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TECHNOLOGY RESTORATION DETAILS AGRICULTURAL MACHINERY METHOD ELECTROSPARK PROCESSING

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The main method for increasing the durability of machines is to apply on worn surfaces one or several layers of coating with high physical and mechanical properties, which will ensure the continued long operation of products. One of the priority tasks of the development of the system of technical service of machines is the development of technologies for the repair of worn parts, since their cost is usually one and a half - two times lower than the cost of new with the same resource. When choosing a technological recovery method, the value of the maximum wear, in which the part becomes unusable for operation, is of great importance. The application of effective technology for the restoration of worn parts of auto tractor machinery by application of electrospray coatings is substantiated. The described technology differs technological flexibility, cheapness, simplicity, does not require the use of expensive and scarce materials and equipment, and also meets the requirements of environmental safety. The proposed technology can be used to restore a wide range of parts of cars, tractors and other machines. The technology of the restoration of seats under bearings in details from aluminum alloys with the help of electroscope doping can be used in the system of technical service of machines. In conditions of friction, both with and without lubricant, on the surface of coatings obtained on an aluminum alloy D1 by means of electroscope doping with AlSn alloy electrodes, wear resistance is several times higher than the wear resistance of hardened steel.

Key words: electrospark, operation, labour input, repair, restoration, resource, covering, landing place.

Introduction. One of the methods for solving the problem of improving the performance characteristics of parts is the introduction of new materials that have low density, but at the same time meet both technological and mechanical requirements. These materials include aluminum alloys. In mechanical engineering in recent years, the use of aluminum alloys is increasing, but the rigidity of the conditions of the use of modern technology and the aggressiveness of the applied environment do not allow to provide the necessary wear resistance of the surfaces. Up to 90% of machines are inoperative due to the extreme wear of the working surfaces [1,2].

Problem. The main method of increasing the longevity of machines is applied to the worn surface of one or more layers of coatings with high physical and mechanical properties that ensure a long future performance. Recently, electrospray doping has become increasingly widespread in restoring the dimensions of worn parts. Electrospray doping allows you to get a coating with given properties. However, the restoration of aluminum parts by means of

electroscope doping is currently not sufficiently studied. This leads to difficulties in the development of standard technologies to restore worn parts from aluminum alloys [2,3,4,8]. In terms of aging automobile and tractor equipment and reduce supply equipment and spare parts through their repeated price increase, it is necessary to make better use of the existing fleet of machines and production equipment, to maintain its commitment to work through the timely and quality maintenance. It should pay more attention and means of improving the technological processes of repairing worn parts. It is known that a large part of the equipment falls into repair not through breakdowns, but because of the wear of the working surfaces. Therefore, increasing the wear resistance and durability of parts is an important and topical task.

Analysis of recent research and publications. The literature does not adequately cover the following issues: - the influence of the operating modes of the installation of electroscope doping, the material of electrodes of different chemical compositions on the transfer of material from the electrode to the component; - the possibility of obtaining on the aluminum surfaces of nanostructured coatings and their impact on wear; - influence of the structure of the electrode on wear-resistant coatings on aluminum surfaces; - possibility of work of wear-resistant coatings in pairs with hardened steel; - the possibility of obtaining wear-resistant coatings without increasing the layer [2,3,4]. The conducted literary review showed that the application of protective coatings, both on the cutting tool and on the parts of machines, by the method of electroscope doping, is one of the most effective and economically viable methods, both for increasing the productivity of cutting, and for extending the service life of machine parts..

The purpose of research. Study of the characteristics of the coating obtained by the method of electroscope doping to improve the wear resistance and durability of parts.

Research results. Electrospray doping of metal surfaces is a phenomenon of electric erosion and polar transfer of anode material to a cathode under pulsed discharges in a gas environment. The surface layer is formed at the expense of the molten metal that remains on the surface of the well, and the adjacent layer of metal subjected to structural changes from rapid heating and cooling of the metal. However, the properties of this layer are not defined by the end. For simplicity, studying the layer researchers split it into zones. The authors [1-4] divide it into the following zones, presented in Fig. 1. The resulting zones usually do not have a clear difference and in most cases they overlap each other. But despite this, the listed zones have their own characteristics that affect the properties of the surface and in many cases, cause the possibility of a successful operation of the part or cutting tool. A more detailed description of each of the zones is considered in the work [1-4]. The dynamics of the process of electrosurgical doping represented by compact electrodes can have a number of options related to the characteristics of the material of the electrodes, the parameters of the pulses, the kinematics of the motion of the electrodes, and others. About the process of electroscope doping with compact electrodes we can say that this process involves several cycles: - the formation of an electrical contact between the anode (electrode) and the cathode

(the part), after the convergence of the electrodes and breakdown between the electrode gap; - electric erosion of electrodes; - Polar transfer and formation of a surface layer on the surface of the cathode (a part or instrument); - the rupture of the electrical contact between the anode and the cathode, at the moment of the divergence of the electrodes.

