INFLUENCE OF ADHESION OF COATINGS OBTAINED UNDER SHS CONDITIONS ON CORROSION RESISTANCE OF STEELS

I. Kruhliak, Doctor of Technical Sciences, profesor,
D. Kruhliak, Candidate of Technical Sciences, assistant professor, O. Danilchenko, student

Dniprovsky State Technical University, 59002, Kamianske., Str. Dniprobudivska, 2
e-mail: seredabp@ukr.net

At present, the main methods of applying a protective coating are galvanic discharges in electrolysis, gas-thermal spraying, or metallization, thermal diffusion saturation in powder, immersion in molten metal, plastering. The adhesive and diffusive metal coatings are distinguished by the type of metal layer protective compound. Surface saturation with aluminum, chromium, zinc and other elements refers to diffusion saturation with metals. The product, whose surface is enriched with these elements, gets valuable properties, which include high heat resistance, corrosion resistance, increased wear resistance and hardness. In this regard, for Ukraine, the development of new methods of chemical-thermal treatment is actual, it allows regulating the composition and structure of protective coatings, providing the necessary performance characteristics with the minimum time of their formation. Such technologies are based on the phenomenon of self-propagating high-temperature synthesis.

One of the main characteristics, which signifies the practicality of the coating, is adhesion (the quality of its adhesion to the material). The greatest high value of the bonding of aluminium-coated coatings was removed when alloyed with silicon. Adhesion on steel 45 with a growth of 5.7 (alloyed with silicon) up to 6.8 MPa (alloyed with titanium). In the case of the pairs with coverings taken away in isothermal minds, the thickness of the joint increased by 1.15÷1.27 times. The obtained results correlate with the indicator of the total brittle fracture score, which is 20÷25 % higher in isothermal coatings. This can be explained by the effect of prolonged heat treatment on the structural material, when obtaining coatings in isothermal conditions. When processing under SHS conditions, this effect is reduced to a much shorter time and in our conditions does not exceed 60 minutes, while to obtain the same thickness in isothermal conditions requires 2.5÷3 times more time.

Thus, it is established that the use of high-temperature synthesis increases the adhesion of the protective coating to the substrate. Analysis of the structure of coatings and the nature of the distribution of chromium, aluminum and alloying elements obtained using a scanning electron microscope Carl Zeis AG-SUPRA 40 WDS, showed that in alloy coatings obtained under SHS conditions, the coating limit and material is less pronounced. This fact indicates increased adhesion properties. The study of the nature of the change in microhardness in the thickness of the coatings found that there is a smooth change in microhardness. The gradient structure of the coating, where there are layers with low hardness, serves as a damper under shock dynamic loading, which does not lead to cracking and delamination of the surface.

References

1. Surface strengthening of working materials in the conditions of complex influence of aggressive substances: monograph / B.P. Sereda, L.P. Bannikov, S.V. Nesterenko, O.S. Gaidaenko and others. DDTU, 2019. 173 p.
2. Zimon A.D. Adhesion of films and coatings / A.D. Zimon. – M.: Chemistry. – 1977. – 351 p.