eISSN: 2349-5715 pISSN: 2349-5707
Volume: 11, Issue 04, April-2024 SJIF 2019: 4.702 2020: 4.737 2021: 5.071 2022: 4.919 2023: 6.980 2024: 7,662

УДК621.785.

STRENGTHENING OF A METAL SURFACE WITH AN ELECTRIC ARC

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Abstract: The aim In the article, the strength of the metal surface is increased by treating it with an electric arc. When samples made of cast iron are treated with an electric arc, it can be seen that the hardness and strength of the surface layer increases by 20% compared to other thermal treatments.

Key words: Metal, cast iron, microstructure, sample, technological, hardness, repair, mechanical, material, abrasion resistance, energy, crystal lattice, deformation, electricity, temperature, recovery.

Methods: The influence of technological parameters of electric arc processing on the structure and properties of cast iron surfaces was studied in the experiment. Cast iron is usually considered a special class of iron-carbon materials and has good ductility. However, in recent decades, these alloys are increasingly replacing steels. At least two reasons can be seen for this phenomenon. The first of them is purely economic, according to which the casting method has an undeniable advantage over forging and volume stamping, does not involve processing.

Results: According to the obtained results, the increase in the electric current leads to a significant increase in the depth of the strengthening zone, while the microhardness decreases.

The results of the abrasion resistance of the obtained samples showed that the abrasion resistance increased by 4 times compared to the untreated material. The corrosion resistance of reinforced samples increased by an average of 2 times.

Summary: The recommended method of strengthening metal surfaces increases the wear resistance and corrosion resistance of machine parts and mechanisms. The bent parts of the machine and mechanism are processed with an electric arc, the surface layer is strengthened and brought out to the final size. It can be seen that the corrosion resistance has increased by 4 times, and the resistance to aggressive environment has increased by 2 times.

Introduction: The development of the industry is inextricably linked with the creation of new materials with high technical and economic indicators. One of the most important tasks of mechanical engineering is to improve the mechanical properties of metal parts that work with worn parts. An effective solution to this problem is the introduction of modern technological methods to ensure the condition of the surfaces of the material. For parts operating in frictional conditions, surface hardness and abrasion resistance and mechanical properties are most important while maintaining the plasticity of the main part of the product. Therefore, it is recommended to improve the properties of its surface layer, not the entire material of the part.

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The analysis of modern methods of strengthening the surfaces of steel products shows that one of the promising areas is strengthening with the help of concentrated energy streams. This is because the main direction of development of new processing methods is to increase by heating, cooling and deformation. It is an increase in the concentration of crystal lattice defects in the processed materials, changing their distribution in the material and, as a result, improving the mechanical and other properties of materials that are important for technology.

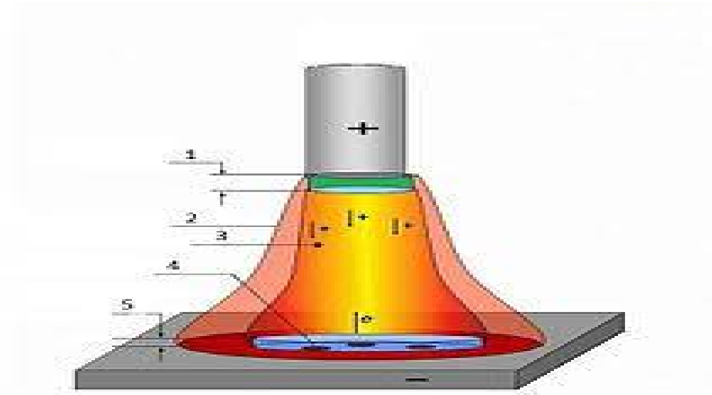

Fig. 1. The structure of the electric arc during arc welding. 1-anode area, 2-arc and shielding gas area, 3-arc, 4-cathode spots, 5-cathode area

During arc welding, during electrode melting, the temperature in the anode region is equal to 2500-4000, the temperature in the arc column is from 7,000 to 18,000, and in the cathode region - 9,000 - 12,000.

Heating with concentrated energy streams can be performed with or without melting of the surface of the processed product being repaired. Automatic recovery of the melted area is considered a special type of heat treatment. Its essence is the rapid solidification of thin surface layers and the formation of metastable structures in them.

The formation of a fine structure often leads to an increase in product performance properties, and after the liquid state, the use of one-way heat treatment is becoming widespread. Small irregularities may appear on the surface of the processed product with this type of welding as a result of outgassing and shrinkage of the metal during hardening. Correct and careful selection of the processing mode often allows limiting these errors to a few tens of micrometers. Further mechanical processing allows to eliminate these defects

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The influence of technological parameters of electric arc processing on the structure and properties of cast iron surfaces was studied in the experiment. Cast iron is usually considered a special class of iron-carbon materials and has good ductility. However, in recent decades, these alloys are increasingly replacing steels. At least two reasons can be seen for this phenomenon.

