INVESTIGATION OF THE EFFECT OF THE TECHNOLOGICAL COATING PROCESS ON THE PHYSICAL AND MECHANICAL PROPERTIES OF THE COATING

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Abstract: In this article, the details are considered in the electrocontact method by simulating the coating process when applying wear-resistant coatings to the work surface in two modes: liquid-phase and thermal cooking under technological conditions. The electrocontact method obtained a new content (80% Fe + 8% Ni) +10% SiC + 2% WC in the powder coating product, which corresponds to the thermodynamic parameters of the coating.

INTRODUCTION

It is known that about 80% of the parts are rejected with a gap of no more than 0.6 mm, and 10% - with a gap of 1.2 mm, most of which can be restored at repair plants. In this case, restoration technologies should not reduce the strength of parts, more than 60% of which relate to parts of the "Shaft" type. Currently, there are various methods for restoring such details. The use of metal powders, as well as their mixtures, is a promising direction in the formation of surfaces with characteristics corresponding to the specified requirements and the expansion of the technological capabilities of the ECW method.

Currently, there are many technologies for restoring stepless and stepped shafts, which can be divided into the following groups:

- various types of coatings for arc liquefaction;
- spraying;
- electrolytic coating;
- surface welding with tape and electric contact wires;

The reason for the decrease in their viscosity by 20-40% or even more under the influence of high temperatures during the reconstruction of shafts with various types of arc coating is the formation of residual stresses of the structural variety of molten metal. At the same time, labor-intensive heat treatment processes are not very effective in the presence of defects in the form of pores, scratches and microcracks in the molten metal. Another important disadvantage is the deformation of the shafts during the application of a diluent coating.

One of the promising technologies for restoring cylindrical surfaces is the method of electrocontact baking (ECP). Scientists around the world have conducted a lot of research on the restoration of the size of corroded parts and the strength of work surfaces, the use of various technologies in this area. They developed the basics of the electrocontact method, the technology of obtaining coatings from materials in the form of wire, tape. Including R.K.Taylor, F.V. Lenel, L.A. American scientists, such as Shepard, conducted experiments on conducting electric current directly from parts. The results of these studies made it possible to connect metals that cannot be connected by simple methods. E.S.Karakozov, S.V.Klimenko, V.A.Dubrovsky, M.I.Chernovol, R.A.Latipov, M.Z.Nafikov, V.M.Korzh, V.I.Chernoivanov, M.M.Dorozhkin, V.K.Yaroshevich, V.A. Scientists from Russia, Ukraine and Belarus, such as Vereshchagin, conducted research on the technology of obtaining coatings with various properties using reinforced metal materials and steel wire by the electrocontact method. Scientists from Uzbekistan M.A.Abralov, K.Z.Kosimov, M.Ergashev, N.S.Dunyashin and others are carrying out research work on restoring and improving the eaten dimensions of parts, creating components for welding from noble materials. When receiving moldings using the developed technologies and powdered composite materials, the service life of parts increased by 1.5-1.8 times, the period between repairs increased, the cost of repairs decreased by 10-15%.

The purpose of this work is as a result of thermodynamic modeling, it is established that the physical and mechanical properties of the coating applied to the surface of the parts depend on the composition of the coating and the technological parameters selected during the coating process for the formation. Determination of the values of technological indicators that provide the most optimal physical and mechanical properties of the coating by studying the effect of technological indicators on the application of a coating with a content of +10% SiC +2% WC, developed as a result of thermodynamic modeling (80% Fe+8%). Investigation of the influence of technological indicators of the coating process on the macro- and microstructure of the coating. By examining the macro- and microstructure of any material, including the coating material applied to the surface of the part, it is possible to evaluate its physio-chemical and operational properties . To this end, we investigate the selected current strength, voltage, initial pressure applied to the powder, and the coating rate during the coating process, the effect on the macro- and microstructure of the coating.

