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The Mode Coating Effect on Its Thickness and Adhesion

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Abstract

The article reflects the results of the chromium-nickel powder coating investigation, applied by the laser method on two different materials. The results of mode coating influence on its thickness are presented. To assess the effect of the base-material was determined coating cohesion with the warp. The obtained data reveal the influence of the base material as well as the modes coating.

Keywords: mechanical engineering, coating thickness, laser surfacing, adhesion.

INTRODUCTION

Mechanical engineering is the leading branch of the heavy industry of the country. The economy, reliability and durability of the produced machines is the most important indicators of their perfection. Reliability is a complex characteristic of machines and designs, including such internals as durability, maintainability and safety. These indicators determine the effectiveness of the technology use and the quality of its work.

Necessity of reliability due to the continuous increase of the machines quantity and produced equipment and extension of their applications. Mechanical engineering accounts for about 1/5 of the country's industrial output, almost 1/4 of major industrial- production funds and 1/3 of industrial- production personnel.

The causes of failures, damages and accidents often lie in the inadequate level of design and construction, during which not fully used achievements of science, the progressive materials of production are being applied to a limited extent. The technological scope of discipline is insufficiently conducted operations. Another test control failure of equipment parts cause is corrosion.

Annual metal losses from corrosion is about 15 million tons. These irrecoverable losses speed up the process of using non-renewable resources. However, the main damage from corrosion is not so much related with direct losses of metal, but with the failure of metal structures, the cost of which is much higher than the metal cost.

Also, the problem area is the restoration of equipment and node components surfaces. The suggested way to solve the problem is to apply protective coatings using laser surfacing.

As a base-material, two steel brands were selected: St3 and U8A. The chemical composition of the studied steels and the requirements of GOST are presented in table 1 and 2.

Table 1: Chemical composition (%) of steel St3.

C	Si	Mn	S	P	Cr	Ni	Cu
Elements content in test material							
0,18	0,04	0,47	0,031	0,026	0,03	0,03	0,04

Table 2: Chemical composition(%) of steel U8A.

C	Si	Mn	S	P	Cr	Ni	Cu
Elements content in test material							
0,79	0,40	0,27	0,016	0,021	0,18	0,10	0,17

The samples were applied coating by the method of laser pressure welding. The powder Plakart-03.98.-P was used as a main material. It is used for surfacing bearings, diesel engines valves, fans blades,agricultural implements and mixer blades. Powder is designed for protective coatings creation that have a high resistance to abrasive wear, corrosion and oxidation. The chemical composition of the powder is presented in table 3.

Table 3: Chemical composition of powder Plaquart-03.98-P.

Element name	C	Cr	Si	W	Fe	Co	Ni	B	S	P
Quantity, %	0,81	17,26	4,49	-	4,18	-	69,78	3,48	-	0,1

Prior to testing, the samples diameter was found using the direct measurement method. The obtained results are presented in table 4.

Table 4: Samples diameter before the test.

№ sample	Samples diameter, mm			
	d_1	d_2	d_3	d_{cp}
1	19,85	19,90	19,85	19,87
2	19,84	19,88	19,93	19,88
3	19,85	19,87	19,90	19,87
4	19,87	19,94	19,83	19,88
5	19,85	19,88	19,90	19,88
6	19,84	19,86	19,91	19,87
7	19,86	19,89	19,92	19,89
8	19,87	19,84	19,89	19,87

The main parameters for laser melting are: laser power and speed of relative movement of the laser head.

Tests of laser melting was performed by changing the main parameters. For each parameter two specific values were chosen. The tests of the selected melting regimes at different base- materials were made, varying the parameters according to table 5.

Table 5: Laser melting variable parameters .

№ sample	Parameter value		
	Laser power, Vt	Laser head movement speed, mm/s	Steel grade
1	1800	10	St3
2	1200	10	St3
3	1800	5	St3
4	1200	5	St3
5	1800	10	U8A
6	1200	10	U8A
7	1800	5	U8A
8	1200	5	U8A

After coating, its thickness was determined by the direct measurement method. The results are presented in table 6.

Table 6: Coating thickness

№ sample	Samples diameter before tests,mm	Samples diameter after coating ,mm	Coating thickness,mm
1	19,87	20,45	0,58
2	19,88	20,44	0,56
3	19,87	20,44	0,57
4	19,88	20,44	0,56
5	19,88	20,43	0,55
6	19,87	20,45	0,58
7	19,89	20,43	0,54
8	19,87	20,44	0,57

The bonding strength of the coating with the base- material (adhesion) was determined. The researches were conducted by qualitative (temperature change method) and quantitative methods (shear method). The method of temperature change did not reveal differences in the modes coating application.

Shear method: loading rate was 6 mm/min. Presumably, the base- material should not influence the adhesion of the powder to the base metal. The obtained results confirm our hypothesis (Table 7).

Table 7: Adhesion measurement results.

№ sample	Maximum shear load, H
1	63000
2	62950
3	62500
4	63050
5	61500
6	61000
7	61350
8	60800

CONCLUSION

The following conclusions can be drawn as the result of the study:

1. The base- material does not affect on the adhesion and the applied coating thickness.
2. Changing the coating application modes does not affect the homogeneity of the chemical composition.
3. Coating regimes do not affect the resulting thickness and coating adhesion.
4. The method of laser surfacing makes it possible to obtain a homogeneous boundary fusion of covering-base. In operations, this will avoid chipping of the parts surfaces.