The first of them is purely economic, according to which the casting method has an undeniable advantage over forging and volume stamping, does not involve processing. In addition, it is possible to thermally treat cast iron, steel, including surface heating with high-frequency current (HFC). In addition, it is not inferior to steel in terms of hardness and abrasion resistance.

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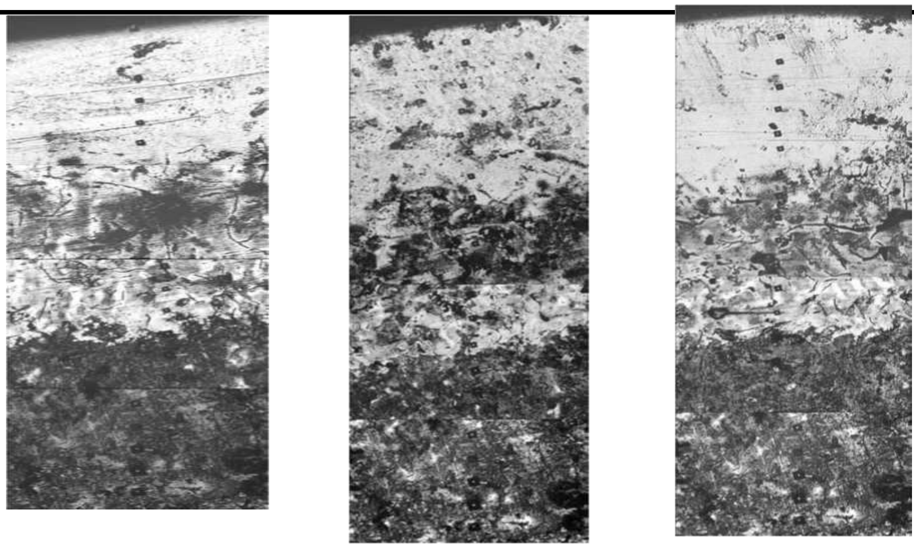

Picture. 2. Microstructure of cast iron surface processed by electric arc

SCh-32-52 (X 125): a – I = 100A, b - I = 130A, v - I = 150A, v = 0.03 m/s

Processing was carried out on a sample of gray cast iron SCh32-52 in the initial softened state. The structural structure of gray cast iron consists of a graphite metal structure in the form of a plate on a metal base. The metallic base of gray cast iron is formed from austenite during eutectoid decomposition and can be pearlite, ferrite and ferrite-pearlite. The mechanical properties of gray cast iron depend mainly on the metal properties and mainly on the number, shape and size of the graphite structures. The pearlite phase is strong and has high resistance to warping.

The research was conducted in an experimental setting. An electric arc is formed between the surface of the part and the tungsten electrode under voltage by means of a high-frequency spark discharge. Inert gas-argon is used to protect the electrode and the heated part of the part surface from oxidation.

The device is equipped with a scanning magnetic system, which allows to increase the processing index. From the current in the control winding, the current through the scanner device varied from 2 A to 5 A, and the current frequency was 50 Hz. Processing width is 10 mm. The desired area of surface reinforcement was achieved by heating at a speed of 0.01 to 0.5 m/s along the specified direction. The thermal cycle of heat in the surface layer of the part is regulated by changing the arc current (100-250 A) and a voltage of 46 V put Dissolved and undissolved surfaces were treated.

The microstructure and grain size were examined using a MIM-7 optical microscope with 800-1000x magnification. X-ray spectral analysis was performed on a DRON-2 X-ray diffractometer, and electron microscopic analysis was The microstructure and grain size were examined using a MIM-7 optical microscope with 800-1000x magnification. X-ray spectral analysis was performed on a DRON-2 X-ray diffractometer, and electron microscopic analysis was performed on a REM-200 solution electron microscope. Microhardness was determined by weighing on a PMT-3 device with a load of 1 MPa.