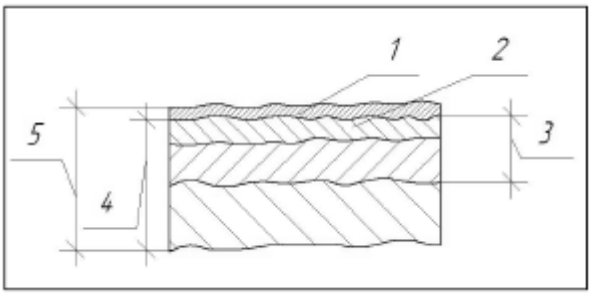

Fig.1 Surface layer, obtained after EIL: 1 - zone of deposit material electrode (anode); 2 - "white" layer, formed from the molten material of the workpiece; 3 - zone of thermal influence; 4 - zone of plastic deformation; 5 - modified surface layer**.**

In the process of EIL in the areas of the surface to be treated with successive local influences of impulse discharges, the changed surface layer, its formation, is the final stage of the process of electroscope doping. It is established that the quantitative and qualitative characteristics of the surface layer, which is formed during the process of electroscope doping, depend on such factors as processing time, physical and mechanical characteristics of the electrode material and impulse discharges, and others. As a result of the EIL process, the changed surface layer is a set of large numbers of wells (a set of crests and cavities) that significantly affect the surface roughness parameters [4,6]. Having analyzed the results of the authors' research it can be said that the main types of transfer and interaction of the substances of the electrodes are: - Strengthening occurs due to the deposition of the material of the anode on the surface of the cathode. The strengthening effect can be ensured if, as an anode, the material with the highest wear resistance, hardness, etc. is used. [5,6]; - The surface layer obtained in the EIL process is the result of the interaction between the materials of the anode and the cathode between them and with the subsequent formation of solid solutions, oxides, nitrides, chemical compounds; - The process is due to the interaction of materials of electrodes and due to impulse influences of high temperatures and pressure, which lead to the appearance of nonequilibrium structures, new phases [4,5]. Thus, for example, authors [4,7] used stainless steel and tungsten alloys as electrodes and investigated their operational properties, wear resistance and heat resistance. In the course of the research, the authors found that with the electroscrew doping of titanium alloys with stainless steel (11Х15Н25М6АГ2), aluminum, solid alloys (Т15К6, ВК6М) and W-Cr-Co, W-Fe-Ti alloys, increase of durability and heat resistance in comparable with materials without coating. The increase in the resistance of the reinforcing materials to three times is observed with the use of aluminum as an electrode material, due to the formation of intermetallides TiAl in the surface layer. Similarly, when using as an anode of steel and an alloy W-Cr-Co, the thickness of

the molded layer is increased by 1.5 - 3.6 times more than with solid-alloy electrode materials. In [5,6], the authors conducted the study of the EIL process, applied a protective coating on the surface of the titanium alloy VT18. As electrodes (anodes), Al, TiAl, Ni3Al were used. The choice of electrodes is related to their ability to increase the thermal stability of alloys of titanium and heat resistance. In one of the works [6,7], a solid BK6M alloy was used as a material of the electrode, designed for drilling, cutting, deployment, milling of steel, cast iron, some hard-working materials, and reinforced with cutters and drill bits of high-speed steel R18F2. In the course of the study, they managed to obtain an increase in the stability of the tools several times: drills and cutters to 1.6; Cutter to 1.7. The wear resistance of the cutters depended on the electrode material, the minimum of which was the cutters with a coating of T15K6 alloy, the cutters with a coating of VK6M alloy had a high resistance. From the obtained diagrams it is seen that with

