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Methods of Manufacturing Cast Details with a Solid-Alloy Coating and Heat Treatment

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ABSTRACT: The article discusses the innovative technology of manufacturing molded machine parts and equipment with a wear-resistant carbide coating by casting on gasified models. The methods of applying wear-resistant coatings on the working surface of cast parts are given. Methods for determining the hardness and abrasive wear resistance of cast steel samples and parts after optimal heat treatment with double phase recrystallization, which increase the wear resistance of parts by 2-3 times, have been studied.

KEY WORDS: gasified foam model, carbide coating of smortite type, heat treatment with double phase recrystallization, hardness, microhardness, abrasive wear resistance of finished products.

I. INTRODUCTION

Most parts of agricultural and metallurgical machinery and equipment fail as a result of abrasive and abrasive-corrosive wear [1-3]. Such details include the tines of the harrow of tillage machines and rollers of the rolling mill of metallurgical equipment.
Tooth harrows are used for final cutting of the upper layers of the soil after being treated with a plow or cultivator, destroying weeds and planting fertilizers, leveling the field after sowing and ozimi, and rolling rollers for transferring thin hot rolling material to the main delivery platform and are the most simple universal tool.
Many machine parts and equipment are made by casting in earthen form without a hard-alloy coating of steel or cast iron, and the shelf life of these parts does not exceed one season, as they wear out quickly during operation. The disadvantages of the first option are insufficient hardness and wear resistance, and the second - the high consumption of scarce hard alloys and fluxes. In accordance with the task, the goal of this work is to research and develop the technology for producing foam models and to obtain cast parts with a hard alloy coating and high abrasive wear resistance [4].

II. OBJECTS AND RESEARCH METHODS.

The objects of study are the teeth of the harrow and rollers of the rolling mill, experiencing intense abrasive-corrosive wear when sliding on the soil and metal. According to these technologies, a foam model is first produced, onto which a wear-resistant carbide coating is applied, then it is formed into the casting box of the container and is poured with liquid metal of 35GL steel. During pouring, the foam model burns, and its place is filled with melt. In this way, the foam model is produced and cast parts with a wear-resistant carbide coating are obtained [4]. Improving the wear resistance and service life of these parts is a very urgent problem.
The method of casting on polystyrene gasified models is increasingly used and recognized at many machine-building plants and steel mills in our country, intensive research and development of new innovative technologies and ideas are being conducted, the range of its use for various types of castings, both harrow teeth and rolling rollers are expanding. the camp. This made it possible to increase production efficiency by reducing the complexity of foam models and castings, as well as improve the quality of steel or cast iron castings, improve their accuracy, ensure a flat surface and reduce allowances for machining or without it at all [4].
Universal harrow tines are made from medium carbon steel 45, 50 or manganese steel 65G, 70G and are considered both imported and imported spare parts for machine parts and mechanisms. Parts manufactured from manganese steel 65G, 70G are considered to be of high quality, but we do not manufacture them, but buy them as imported material for

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currency. Parts produced from medium carbon steels 45, 50 are considered good if the steels produced by us comply with GOST 1050-99. Rollers of the rolling mill are made of heat-resistant steels 12MH, 15XM, 12X13 and are both imported and imported spare parts. Heat-resistant steels have enhanced mechanical properties at high temperatures of 500-600°C. It has been established that at high temperatures the metal behaves in many ways differently than at normal or even at 300-350°C. Therefore, in materials science, special attention is paid to heat-resistant steels designed specifically for work at high temperatures. Rollers of the rolling mill are used at “Uzmetkombinat” JSC. Tooth harrows work in hard-deep and hard aggressive and soil conditions for abrasive-corrosive wear, and rolling mill rollers - at high temperatures for abrasion. Therefore, these parts fail as a result of abrasive wear. This circumstance leads to a decrease in the productivity of machinery and equipment, an increase in the consumption of spare parts and to an unjustifiably large loss of material resources and costs for repair and rehabilitation work, as well as to an excessive expenditure of labor resources.