The methodology of the study. To study the effect of current and voltage on the macro– and microstructure of the coating, we calculated for thermodynamic modeling: technological conditions of preparation in the liquid phase and during heating: i – current and U – voltage; G(1) and G(2) - the amount of powder mixture on the coating; τ(1) and τ(1) is the instantaneous amount of powder used by thermodynamic functions for research, such as the time required to heat the mixture. In addition, reflecting the coating rate: q is the powder transfer rate, n is the number of revolutions of the part, and the speed of the longitudinal s – pressing of the coating roller corresponded to the initial values of R – pressure applied to the powder when coating the ham, at the minimum values that the device can use for coating the ham. can achieve.

We calculated the minimum amount of powder mixture to be applied to the surface of the part and the distance between the rollers according to the formula below for cylindrical parts:

$$q_{(i)} = \frac{s \cdot h \cdot \pi \cdot d \cdot n \cdot \rho_{(i)}}{10\xi}$$

Where s -is the speed of movement of the roller along the axis of the detail, mm/rev;

h-is coating thickness, cm;

d-is a diameter of the detail, cm;

n-is the number of revolutions of the covering roller or detail, t/m;

p (i) -is the coating density corresponding to the technological conditions, g/cm^2;

ξ-is a coefficient reflecting the degree of involvement of powder particles on the surface of the part and the roller. ξ-the value of the coefficient reflecting the degree of absorption of powder particles into the range of surfaces of the part and the roller is 0.55, depending on the granulometric composition of the powder mixture, the number of revolutions of the coating roller and the part, as well as their surface S defined in the range of 0.85. We assumed that ξ = 0.65 for experiments.

Then the minimum amount of powder mixture is applied, which must be transferred to the roller from the surface of the part to comply with the technological conditions of coating in the presence of the liquid phase:

$$q_{(1)} = \frac{0{,}95 \cdot 0{,}2 \cdot 3{,}14 \cdot 2{,}9 \cdot 12 \cdot 6{,}65}{10 \cdot 0{,}65} = 21{,}2 \approx 22\ \mathrm{g/s}$$

At the same time, in order to comply with the technological conditions of baking , it is heated:

$$q_{(1)} = \frac{0{,}95 \cdot 0{,}2 \cdot 3{,}14 \cdot 2{,}9 \cdot 12 \cdot 5{,}17}{10 \cdot 0{,}65} = 16{,}5 \approx 17\ g/s$$

Research results and their discussion. In the case of coating in liquid-phase technological conditions, the selected technological parameters obtained as a result of thermodynamic modeling to study the effect of current and voltage on the macro- and microstructure of the molded coating material are presented in Table 1.

№ researches	I, A	U, в	q, г/м	n, t/м	s, мм/t	p, g/мм^2
1	308	1,42	22	12	0,95	850
2	315	1,45				
3	326	1,50				
4	336	1,55				
5	347	1,60				

1 – table

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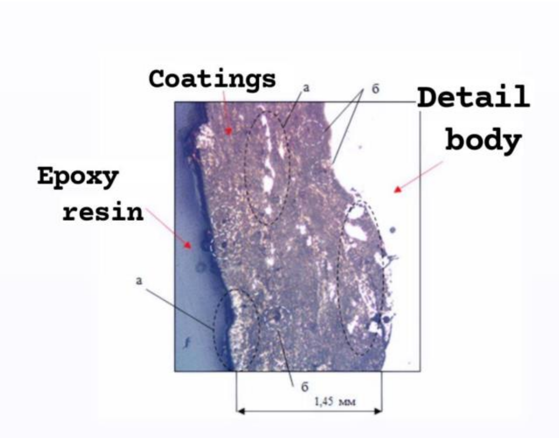
Technological indicators selected to determine the effect of current and voltage on the macro- and microstructure of the coating material in liquid-phase technological conditions

