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# The study of the microstructure and mechanical properties of low carbon steel, microalloying by boron

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**Abstract**

The paper presents the results of the study of non-metallic inclusions, the structure and mechanical properties of low carbon steel, microalloying by boron. The study of the amount and composition of nonmetallic inclusions showed that with the introduction of boron the volume fraction of oxide and oxysulfide inclusions increases and the volume fraction of sulfide inclusions significantly decreases. At the same time, the alloying of steel with boron increases to 99.7% the proportion of inclusions with a size of no more than 5 microns against 80.6% in the metal without boron. In the metal with boron, nonmetallic inclusions larger than 10 μm are absent, while in the metal without boron their share is 13.6%. Studies have shown that in a metal containing 0.011% boron, independent boron-containing inclusions were not detected. Boron was not detected in the composition of the studied nonmetallic inclusions. In all samples, steel nonmetallic inclusions are represented mainly by oxide, oxysulfide and sulfide inclusions. In the boron-free steel, a small amount of perlite is present along with the ferritic phase. Steel microalloying by boron is accompanied by the formation of a dispersed ferrite-bainite structure, which consists of fine-grained ferrite with bainite sites with a tendency to form bainite strips along the rolling direction. The microhardness of ferrite and perlite in steel without boron does not exceed an average of 180 and 214 HV10, respectively. It is noted that the presence of boron in steel in an amount of 0.011% increases the microhardness of ferrite to 260 HV10 and bainite to 335 HV10. The mechanical properties of hot-rolled steel with a thickness of 10 mm from boron-containing low-alloyed steel, due to the predominant formation of small rounded inclusions with a size of no more than 5 microns and the formation of a fine ferrite-bainite structure, are characterized by enhanced strength properties with preservation of plastic characteristics. The absolute values of the yield strength and temporary resistance of steel with boron reach 575 and 650 MPa, respectively. With such strength properties of metal, high plastic characteristics are preserved. Rolled steel without boron is characterized by reduced to 540 and 610 MPa tensile strength and temporary resistance, respectively.

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