also act as depassivators, destroying and removing the film of metal oxides formed on the surface of the part.

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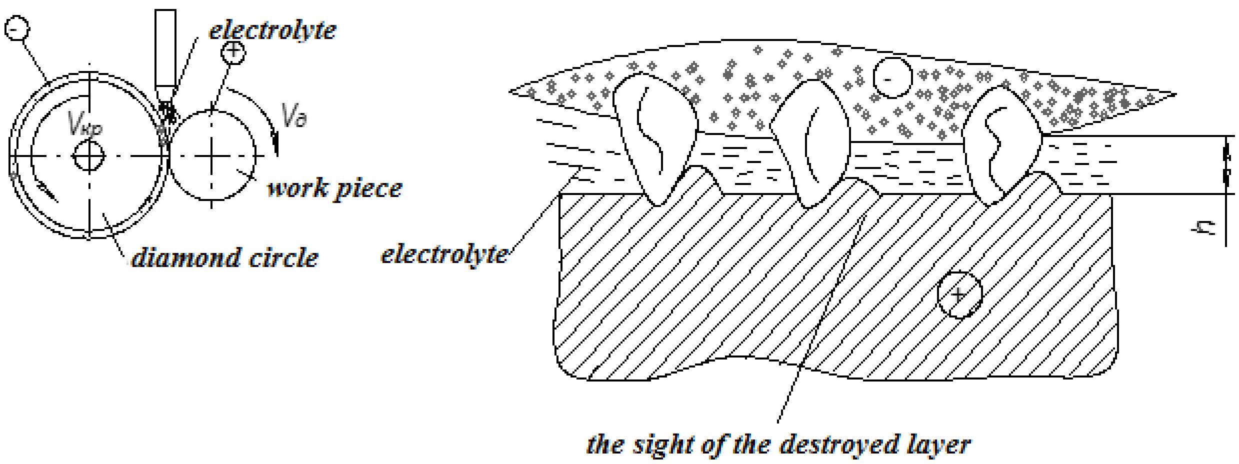

Figure-1. Scheme of electrochemical grinding.

MATERIALS AND METHODS

If the electrochemical removal significantly prevails over the mechanical one, the process is close to the electrochemical dimensional processing in a flowing electrolyte based on the results of exposure to the treated surface. In this case, the process can be considered cold, and the treated surface is free from machining defects. In the case of a predominance of mechanical removal, the quality of the treated surface is close to the results of diamond grinding. There are several methods of abrasive-diamond grinding with simultaneous influence of electrochemical processes on the work piece and tool. When changing the polarity of the electrodes (circle-anode, part — cathode), i.e. the so-called processing on the reverse polarity, the metal ligament of the circle dissolves. The process is characterized by intensive self-sharpening, reducing the cutting force and temperature, resulting in increased processing performance. The wear of the circles in this case increases significantly. Only diamond circles are used for grinding parts made of hard alloys, and diamond and less often abrasive circles on metal bundles are used for high-temperature alloys, stainless and structural steels. The same rectifiers used for electrochemical grinding are used as current sources. The voltage of the current source 3-5 V.

The use of abrasive wheels on a metal bundle is possible when grinding with continuous electrochemical correction of the circle. In this case, an additional cathode is installed, which destroys the ligament. The advantage of this method of grinding is that there is no friction between the binder and the surface to be processed. For the same purpose, a reversible power supply is sometimes used, giving a reverse half-wave. It is known to use an electro-neutral abrasive tool, in which the electrochemical and mechanical processes are separated in space. Electrochemical removal from the surface of the part is carried out in this case by an additional circle. All types of processing methods using anodic processes can be used very effectively in industry.

Electrochemical grinding is a very effective method of processing parts made of magnetic-hard materials. Grains of diamonds or abrasives, cutting into a surface with reduced physical and mechanical properties as a result of electrochemical dissolution, generally perform a non-deforming function, but mechanically remove the products of the electrochemical reaction. Naturally, the tool life in this case is significantly higher and the processing quality is better.

The study of the cutting properties of circles made of various abrasive materials showed that during electrochemical grinding, circles made of green silicon carbide have a higher efficiency than circles made of white electro corundum and provide a roughness of Ra = 0.164-0.08 microns.

Electrochemical grinding of parts made of magnetic-hard materials is characterized by very small values of the longitudinal feed rate-no more than 0.5 m / min - and significant-up to 2 mm-grinding depths. Under these conditions, the process parameters are significantly affected by the voltage of the current source. Thus, increasing the voltage from 5 to 30 leads to a significant decrease in the power parameters of the process due to an increase in the electrochemical component of the removal. The optimal operating voltage of the current source when grinding with abrasive wheels on metal bundles SESH-2 and M5-5 should be considered 10-16 V. Increasing the voltage beyond the optimal leads to the appearance of electric contact and electro erosion processes in the processing zone and, consequently, increasing the roughness of the treated surface. At low voltage, electrochemical grinding becomes an abrasive grinding process with circles that have low cutting properties.

Insufficient performance of the process, rapid loss of cutting properties, which leads to frequent edits of high-strength abrasive wheels on metal bundles, a large marriage caused by the operation of significantly blunted grains of silicon carbide, etc., led to attempts by domestic and foreign researchers to use circles made of synthetic super hard materials, in particular, synthetic diamonds, for electrochemical grinding. Electrochemical grinding with diamond wheels provides 1.5-2 times greater performance compared to abrasive wheels. At the same time, in contrast to grinding with abrasive wheels on a metal bundle, the insignificant influence of the properties of the processed material and heat treatment on the process parameters and performance was established.

DISCUSSION AND RESULTS

Diamond circles are more resistant, retain high cutting properties for much longer, and provide a higher quality of processing compared to silicon carbide circles. The best results are provided by circles with a grain size of 100/80-125/100 with diamonds of the DIA brand.

Intensification of grinding performance is achieved by increasing the speed of the longitudinal feed. The voltage of the current source, which determines the role of electrochemical dissolution in these conditions, significantly affects the grinding performance. However, the area of optimal values of working stresses when grinding with diamond circles in comparison with abrasive ones on a metal bundle is much lower and is only 6-12 V.

The study of the quality of the surface layer after electrochemical grinding with diamond circles showed that the surface layer is characterized by reduced micro hardness and the absence of macro-stresses. Electron microscopic studies showed no structural changes. It is also established that electrochemical grinding has virtually no effect on the magnetic properties of parts (residual induction and coercive force).

Of particular interest are attempts to intensify the process of electrochemical grinding of parts made of hard-to-process materials, including magnetic-hard alloys, by applying oscillating movements, vibrations, ultrasonic vibrations, and so on to the grinding wheel.it Should be noted that there is currently no unity of views on these issues. In some works, the influence of these processes on the process indicators has not been established. In others, on the contrary, it is found that, for example, ultrasonic vibrations with an amplitude of 15-25 microns intensify both the anode process and the cutting process, resulting in significantly increased productivity. Obviously, conducting research in the same methodological conditions will allow us to clearly resolve some controversial issues.

CONCLUSION

The results of research work give reason to believe that electrochemical grinding of magnetic-hard alloys, especially diamond circles, is a highly effective technological process that provides a significant increase in productivity and the quality of the surface layer and the performance characteristics of the parts allow the use of electrochemical grinding as a rough and final processing method.

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