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RESTORATION OF PARTS OF AGRICULTURAL EQUIPMENT BY ELECTRODEPOSITION OF IRON-BORIDE COATINGS WITH SUBSEQUENT CYANIDATION

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Parts of agricultural machinery that are sent for repair have a wide variety of defects that may arise during the operation of the machinery as a result of structural defects of individual components and deviations from the technical conditions for their manufacture or due to violations of the rules of technical operation of the machinery and, most importantly, from natural wear and tear. Modern agricultural machinery has a sufficiently perfect design, and its production is one of the most advanced in the field of mechanical engineering, so defects in parts due to structural or production reasons are extremely rare. Conditions can have both a positive effect, slowing down the process of defects from natural wear and tear, and a negative effect, causing accelerated wear and various damage to parts. As a result of wear, the initial dimensions of the mating surfaces of the parts change, and their geometric shape is distorted if the wear is uneven. Risks, dents, local chipping or chipping of metal, or surface cracks are observed on the connected surfaces of the parts. The latter occur due to metal fatigue. The operation of parts under loads exceeding the calculated ones, and violations of the rigidity and mutual position of the parts in the assembly, in addition to wear, can lead to more noticeable residual deformations in the form of bending, twisting, dents, etc., high temperatures, they are also exposed to gas corrosion and warping. To restore the full functionality of worn parts, it is necessary to return them to their original dimensions, geometric shape and surface properties, primarily hardness, since all properties of the core, as a rule, are preserved, if you do not count individual cases of the initiation of fatigue cracks during the wear process. In this case, the interchangeability of parts and the fitting of connections are completely restored, the restoration of agricultural machinery parts in different ways is of particular interest [1, 2].

Hardness, wear resistance, internal stresses, fatigue strength, strength are the most important characteristics of the quality of electrolytic iron coatings, on which the possibility of their use in various operating conditions depends. The wear resistance of the coating is the main indicator of the durability of the restored parts. Many parts of agricultural machinery work under sign-changing loads during operation, therefore the works of many scientists are devoted to the study of the fatigue strength of electrolytic iron coating. The fatigue strength of parts, the degree of electrolysis, the thickness of coatings and other factors are reduced by 17.5–70.2%. However, no matter how high the properties of the resulting coating are, its performance is mainly influenced by the strength of adhesion to the base. This parameter depends on the material of the part, internal voltages, electrolysis. At present, the simplest and most reliable method of surface preparation is the method of etching renewable parts in the fertilizing electrolyte. The main advantages of this method include low operational costs, cost-effectiveness, reduction of adhesion defects and increased technological reliability of the process. One of the conditions for the intensification of fertilizing is the use of high current densities. At a current density of 60 A/dm^2 under normal conditions of fertilizing, the appearance of a dense network of cracks is observed on the coating. Such a coating has low wear resistance, deposition process. is accompanied by active dendrite formation. At a cathodic current density of 80-100 A/dm2, the deposition rate was 18-20 μm/min, the microhardness of the coatings was 6500-7000 MPa. However, fertilizing with coatings is also characterized by serious disadvantages: a low rate of deposition and heating of the bath with electrolyte to 70-90 ° C, which leads to evaporation of the electrolyte, its aggressiveness and significantly complicates the operation of the bath, requiring significant energy consumption for heating. According to many researchers, these shortcomings can be eliminated by using non-stationary conditions of electrolysis [2, 3]. For the intensification of the iron-making process, it is necessary first of all, to lower the working temperature of the electrolyte. However, the disadvantages of cold electrolytes are low performance, low microhardness and low wear resistance of the resulting coatings. Improvement of technological processes of deposition of iron coatings from cold electrolytes can be carried out in the following directions: 1) use increased current densities to create stable electrolytes; 2) ensure high productivity of the electrodeposition process by using non-stationary conditions of electrolysis. The use of high current densities leads to cracking of coatings and abundant dendrite formation. Non-stationary conditions of electrolysis are created by conducting the deposition process in flowing electrolytes, using ultrasonic and magnetic oscillations, introducing software control of electrodeposition parameters, and using periodic currents of various forms. Most of these methods have not been widely used in repair production due to the complexity of the installations and the insufficient efficiency of the processes. It is possible to slightly increase the output of the iron bay, as well as the microhardness of the coatings, using flow fertilizing. The use of an electrolytic iron-boron alloy will allow to restore parts made of alloyed steels, which are difficult to restore by diffusion metallization methods. The technology will allow to restore parts of agricultural machinery, the wear of which varies from 0.01-0.7 and more mm on cylindrical surfaces with a diameter of 50-200 mm. It is expected to obtain strong iron boride coatings with the required thickness. After cyanidation at a temperature of 500, the coating will have high operational properties. This method of restoration can be used to restore the strengthening of the belts of the spools of hydraulic distributors P-80. In addition to the valves of the hydraulic distributor, parts of suspensions of imported and domestic trucks are suitable for the proposed technology. steering knuckles of cars, engine parts (the surfaces under the bushings on the connecting rods are restored), hydraulic drive parts of tractor gearboxes: hydraulic distributor sleeve, secondary shaft, sealing ring. For the listed parts, currently the most common method of restoration is chrome plating or replacement with a new part. We believe that the application of an electrolytic iron-bar coating with subsequent chemical-thermal treatment at a temperature of 400–600 °C will allow to restore the repair fund and increase the service life.

