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MANAGEMENT AND CONTROL OF QUALITY PARAMETERS OF WEAR-RESISTANT COATINGS

The quality criteria of wear-resistant coatings are considered. The algorithm of consistent actions to obtain high quality coatings made by the complex technological method ECSSC (electrocontact strengthening of sprayed coatings) is proposed. Ishikawa diagram is plotted which allows to identify the causes of the quality criteria impairment of wear-resistant coatings obtained by the combined technology.

Keywords: *quality criteria, complex technological method, Ishikawa diagram, wear-resistant coatings*

Introduction. The quality of the product can be considered as a major motivation for its purchase under competitive conditions as well as one of the factors of its competitiveness. Market requires competitive technologies that would provide appreciable effect provided their own low cost and complexity. Development of new manufacturing methods to improve wear resistance and durability of machine parts is a priority of modern mechanical engineering. Among resource-saving technologies coatings play a very important role, because in many cases it is not necessary to harden the whole machine part and is enough to make a coating layer with required properties. Coatings made by electrocontact strengthening of sprayed coatings method (*ECSSC*) allow to increase wear resistance, heat resistance, corrosion resistance, fatigue strength, etc., due to changing the material condition on the surface. However, the problem of quality assessing is not sufficiently studied, because currently there is no complex quality assessing of the coatings obtained by the combined technology and the quality of coatings is determined by single properties.

Problem statement. The objective of this paper is to obtain quality coatings made by combined technology.

Discussion of results. Making coatings that ensure serviceability of machines and equipment under critical conditions of operation provides prerequisites for significant advance in the development of many branches of national economy. Among various coating technologies nowadays the gas-thermal spraying methods have found the widest application.

It is known that among various gas-thermal spraying methods the electric arc metallization (EAM) one is the cheapest and simple method of making coatings requiring no expensive equipment. In addition, EAM method is characterized by high productivity, insignificant thermal influence on a machine part, technological flexibility of using parts of various sizes.

Using traditional methods of implementing schemes of gas-thermal spraying allows to form a coating that meets the needs of many repair industries [1]. However, the quality parameters of these coatings are not always adequate to the increased requirements of the operating characteristics of machine parts engaged in intensive manufacturing processes.

Under these conditions possible ways of improving the quality of coatings made by electric arc metallization and expansion of its rational use are search for new methods that allow us to make a qualitative breakthrough in the properties of wear-resistant coatings.

High wear resistance, hardness (microhardness) and other properties of coatings can be provided by the methods such as thermo- or thermomechanical strengthening. Using a combination of spraying technologies followed by thermomechanical strengthening opens great opportunities to create high quality protective coatings [2].

Realization of electrocontact strengthening after electric arc metallization allows to get a hardened layer composite structure of relatively large thickness on the surfaces of the «shaft» − type parts.

The combined technology results in an increase in physical and mechanical properties, operating characteristics of restored surfaces and simultaneous reduction of modes parameters both of spraying and electrocontact strengthening. This increases the adhesion of the coating to 200 MPa, the porosity is reduced to 5...3%, operating characteristics, wear resistance, durability and reliability of machine parts are improved. Large thickness of the hardened layer up to 3 mm allows to use the method of maintenance size during further repairs of these parts [3].

The strengthening process of sprayed coatings is provided by the combined action of temperature that does not exceed 0.8 ... 0.9 melting temperature, pressure and high heating rates. The main advantage of electrocontact strengthening process is the maximum reproducibility of mechanical properties of coatings.

Depending on the purpose, operation conditions, reliability and durability of using machine parts quality requirements are determined. It is necessary to have understanding of basic properties of the wear-resistant coatings, such as mechanical, physical, safety, fatigue characteristics, etc.

The criteria of wear-resistant coatings quality are low porosity of the coating, high hardness (microhardness), adhesion and cohesion strength of coating, as well as the elastic modulus and Poison's ratio.

The quality control of coating envisages control in preparation of surfaces before coating as well as during application and after coating obtaining.

To provide coatings quality made by the combined technology the algorithm of consistent actions has been developed and proposed (Fig. 1).

The statistical method is one of the most effective components of the integrated system of products quality control. Statistical methods for products quality control are now becoming increasingly popular and are commonly accepted in the industry.

These methods of quality management are based on a systematic approach that consists in consideration of all events, phenomena and processes interconnection in their interrelationship, setting priority, work on causes rather than effects, regularity, getting any case to its logical conclusion.

The solution of the problem of quality assessment should begin with finding the key cause, i.e. identifying the main causes of defects and their appearance. It is therefore proposed to build up cause-effect diagram that allows to identify the most significant factors affecting the coating quality.

If during the manufacturing process of coating application the quality of the modified surface layer proved to be unsatisfactory, then at some point there had happened deviation from the given conditions. For creation of quality wear-resistant coatings it is necessary to make the most important quality parameter comply with various cause factors.

In plotting Ishikawa diagram the most important external factors from technical perspective have been chosen (Fig. 2).

