INTENSIFICATION OF CHEMICAL AND HEAT TREATMENT PROCESSES

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It is relevant to improve the technological processes of manufacturing machine parts by developing new methods of surface hardening, which significantly increase the durability of the working layer and the surface of parts with a significant acceleration and simplification of surface hardening technologies. The use of physical and technical processes makes it possible to intensify chemical and thermal treatment.

A method of diffusion boriding of steel products was developed, which included preliminary application of a coating on the steel surface, which included a boron-containing substance, an activator sodium fluoride and a binder of a BF glue solution in acetone, and subsequent heating with high-frequency currents. Magnesium polyboride (amorphous boron) was used as a boron-containing substance and the activator lithium fluoride was additionally introduced, with the following ratio (wt. %): magnesium polyboride (amorphous boron) 76-90, lithium fluoride 5-12, sodium fluoride 5-12. Heating was carried out cyclically at temperatures of 750-1200 °C for 1-5 minutes with the number of treatment cycles from 6 to 30.

Analysis of the results showed that after pairing steel products with high-frequency currents with cyclic heating, boride layers with a thickness of up to 250 microns and a microhardness of up to 23 GPa are formed. The significant growth rate of the boride layer is explained by the formation of defects in the crystal structure due to multiple phase transformation, which increases the diffusion processes of atomic boron saturation. The formation of a hardened layer in a short period of time, namely up to 5 minutes, when the sample is heated by high-frequency currents, makes it possible to obtain a viscous boride layer with a reduced microhardness of up to 18 GPa. The formation of such a layer is associated with a special phase composition and structure of the layer. These features are caused by the high rate of boron diffusion deep into the steel due to rapid heating from room temperature to processing temperature. Diffusion in this case can occur along the boundaries of grains (sub-grains, blocks). At boriding temperatures, the structure of steel is austenite, according to the iron-carbon state diagram. Therefore, during processing, austenite is saturated, close to the rudimentary state. The higher the heating rate, the smaller the austenite grain and, accordingly, the smaller the block size when the set temperature is reached. This factor, in turn, leads to a longer length of grain boundaries (sub-grains, blocks), which ensure rapid movement of the saturating element from the sample surface to its core. Also, when the process of borage is intensified by microwave methods, the activity of the saturating borage-containing medium decreases (a short duration of exposure during borage and a certain amount of borage-containing coating). As a result, the boron concentration required for the formation of the boride zone does not have time to form in the surface layers of steel.