Due to high hardness and wear resistance, Fe–B coatings can be widely used for the restoration of parts of agricultural machinery. Currently, hardened iron boron coatings are used to restore the following parts: valves, pushers, lower heads of connecting rods, gearboxes, valves of hydraulic distributors, etc. The research conducted by us (we determined the optimal composition of the electrolyte and electrolysis modes, studied the structure, hardness, internal stresses, strength of adhesion to the base metal and wear resistance) developed a technological process of restoring worn parts of agricultural machinery with electrolytic iron boride coatings. The technological process involves a sequence of operations that ensure the deposition on the worn surface of the part of a well-adhered coating layer of the required hardness and thickness. Operations must be performed in the following sequence:

1. Primary mechanical treatment of surfaces to be restored.
2. Washing in an organic solvent.
3. Installation of parts in a suspended device.
4. Chemical degreasing with Vienna lime.
5. Washing the suspension with parts with running water.
6. Anodic etching in a 30% solution of sulfuric acid with the addition of 10-30 kg/m^3 of iron sulfate. The density of the solution is 1.23, the current density is 50-60 A/dm^2. The duration of anodic etching is 1-2 minutes. Cathodes are lead plates.

7. Washing the suspension with parts in cold running water.
8. Electrodeposition of iron boride coatings in an electrolyte of the following composition: iron chloride - 350–400 kg/m3; citric acid - 4-5 kg/m3; sodium decahydroborate - 1.1–1.3 kg/m^3; hydrochloric acid - up to pH=0.9-1.1. The temperature of the electrolyte is 40 °C. The current density is 25-35 A/dm^2. The coefficient of asymmetry is 5-6. The electrodeposition process should begin with the application of the coating sublayer in the overclocking mode, in which the asymmetry coefficient is set equal to 1.25-1.3, and the current density of the cathode half-cycle is 10-15 A/dm2. The duration of the overclocking mode is 4–6, after which the asymmetry index and current density increase to the calculated values.
9. Washing the suspension with parts in cold running water.
10. Neutralization in a 10% caustic sodium solution for 4 min.
11. Washing the suspension with parts with running water.
12. Dismantling parts from the suspension.
13. Quality control of coatings.
14. Mechanical processing.

In practice, there is a need to restore parts made of highly alloyed and particularly strong steels. To ensure reliable adhesion of coatings to the base metal, preliminary etching in a sulfuric acid solution can be recommended. The build-up of Fe-B coatings is carried out with soluble anodes made of low-carbon steel, which are placed in covers made of fiberglass. In order to ensure the stability of the electrolyte, as well as to improve the distribution of metal on the surface of the part being restored, the ratio of the areas of anodes and cathodes should be 2:1. Anodes should not exceed the length of the parts to be covered and should be suspended. into the bath symmetrically in relation to each detail and on the same level with them..

The method of electrolytic deposition of wear-resistant coatings from chloride electrolytes using periodic current is substantiated. The dependence of the wear resistance of iron boride coatings on electrolysis parameters was obtained. The most rational composition and parameters of electrolysis for obtaining high-quality wear-resistant coatings have been determined. The most rational values of electrolysis parameters are as follows: asymmetry index - β=6.43, cathode current density - Dk=18 A/dm^2, concentration of sodium decahydroborate 1.07 kg/m^3.

References

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