Deformation Changes of Mechanical Properties of Surfase Coatings Deposited on Figured Substrate

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Abstract - **The article deales with theinvestogation of elastic deformations influence on the cohesion and adhesion of surface coatings, deposited on the cylindrical and spherical substrates.**

Keywords - **Elastic deformations, surface coating, cohesion, adhesion**

I. INTRODUCTION

Results of experimental studies [1] showed that the value and sign of internal mechanical tensions (IMT) in surface coatings with the same materials deposited on substrates of different size and shape are mot equal. Because of their elastically deformed state, it suggests that form of substrate also influences on the deformation changes of mechanical properties of coatings. Therefore, considerable interest is the study of the nature and extent of this influence.

II. MAIN PART

One of the most common forms of simple parts is cylindrical and spherical. If necessary, coating can be deposit on external (curved) and inner (concave) surface of figural parts. In practice, the behavior of surface coatings, deposited on the outer and inner surface details significantly different. This can be explained by the fact that for external and internal surfaces mechanisms of IMT occurrence, distribution and their influence on the mechanical properties of coatings are different.

When deposit a thin layer of coating on the outer surface of the cylindrical or spherical parts in it will be observed the appearance of compressive IMT. They arise and act in coating with certain constant pressure between the coating and the substrate, which is caused by reduction of the size coating after deposition (shrinkage). Such tension is directly proportional to the temperature expansion factor, modulus of elasticity, base diameter, the temperature difference between cooled and coverage substrates, and inversely proportional to the thickness of the coating. Since the shrinkage pressure between the coating and substrate acting in the direction of forces caused by intermolecular interaction at contact surface coating and substrate, so covering the outer surface of cylindrical and spherical parts are characterized by high adhesion strength. With increasing of coating thickness compressive stress passes in stretching stress, which increases with the thickness of the coating and the substrate.

If the adhesion strength of the system is greater than the cohesion of the coating, and the IMT value exceeds the border of strength of the material in the upper coating layers may appear transverse cracks, which are distributed inside the coating and cause further flaking coating. Reduce the negative influence of stretching IMT it is possible by increasing the radius of curvature of the subtrate or limiting the thickness of the coating and the substrate. That is, increasing the radius of curvature of the subtrate is accompanied by the growth of strength characteristics.

When coating the inner surface of cylindrical parts IMT distribution through the coating thickness will be different than for external coating. In this case, the internal coating layers will be under the influence of IMT, which will vary in thickness on the compressive stress. And to coheion destruction mostly does not reach as low adhesion strength through internal coverings of their detachment from the substrate occurs before cracking.

To study the deformation changes of cohesion and adhesion of cylindrical parts coatings authors used analytical model [2]. Results of calculations show that cohesion of surface coating deposited on cylindrical substrate is approximately 1,5-2% lower than that applied to flat substrate. And adhesion of cylindrical parts coatings is nearly 2% higher than adhesion of flat one.

III. CONCLUSION

1. Form of substrate influences on the deformation changes of mechanical properties of coatings.

2. Cohesion of surface coating deposited on cylindrical substrate is approximately 1,5-2% lower than that applied to flat substrate. And adhesion of cylindrical parts coatings is nearly 2% higher than adhesion of flat one.

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