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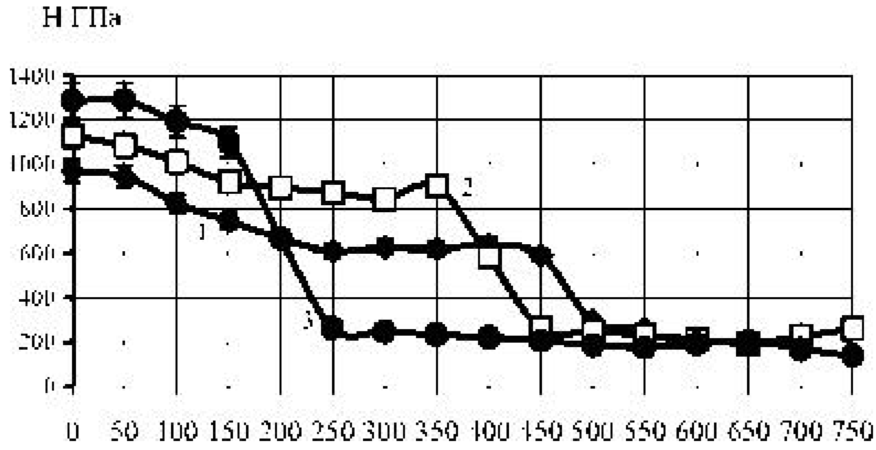
Abrasion resistance of the sample was seen by the machine snub. Corrosion resistance was determined by the standard method.

Results. In the experiment, it can be seen that the base metal zone is clearly separated from the boundary of the treated zones of the gray cast iron sample pre-softened or normalized sample. (Fig. 2). The surface layer has a very homogeneous cementite microstructure oriented towards the heat sink.

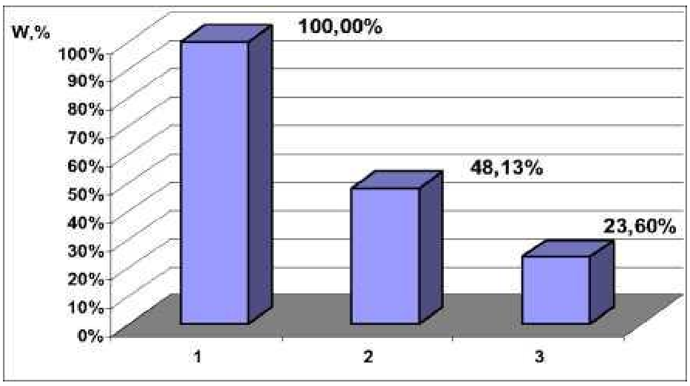
The microhardness in this layer ranges from 850 to 1100NV. These lamellae are followed by a layer of pearlite-cementite mixture with graphite inclusions. The microhardness of this layer is from 380 to 500 NM. The base metal will have a pearlite structure, and the microhardness of this layer will be in the range of 200 to 260 NM. The depth of the general coating layer varies from 220 µm to 460 µm, depending on the mode of operation of cast iron SCh 32-52.



Picture. 3. Distribution of cast iron microhardness by depth SCh 32-52

1 - g = 0.03 m/s, 2 - g = 0.05 m/s, 3 - v = 0.06 m/s

With an increase in the operating speed, the microhardness (Fig. 3) first increases with an increase in the surface cooling rate, and then decreases due to a decrease in the amount of heat transferred from the electric arc to the metal surface. As the speed of the electric arc increases, the depth of the reinforced zone decreases (Fig. 3), which can be explained by the decrease in heat flow due to the decrease in the arc exposure time in this part of the metal surface. The optimal operating speed is in the range of 0.03 to 0.06 m/s, where the maximum microhardness is achieved with a slight change in the depth of the surface layer.



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Picture. 4. Analytical histogram of the relative quantity of the surface corrosion resistance of the samples

2- Unprocessed sample; 2- Polished processed sample; 3- Unpolished machined sample

An increase in the electric current leads to a significant increase in the depth of the strengthening zone, while the microhardness decreases.

The results of the abrasion resistance of the obtained samples (Fig. 4) showed that the abrasion resistance increased by 4 times compared to the untreated material. The corrosion resistance of reinforced samples increased by an average of 2 times.

Discussions. In the 70s of the last century, one of the Russian scientists on increasing the strength of the metal surface by laser, electron beam and plasma methods. N. Rykalin, A. A. Uglov, V. S. Kraposhin, I. N. Kidin, L. I. Mirkin, V. S. Kovalenko, A. G. Grigoriants conducted scientific work. Russian scientists A.E., who have made a great contribution to the development of electric arc processing technology in recent years. Mikheev, A. V. Giri, S. S. Ivasev, R. V. Karpov's scientific work can be seen.

The microstructure of the surface of cast iron treated with an electric arc during the experiment is studied in the study "Valley Energy Mesh." The head of LLC enterprise is mature metallurgist A. The implementation was achieved with the instructions of Okhunjanov.

Conclusion. The recommended method of strengthening metal surfaces increases the wear resistance and corrosion resistance of machine parts and mechanisms. The bent parts of the machine and mechanism are processed with an electric arc, the surface layer is strengthened and brought out to the final size. It can be seen that the corrosion resistance has increased by 4 times, and the resistance to aggressive environment has increased by 2 times.

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