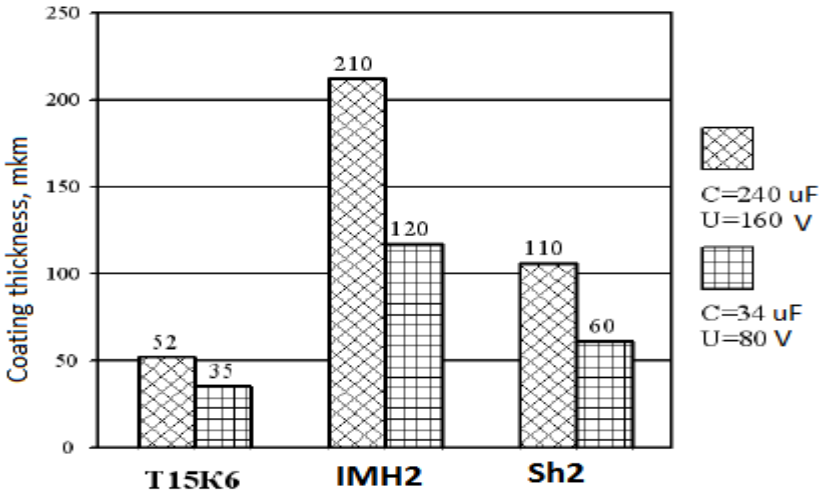

Fig.2 The thickness of coatings of samples from steel 15ХГН2ТА at different materials of electrodes.

the increase of energy regimes EIO: voltage from 80 V to 160 V and capacitance from 34 uF to 240 uF thickness of the coating increases with any material doping electrode. At the same time, when processing with a doping electrode T15K6, the thickness of the coating increases by 48,6%, when treated with the electrode IMH2 - by 75%, while processing electrode Sh2 - by 83,3%. One of the priority tasks of the development of the system of technical service of machines is the development of technologies for the repair of worn parts, since their cost is usually one and a half - two times lower than the cost of new with the same resource. When choosing a technological recovery method, the value of the maximum wear, in which the part becomes unusable for operation, is of great importance. In the general case, 85% of parts of machines become unsuitable for wear that do not exceed (0,2 ÷ 0,3) • 10-3 m [7,8], with the vast majority of reconstructed parts (about 80%) - has a maximum wear to 0,2 • 10-3 m. The same statistics are subject to aluminum bearing shields of electric motors, aluminum covers of electric generators, seat of bearings in cases of pumps from aluminum alloys and other devices of different type. According to statistics among all recoverable surfaces of autotractor parts, about 40% are worn outs [7]. Since the chemical composition of aluminum parts, working conditions, hole diameters, including bearing seats under bearings, vary in

different parts, then technological methods of their restoration differ. Widely used methods of restoring aluminum parts of machines, of which 70% make up various types of welding and surfacing [8], are not always effective for the following reasons: - do not provide for strengthening of worn surfaces; - lead to distortion of parts due to the supply of a large amount of heat, which requires further further machining. Therefore, the introduction of new, progressive ways of repairing aluminum parts is very relevant. Studies on electroscope doping on alloys D16T, AK4 and other electrodes from various elements have shown that on aluminum alloys, it is possible to obtain a coating of low-melting elements Sn, Zn, Pb with melting temperature Tpl <Tpl of aluminum. As a result of experiments on the application of coatings by means of electroscope doping on an alloy D1 with processing electrodes from Al-Sn, it was established that, when tested for wear resistance in friction in oil, the wear of the counter body of hardened steel exceeds the wear of the sample from an alloy D1 coated ~ 6-7 times and is an order of magnitude higher than the durability of the alloy A1 without coating. Elemental analysis showed the presence of oxygen in the coating. X-ray diffraction analysis did not show the presence of metal oxides in the coating, which gives grounds for assuming the presence of oxides in an amorphous state. It has been established that the wear resistance of the coating is ensured by SnO2 tin oxides, the hardness of which reaches HV 1200 kg / MMI. 2. At a minimum processing speed, the maximum increase in the coating layer and the maximum surface roughness is achieved, but maximum wear resistance is not achieved. The highest wear resistance is obtained at a high processing speed, when there is a "retraction" of the surface, in which there is no increase, but the properties of the surface change as a result of its modification. Test of wear resistance showed that the wear of the Al-Pb alloy was several times less than the wear of counter-solids of hardened steel, which confirms the possibility of wear-resistant coatings with the help of electrodes having a structure of a mechanical mixture consisting of a refractory matrix and evenly distributed in it, in the form of a grid, a fusible component. Technology of restoration of seats under bearings in aluminum parts with the help of electrospray doping is as follows: - clearing of seats from pollution; - the diameter of the hole is frozen with the help of the indicator gauge and the definition of the required thickness of the coating; - Coating by means of electroscope doping with the help of technology of "barrier" layers; - mechanical processing of a hole (boring or rolling). Technology of repair of autotractor radiators. For this purpose, the defect is cleaned of dirt and by means of electroscope doping, the surface is modified by an electrode from the Al-Sn alloy, followed by application by means of electroscope doping of the low-melting solder PIC-40. The process of electroscope doping allows you to destroy the oxide film on the surface of the tubes and facilitate further lushing the surface of the low-melting solder PIC-40. After losing the defective place is soldered by the standard method and does not make any difficulty. Application of preliminary application of a sublayer by electrodes from Al-Sn alloy and solder PIC-40 on a defective surface by means of electroscope doping will allow to reduce the number of preparatory operations and increase the reliability of soldered joints while reducing the cost of