The Department of Materials Science of the Tashkent State Technical University and Engineering Technology of the Almalyk branch of the Faculty of Energy and Mechanical Engineering of Tashkent State Technical University and the enterprise “Metallmexqurilish” HC developed technological processes for manufacturing bimetallic machine parts and equipment for various purposes using gasified models. To provide the necessary wear resistance, parts are made from medium to high carbon steels, and sometimes from cast iron. The working and formative parts of these parts are subjected to either heat treatment or they are fused with cast hard alloys. After heat treatment in these parts, low hardness and wear resistance are observed, and for surfacing, a high consumption of deficient hard alloys is necessary.

III. RESULTS OBTAINED AND THEIR DISCUSSION.

It is more rational to obtain these parts by casting on polystyrene gasifying gasified models with simultaneous application of a wear-resistant carbide coating of the type sormit of the recommended composition%: C = 2.5-3.0; Si = 0.7-1.0; Mn = 0.6-1.0; Cr = 25-29; Ni = 0.6-1.0; S, P = 0.03. Therefore, to obtain cast parts of machines, the method of casting using gasified models is used. Currently, these parts are manufactured using new innovative technologies by casting on gasified models with wear-resistant carbide coating with a layer thickness of 2.0-2.5-3.0 mm and their subsequent heat treatment with double phase recrystallization [5,6].

This method consists in the fact that the model of the future casting is made of a pre-foamed suspension polystyrene PSV (TU 6-06-1690-98) with a grain size of 3-4 mm. Polystyrene is a hard transparent plastic with a density of 1.05 g / cm^3. It dissolves well in aromatic and chlorinated hydrocarbons, esters, ketones, carbon disulfide, but is insoluble in lower alcohols, gasoline, and esters. In the places of contact of the granules under the action of this pressure, they are joined, and at a sufficiently high temperature up to 100-115°C granules are sintered into a monolithic uniform mass of foam. During cooling, the process of glass transition of polystyrene proceeds and the condensation of the blowing agent is similar to that in a separate granule. After complete cooling in running water, the aluminum molds open and remove the finished foam model from it. After drying, the finished models were covered with a layer of non-stick paint and after re-drying, the foam models were fastened in the container's box with the help of standpile-collector elements and a gating system. After the foam models were assembled, they were molded with dry quartz sand (1Q0315, etc.) to the top of the flask, and at the same time pneumatic vibration was compacted. The model models are arranged horizontally, and their working surface is up. For the formation of a hard-alloy wear-resistant coating in the casting process, a paste was prepared consisting of powders of hard alloy and a solution of 4% polyvinyl butyral in alcohol.

Before forming, the resulting foam models are glued together, and the glued foam models are arranged horizontally, and their working surface, coated with a hard-alloy coating, is upwards. In order to form a hard-alloy coating during the casting process, a paste was prepared consisting of powders of a hard alloy of the type sormit. These pastes were applied to the working surface of the foam model and subjected to heat drying. After drying, the foam models were again mounted in the casting box of the container. Then the flask was installed in the main conveyor and poured with liquid metal at a temperature of 1600-1650°C through the gating system with a siphon supply of metal. Molten metal was fed directly to the foam model. Under the action of this melt, polystyrene is gasified and the cavity-forming cavity is filled with a metal in composition corresponding to 35GL steel. This method produces steel casting of machine parts and equipment with wear-resistant carbide coating [4,5].

Methods of testing and research materials. This goal can be achieved as a result of independent and constant implementation of scientific, laboratory-bench and practical work. That is why in the present work the main methods of testing and researching materials for experimental analysis of cast steel machine parts and equipment made from the local production of “Metallmexqurilish” Tashkent enterprise are given. Figure 1 shows foam models and cast steel rolling mill rolls with wear-resistant carbide coating made by casting on gasified models.

