BORON-ALUMINIZING OF LOW-CARBON STEEL: MICROSTRUCTURE AND PROPERTIES OF THE DIFFUSION LAYER

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Nowadays, despite the development of numerous novel materials, especially non-metallic ones, steels remain among the most essential and widely used structural materials. Various techniques are employed to enhance their service performance. One well-established thermochemical treatment method is boron-aluminizing, a process involving the simultaneous or sequential diffusion saturation of metal and alloy surfaces with boron and aluminium.

As with other thermochemical treatments, the performance characteristics after boron-aluminizing are primarily determined by the hardness, depth, and structure of the diffusion layer, as well as by the structure and hardness of the base metal and transition zone.

This study aims to improve the mechanical performance of low-carbon steels by forming a multiphase surface layer through the simultaneous diffusion of boron and aluminium.

The research was conducted on samples of steel 20 (DSTU 7809:2015, equivalent to AISI 1020). Boron-aluminizing was carried out using a paste containing boron carbide, sodium hexafluoroaluminate, sodium fluoride, and aluminium powder. The samples were treated in a box furnace at 950°C and 1000°C for 1 hour.

Optical microscopy and X-ray diffraction (XRD) were used to examine the microstructure and phase composition of the formed layers. The diffusion layers consisted of large conical complex borides oriented into the steel substrate. Beneath this boride layer, a transition zone formed, enriched with interstitially dissolved carbon, boron, and aluminium. The core retained a ferrite–pearlite structure.

An increase in treatment temperature led to an increase in the layer thickness (up to 49 μm) and a reduction in the width of the transition zone. Varying the aluminium content in the paste from 5% to 30% led to an average 35% decrease in layer microhardness. The maximum measured microhardness of the boron-aluminized layer reached 1700 HV0.05.

These findings demonstrate the potential of boron-aluminizing for enhancing the wear resistance of structural components exposed to frictional and surface stresses.