repairing radiators with aluminum tubes.

Fig. 3. Details recovered by electroscope doping.

Conclusions. The application of effective technology for the restoration of worn parts of auto tractor machinery by application of electrospray coatings is substantiated. The described technology differs technological flexibility, cheapness, simplicity, does not require the use of expensive and scarce materials and equipment, and also meets the requirements of environmental safety. The proposed technology can be used to restore a wide range of parts of cars, tractors and other machines. The technology of the restoration of seats under bearings in details from aluminum alloys with the help of electroscope doping can be used in the system of technical service of machines. In conditions of friction, both with and without lubricant, on the surface of coatings obtained on aluminum alloy D1 by means of electroscope doping with AlSn alloy electrodes, wear resistance is several times higher than the wear resistance of hardened steel.

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ТЕХНОЛОГИЯ ВОССТАНОВЛЕНИЯ ДЕТАЛЕЙ СЕЛЬСКОХОЗЯЙСТВЕННОЙ ТЕХНИКИ МЕТОДОМ ЭЛЕКТРОИСКРОВОЙ ОБРАБОТКИ

Конев С.В., Житков С.С., Кіщенко В.А.

Ключевые слова: электроискровое легирование. эксплуатация, трудоемкость, ремонт, восстановление, ресурс, покрытие. посадочное место.

Резюме

Основным методом повышения долговечности машин является нанесение на изношенные поверхности одного или нескольких слоев покрытия с высокими физико-механическими свойствами, которые обеспечат дальнейшую длительную работу изделий. Одной из приоритетных задач развития системы технического сервиса машин является развитие технологий восстановления изношенных деталей, так как их стоимость, как правило, в полтора - два раза ниже себестоимости новых при одинаковом ресурсе. При выборе технологического способа восстановления большое значение имеет величина максимального износа, при которой деталь становится непригодной к эксплуатации. Обосновано применение эффективной технологии для восстановления изношенных деталей авто тракторной техники путем применения электроискровых покрытий. Описанная технология отличается технологической гибкостью, дешевизной, простотой, не требует использования дорогих и дефицитных материалов и оборудования, а также соответствует требованиям экологической безопасности. Предлагаемая технология может быть использована для восстановления широкой номенклатуры деталей автомобилей, тракторов и других машин. Описанная технология восстановления посадочных мест под подшипники в деталях из алюминиевых сплавов с помощью электроискрового легирования может быть использована в системе технического сервиса машин. В условиях трения, как со смазкой, так и без, на поверхности покрытий, полученных на алюминиевом сплаве Д1 с помощью электроискрового легирования электродами из сплава AlSn, износостойкость в несколько раз превышает износостойкость закаленной стали.

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Summary

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surfaces one or several layers of coating with high physical and mechanical properties, which will ensure the continued long operation of products. One of the priority tasks of the development of the system of technical service of machines is the development of technologies for the repair of worn parts, since their cost is usually one and a half - two times lower than the cost of new with the same resource. When choosing a technological recovery method, the value of the maximum wear, in which the part becomes unusable for operation, is of great importance. The application of effective technology for the restoration of worn parts of auto tractor machinery by application of electrospray coatings is substantiated. The described technology differs technological flexibility, cheapness, simplicity, does not require the use of expensive and scarce materials and equipment, and also meets the requirements of environmental safety. The proposed technology can be used to restore a wide range of parts of cars, tractors and other machines. The technology of the restoration of seats under bearings in details from aluminum alloys with the help of electroscope doping can be used in the system of technical service of machines. In conditions of friction, both with and without lubricant, on the surface of coatings obtained on an aluminum alloy D1 by means of electroscope doping with AlSn alloy electrodes, wear resistance is several times higher than the wear resistance of hardened steel.