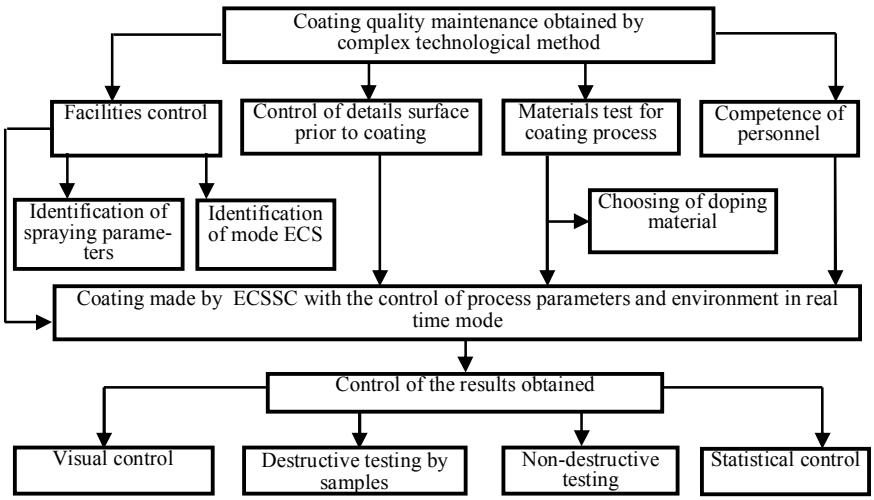

Fig. 1. Algorithm of consistent actions to ensure quality of coating made by complex technological method

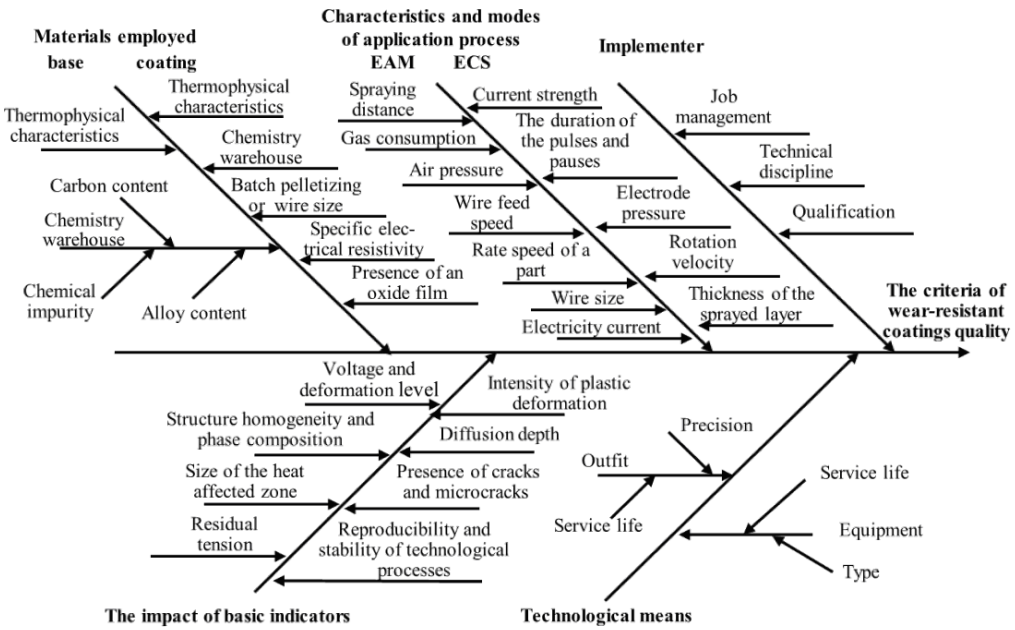

Fig. 2. Ishikawa diagram

On the basis of developed Ishikawa diagram we can analyze and identify the causes that lead to the deterioration in the quality particularly of physical, mechanical and operational properties of the coating obtained by the complex method of technology ECSSC. Of all the possible causes we need to identify the most significant one and decide what action should be taken to prevent it in the future.

The restoration process of worn machine parts is a complex multifaceted problem whose initial solution requires consideration of a great number of different data, interrelationships, interaction laws which requires the use of modern information technology, one element of which is statistical processing of information.

This will significantly improve the quality of the coating along with economic efficiency.

Conclusion. The proposed algorithm of a sequence of control measures allows to provide the necessary quality of coatings made by the complex method of technology ECSSC. The use of the developed Ishikawa diagram makes it possible to determine the most important causes that lead to the deterioration of values of quality criteria of wear-resistant coatings and to timely propose measures for their elimination.

References

1. Посвятенко Е.К. Електродугова металізація як спосіб ремонту та інженерії поверхні автомобільних деталей, вузлів та агрегатів / Е.К. Посвятенко, І.К. Римаренко, Л.А. Лопата, НА. Савченко // Системні методи керування, технологія та організація виробництва, ремонту і експлуатації автомобілів : зб. наук. прац. – К.: НТУ, 2002. – Вип. 15. – С. 186-190.

2. Лопата Л.А. Основные направления получения качественных износостойких покрытий методом электродуговой металлизации / Л.А. Лопата, Н.А. Савченко // Инженерия поверхности и реновация изделий : межд. научно-техн. конф., 28 – 30 мая 2002 г. Крым, Украина : тезисы докл. – К., 2002. – С. 98–100.

3. Лопата Л.А. Влияние технологических факторов электроконтактного припекания на формирование напыленного порошкового слоя / Л.А. Лопата, Н.А. Медведева, В.Н. Кулижский // Конструювання, виробництво та експлуатація сільськогосподарських машин: зб. наук. праць. – Кіровоград: КНТУ, 2005. – №35. – С.417–420.

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УПРАВЛІННЯ ТА КОНТРОЛЬ ПОКАЗНИКІВ ЯКОСТІ ЗНОСОСТІЙКИХ ПОКРИТТІВ

Розглянуті критерії якості зносостійких покриттів. Запропоновано алгоритм послідовних дій для одержання якісних покриттів, які отримано комбінованою технологією ЕКЗНП. Розроблено діаграму Ісікави, яка дозволяє виявити причини, що призводять до погіршення значень критеріїв якості зносостійкого покриття отриманого комбінованою технологією.

Ключові слова: критерії якості, комбінована технологія, діаграма Ісікави, зносостійке покриття.

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