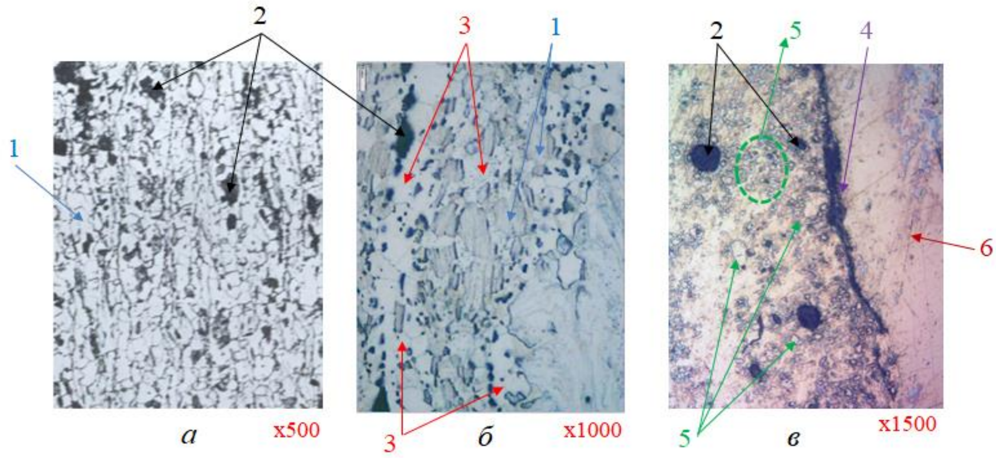
And for coating, we made samples from St 3 steel: diameter 25 mm, length 60 mm. During the study, we processed a total of 50 surfaces of steel samples (80% Fe+8% Ni) with a content of +10% SiC+2% WC for each selected technological indicator. During the study, the current power in the coating was adjusted by regulating the voltage in the first coil of the device transformer in accordance with the procedure described in Chapter 2, Section 2.1, and measuring it using an ammeter connected to the second coil roller for coating. from the device transformer. The feed rate of the powder mixture to the surface of the part and the distance between the rollers Chapter 2, Section 2.1, we controlled using the crane of the hopper of the device in accordance with the procedure described in the section, the number of revolutions of the part during coating and the traction speed were set in accordance with the table from the gearbox of the machine. Conducting macro– and microstructural analysis of coated samples in the order presented in Chapter 2, Section 2.3, we performed preparation of the grinds and visualization of the surfaces of the grinds magnified 25-50 times in MBS-9, 100-1000 times in the model and 1200-2000 times in the state in "NEOPHOT-Metallographic microscopes 21" (Germany). Micrography is implemented in the device for automatic porosity analysis SIAMS 700th (Germany). Sample №. 1, obtained at a voltage of 308 A, current strength and 1.42 V, corresponding to the result of thermodynamic modeling, to a solution of 3% nitric acid in alcohol 1...The microstructure after immersion for 1.5 seconds is shown in picture1.



a-places with liquid phase coating, b- places with chicken porous

1 – picture №. 1 - microstructure of digital sample x150

Sample №. 1 analysis of the microstructure of the slag surface in a 150 times enlarged hole (pic. 1) shows that the coating structure is an inhomogeneous structure, with shiny grooves formed from grains of Fe-Ni alloy powder, which tightly adhere to each other under the influence of not very high temperatures, and are oriented parallel to the images of Gods A and B in the microstructure (Fig. 1), taken at magnification from X500 to x1500, are shown in pic. 2.



а- in combination with the maturation of the powder, б-places with liquid-phase coating, в- borders coating with the detail: : 1-powdered grains; 2-porosity; 3- liquefied recrystallized phase (Fe-Ni alloy); 4-microcrack in the coating boundary with parts; 5- Sc and WC powder grains.

2 – pic. №. 1 – microstructure of a digital sample obtained at different magnification.

Conclusions. According to the results obtained when determining the effect of the selected current and voltage on the macro- and microstructure of the coating when applying the coating with an electrocontact composition + 10% SiC + 2% WC on the surface of the parts (80% Fe + 8% Ni), we found that the optimal current strength to ensure the technological conditions of coating in the presence of at the same time, the current strength required to carry out the coating process in a solid-phase process medium is 318... We found that it is necessary to have a range of 320 A, but that the pressure applied to the powder mixture should be above 850 g/mm2. In the electrocontact method, the details were determined by simulating the coating process when applying wear-resistant coatings to the work surface in two modes: liquid-phase and thermal cooking under technological conditions. The electrocontact method obtained a new content (80% Fe + 8% Ni) +10% SiC + 2% WC in the powder coating product, which corresponds to the thermodynamic parameters of the coating.

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