UDC 622.75:629.7

USE OF PROCESSES OF ELECTRO-SPARK PROCESSING TO ENSURE THE DURABILITY OF HYDRAULIC EQUIPMENT UNITS OF AGRICULTURAL EQUIPMENT

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The modern concept of effective use of machines and equipment consists in the development of technologies and means of increasing their durability due to the creation of coatings that ensure the specified functional properties of the working surfaces of components and aggregates. In this regard, the research, development and improvement of technologies for obtaining surface layers with a given structure and, accordingly, the necessary properties, is an urgent task. At the same time, it is necessary to take into account that the energetic ability of the interaction of the saturating element, the physicochemical nature of the saturating medium, and the mechanism of phase transformations are of decisive importance in the formation of the layer structure. The technological support of wear resistance of metal surfaces on the basis of electrophysical methods of strengthening and restoration using high-energy concentrated energy flows opens wide prospects. In repair production, methods based on the use of energy flows with a specific power in the heating spot of more than 102 W/mm^2 are widely used to restore and strengthen parts [1].

The most promising currently are methods of surface strengthening and modification based on processing materials with concentrated energy flows. Modern and promising methods of surface treatment of metal surfaces include electrospark treatment, which allows obtaining surface structures with unique physical and mechanical properties at the nano-level [1, 2].

The physical essence of the process consists in the phenomenon of electrical erosion and the polar transfer of the material of the anode (working electrode) to the cathode (electrode-part) during the flow of impulse discharges in a gaseous medium. The main advantages of the method include the ability to form a coating with specified service properties on the working surfaces of parts, high adhesion of the coating to the base, the possibility of local surface treatment, the absence of the need for preliminary surface preparation, and the environmental friendliness of the process. Despite the high efficiency and increased interest in the process of electrospark processing, the properties of the changed surface layer, which determine the tribological properties of coatings, are currently not sufficiently studied [3]. Electroerosion treatment is characterized by the following: 1) ease of obtaining a spark discharge form; 2) the ease of controlling the intensity of the processing process.

The essence of the EDM method is that the space breakdown is initiated. At the same time, the surface material is removed under the influence of this pulse. This leads to the ejection of electrode material into the interelectrode space and its removal by pumping the working medium. The working fluid should provide thermal stability, reduced corrosion resistance, flash point with a higher limit, filterability, non-toxicity, environmental safety, and no odor. At the first stage, the channel is very narrow, the current increases in it due to the decrease in channel resistance and, as a result, the temperature rises. Then the expansion of the channel and the formation of a shock wave are observed. At the next stage, the shock wave separates from the channel and continues to move at a high speed, while the channel expands, but at a lower speed. In the third stage, the hot core of the channel disappears due to the lack of current and deionization of the spark gap. When the spark channel affects the surface as a result of the transfer of material from one electrode to another, physical and chemical changes in the processed material occur in the surface layer, which leads to changes in the properties of the material. On the basis of this effect, a technological operation called electrospark alloying of the metal surface became widespread. Currently, electrospark alloying is used for: increasing hardness, corrosion resistance, as well as wear and heat resistance; decrease in the ability to grip the surface during friction; restoration of tool sizes, parts of machines and mechanisms; changes in electrical properties of contacting elements and emission properties surface capabilities; creation of transitional layers of a certain roughness on the working surface.

