Keywords: boride Fe_2B, eutectics, cubic boron carbide $Fe_{23}(CB)_6$ and Fe-B-Csystemalloy, Gibbs energy, entropy, enthalpy and heat capacity

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THE INVESTIGATION OF AUSTENITE TRANSFORMATION KINETICS OF ENHANCED WEAR RESISTANCE WHEEL STEEL

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Purpose. The purpose of the work was to determine the critical points and to investigate the kinetics of the decomposition of supercooled austenite with the continuous cooling of low-alloy steels for wheels with chromium, nickel and microalloyed with vanadium and molybdenum, for the purposeful development of heat treatment regimes that would increase their durability.

Methodology. The studies were carried out through analyzing experimental and laboratory data.

Findings. In the operation of the wheels in each of their elements there is a complex system of compression and tension strain, which varies rapidly in time. A significant part of the failure of the railway wheels occurs not as a result of their destruction, but as a result of wear and fatigue failure of friction surfaces, which requires substantial material costs for their repair and replacement.

Depending on the operating conditions, steel is used for the manufacture of wheels with different contents of chemical elements abroad. For light conditions of braking and high loads, heat-treated wheels with high wear resistance (class D according to the standard AAR M-107 / M-208) are made of steel from 0.67-0.77% C; 0.60-0.90% Mn (% by weight).

However, as the analysis of previously obtained industrial results shows, it is impossible to achieve the required plasticity level ($\delta \geq 14\%$), without additional doping with such elements as nickel, chromium, molybdenum and vanadium. For pre-laboratory studies, ingots weighing up to 10 kg of test chemical composition (% by weight) were made: C = 0.69-0.71; Si = 0.36-0.57; Mn = 0.72-0.83; Cr = 0.21-0.90; Mo = 0.09-0.15; Ni = 0.21-0.70; V = 0.06-0.11.

According to the results of previous analytical and laboratory studies, the optimum chemical composition of steel for the production of Class D wheels according to the standard AAR M-107 / M-208 was developed. In conditions of metallurgical plant "DNIPROSTAL" steel was manufactured with chromium, nickel and microalloyed with vanadium and molybdenum. In the conditions of PJSC "INTERPIPE NTZ" an experimental industrial batch of railway wheels was manufactured.

At the first stage of the research, critical points were determined for the investigated steel. Critical points for steel wheels with 0.68% C; 0.77% Cr; 0.22% Ni; 0.69% Mo; 0,087% V at heating: Ac1 = 750 °C, Ac3 = 790 °C.

The intervals of cooling rates are determined, within which there is a change in the mechanism of structure formation in the decomposition of austenite. It is shown that at a cooling rate of ~ 1 °C/s, the decomposition of austenite occurs with the formation of perlite; at 1.5 °C/s ... 2.5 °C /s the steel structure consists of perlite, bainite and martensite; at 2,5 °C/s ... 3,5 °C/s - with bainite and martensite; At a cooling rate of more than 3.5 °C/s, the decomposition of austenite occurs with the formation of martensite.

The formation of perlite is completely suppressed in the investigated steel at a cooling rate of more than 2.5 ° C/s. The critical cooling rate for the test steel is 3.5 °C/s.

The results obtained in the work will serve as a basis for the development of optimal modes of heat treatment of railway wheels from experimental steel, and will allow to determine the areas of its effective use.

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