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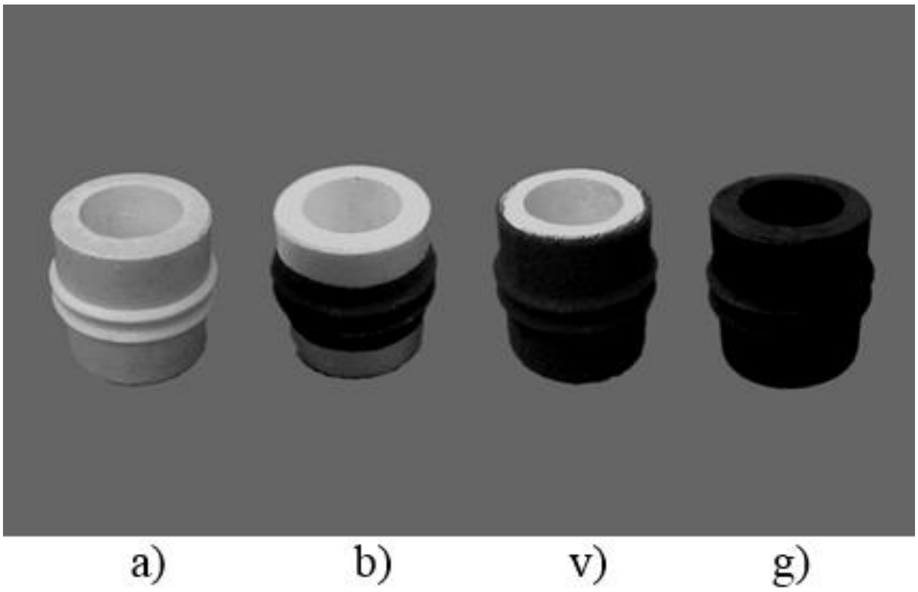

Fig.1. Foam models of rollers of rolling mill No.КБ-10.5287 with wear-resistant carbide coating: a-foam model; b-foam models with coating on the main wearing surfaces; v-foam models for the entire wear surface; g-cast steel parts of the harrow and roller teeth with carbide coating and subsequent thermal hardening.

In this paper, we investigated the composition of a hard alloy of the smormite type. The choice of the composition of the applied coating was made according to two criteria: 1-coating must meet the requirement of 3-5 - a fold increase in wear resistance compared with the wear resistance of the steel base; 2-coating should include affordable and inexpensive components and be distinguished by the simplicity of its application. On this basis, hard metal materials were selected as a coating on the working surface of parts.

Upon contact of the coating from the powder with liquid metal, a solid crust of the casting is formed. Then the coating was melted and after crystallization a wear-resistant carbide coating with the structure of high-alloyed white cast iron of eutectic and hypereutectic composition formed on the surface of the casting. Thus, a multi-layer wear-resistant metal composition was formed on the working surface, consisting of a high-alloyed layer of hard alloy with an eutectic and eutectic composition, rolling over into the zones of eutectoid and eutectoid steel and base metall.

The analysis of the conducted research has shown that to obtain hard-alloy wear-resistant coatings with a thickness of 2.0 to 3.0 mm, it is necessary to overheat the base metal melt to 1650°C and above. Specially made samples and parts were subjected to macro - and microstructural and X-ray structural phase analyzes, chemical and spectral analyzes, and tests for abrasive wear were carried out on the PV-7 friction machine.

The hardening heat treatment of cast specimens and parts was carried out by two quenching: the first quenching 900-1150°C, the tempering 200-240°C, intermediate tempering 600-650°C and the second quenching 920-940°C, the vacation 230-250°C. All parts are made from local raw materials of the Republic of Uzbekistan by casting on gasified models and cast in the foundry of Metallmexqurilish with a wear-resistant carbide coating and their subsequent heat treatment with double phase recrystallization [5,7].

IV. CONCLUSION

Thus, according to the proposed technological regimes, an experimental batch of cast steel parts of the harrow teeth and rollers of the rolling mill was manufactured for carrying out production and field tests. Four batches of parts were presented for testing and their relative wear resistance was determined in comparison with serial parts. According to the obtained test results, it was established that the relative wear resistance of the experimental parts was increased more than three times as compared with the serial ones. The wear resistance of experimental parts without a carbide coating is 1.2 times, with a carbide coating 2.5-2.8 times, with a wear-resistant carbide coating after optimum heat treatment

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with double phase recrystallization 3.5-4.0 times higher [8,10] than local batch products. This technology is implemented in SC “Uzmetkombinat” industrial enterprises of the republic with a significant actual economic effect.

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