To ensure low friction and low wear, it is necessary that the strength of the emerging molecular bonds of the friction surfaces is less than the strength of the lower layers. In a friction pair, such a requirement can be implemented by application soft metal coatings and lubricants. The second group of electrode materials includes soft substances, namely: aluminum, copper, silver, gold, lead, tin, etc. When these materials are applied to the treated surface, a soft anti-friction and anti-corrosion layer is formed, which reduces the coefficient of friction of sliding pairs, which increases the reliability of the connections. Coatings made of such materials have high electrical conductivity, and alloying with aluminum increases the hardness and heat resistance of the product's surfaces. The third group of electrode materials includes other metals, namely: tungsten, titanium, molybdenum, chromium, iron, cobalt, nickel, etc., alloys based on them, including ferroalloys. Restoring the geometric shape of parts by giving them repair dimensions is used. At the same time, the fit of the connections is restored, the interchangeability is preserved partially, within the standard size, and in the case of free repair sizes, it is broken. In the process of operation, there are various factors that have a significant impact on the technical condition of the main components and components. So, before other materials, rubber parts, plastic components change their operational properties due to aging. The effect of corrosion on all unprotected metal surfaces brings significant damage. Its influence is so noticeable that when developing protection methods, corrosion fatigue, corrosion cracking, and corrosion-mechanical wear are specially singled out. The most frequent reason for the need to replace one or another part is mechanical wear. As they wear, the connected parts begin to interact with deviations from the initial settings, which leads to intensive wear of the contacting surfaces. Cracking occurs as a result of fatigue wear. Cracking of the babbitt layer on the bearings of the connecting rods and the crankshaft, the metal on the running tracks of the separators, on the profiles of the gear teeth is destroyed. The reason for such breakdowns lies in improper assembly or violation of operating rules. Along with the installation of new spare parts, there are growing trends in the organization of restoring the functionality of worn parts by various methods. The main task that most repair companies face is the maximum possible reduction in the cost of repairing auto-tractor equipment. The percentage of obsolete and unsuitable for further operation of parts can be reduced several times, using effective methods of restoring and defecting aggregates and spare parts. At the first stage, a thorough cleaning of the part is necessary. At the next stage, parts are inspected by an external inspection, and then using a universal measuring tool. Cracks, dents, dents, areas significantly affected by corrosion, surfaces and landings with significant wear are revealed.

The results of the evaluation of the tribocoupled parameters showed that the load to the front in the studied pair is higher than the calculated maximum voltage at the contact area of the tribocoupled hydraulic units. Using the provisions of the molecular-mechanical theory of friction, it was determined that the working surfaces of the resource-determining coupling of the circular gear pump work in the mode of external friction, and in the contact zones there is a plastic saturated contact.

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UDC 622.75:629.7

APPLICATION OF ANTI-FRICTION COMPOSITE MATERIALS FOR INCREASING THE DURABILITY AND TRIBOTECHNICAL PROPERTIES OF HYDRAULIC EQUIPMENT UNITS

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In conditions of limited financial and material resources, the problem of technical rearmament of agricultural production cannot be solved only by increasing the supply of new equipment. A significant role in this process is assigned to the reasonable use of the available fleet of machines, maintenance of its technical level with the help of qualified maintenance. The power hydraulic cylinder occupies a special place here. The experience of operating hydraulic machines has shown that the share of hydraulic cylinders accounts for 17...30% of failures of the entire hydraulic system. Some agricultural enterprises are forced to carry out repairs on their own. At the same time, due to the lack of experience, technology and equipment, the resource of repaired units often does not exceed 30–60% of new resources. Therefore, the development and implementation of a new repair technology, based on the use of polymer parts made of antifriction composites based on supramolecular polyethylene, abbreviated SVMPE, in the tribo connections of power hydraulic cylinders, will allow to reduce the cost and repair time, which is of significant importance [1, 2].

Hydraulic cylinders and other samples of modern agricultural machinery cannot do without friction units, which require low friction force and high abrasion resistance. In addition to seals and guide elements of hydraulic cylinders, such nodes include all kinds of sliding and rolling bearings, liners, bushings, hinged joints, gears, mechanism guides and many others. Antifriction alloys based on lead or tin, such as bronze, babbitt, etc., were previously used for the manufacture of such nodes. But these materials are expensive and do not always meet all the necessary operational and technological requirements. Therefore, there is a need for a wider selection of antifriction materials [1, 3]. For this purpose, polymers are attractive for several reasons: - easy (technological) processing, - low specific gravity, - high corrosion resistance [1, 2]. Currently, polymeric antifriction materials are made mainly on the basis of polyamides and carbochain polymers, fluoroplastics. Polyamides are thermoplastic polymers, have fairly high mechanical and technological properties and are used as bushings that guide and seal rings. Fluoroplastic is of great interest in the creation of anti-friction parts. It is chemically inert, unable to collect moisture, has high plasticity, low modulus of elasticity, and a very low coefficient of friction, as well as heat-resistant and thermoplastic [3].

Attrition is a complex multi-level process. The main initiator of wear is deformation of the material of the contacting surfaces under the action of contact stresses and temperatures. Thermoplastics (polyamides, polyolefins, fluoroplastics, polyacetals, polyimides, polyphenyl sulfides, polysulfones, polyether ketones) are used unfilled and in the form of a matrix of antifriction