The highest value of impact-abrasive wear resistance ($\varepsilon_{i.a.}$= 9,8) and impact strength (KCU=15,4 MJ/m^2) of deposited Fe-Cr-Mn metal was achieved after quenching at 1150 °C, when the microstructure is mainly austenite (with small quantity of quenching martensite and carbides). The highest value in sliding friction wear resistance ($\varepsilon_{s.f.}$ = 4,2) with satisfactory impact strength value (KCU = 8,5 MJ/m^2) was achieved after quenching at 950 °C, when the structure of deposited metal is martensite-carbides with metastable retained austenite, which realized $\gamma_{ret} \rightarrow \alpha'$ DIMTT.

A new direction in the design of hardening treatments is the use of the principle of austenite heterogenization for the implementation of subsequent martensitic transformations during cooling and DIMTT, on the basis of which new methods and technologies for hardening steels and cast irons are created. Thermo-chemical methods have been created (carburizing, nitro-carburizing, high-speed thermo-cyclic cyaniding with induction heating, decarburizing treatment, etc.) in combination with the original methods of heat treatment (quenching from differentiated temperatures, high temperature thermo-cyclic treatment, low temperature thermo-cyclic treatment, plasma or electron beam treatments, etc.), providing the formation of gradient structures with differentiation of the number of A_{res} and the degree of its metastability along the depth of the layer, taking into account the subsequent evolution of the phase-structural state during operation.

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EFFECT OF DECARBURIZATION QUENCHING ON THE PROCESS OF DESTABILIZING AUSTENITE TO INCREASE THE WEAR RESISTANCE OF HADFIELD'S STEEL

The decarburization process, characterized by a decrease in the carbon content in the surface layers of most high-carbon alloys (steels and cast irons), parts and tools, when heated in oxidizing environments, is a negative phenomenon that reduces mechanical properties, because decarburization is a significant problem in heat treatment of steels as decarburization is detrimental to wear life and fatigue life of components. At the same time, for low-carbon transformer and stainless steels, of ferritic and austenitic classes, decarburization can be used as a kind of chemical-thermal treatment that improves their properties. However, to enhance the mechanical and operational properties of high-carbon alloys, decarburization as a technological process of strengthening processing is not considered in the literature and is not applied in practice. Decarburization of high-carbon steels in the process of heat treatment is considered a very undesirable phenomenon, which one usually tries to prevent. Meanwhile, a new method of thermo-chemical treatment – for decarburizing hardening of Hadfield Mn high-carbon steels is proposed, which is shown that it is possible to increase its wear resistance.

In this work the method of surface hardening based on the destabilization of phase-stable austenite in austenitic grade Hadfield steel as a result of the decarburization during high-temperature austenitization and destabilization during quenching is experimentally presented and justified. The features of the formation of a microstructure in the surface layers during decarburization quenching of Hadfield steel, which gradually varies in depth with a change in the ratio of α′- and ε′- martensites and metastable austenite, are studied in detail. Signs of *ε*- and *α*-martensite and metastable austenite can be observed in the microstructure of the decarburized layer of 110Mn13 steel. Microstructure of *ε*–martensite is characterized by the system of straight sliding lines, crossing at the angle ~60º, whilst *α*-martensite possesses lath (package) structure.

As the holding time at elevated temperatures (1150 °C) increases, the depth of the decarburized layer increases, and in the surface layer of the 110Mn13 steel samples the carbon content decreases, which causes destabilization of the austenite, the degree of which depends on the depth of decarburization in accordance with the actual distribution of the carbon content. The carbon distribution along the depth from the (*x*) surface as a function of the time of decarburization (*t*) can be solved by means of the following equation:

$$C(X,t) = C_S + (C_O - C_S)erf\left(x \big/ 2\sqrt{D\tau} \right),$$

where C_o and C_s – are the initial and the ultimate (on the surface) carbon concentration $erf\left(x \big/ 2\sqrt{D\tau} \right)$– errors function from the value of $\left(x \big/ 2\sqrt{D\tau} \right)$ is determined by means of special tables; *D* – coefficient of carbon diffusion in *γ*-iron could be determined for the applicable temperature of decarburizing austenitization with regard to mutual influence of alloying elements upon thermo dynamical activity of carbon. Dependences of the carbon concentration on the depth of the decarburized layer at different times of austenitization of 110Mn13 steel at a temperature of 1150 °C was experimental showed.

The destabilization of excessively stable austenite during decarburization causes a significant increase in the wear resistance of 110Mn13 steel (optimally by a factor of ~ 4) due to the activation of the mechanism of deformation induced *γ→ε′* and *γ→ε′→α′* martensite transformations in the surface layer during the wear process (DIMTW). The contribution of the mechanism of deformation induced *γ→ε′* and *γ→ε′→α′* DIMTW to an increase in wear resistance exceeds and significantly supplements the role of the traditional hardening mechanism and the formation of packing defects in Hadfield's steel under sliding friction conditions.