Cheylyakh Y.A.[1], Cheiliakh A.P.[2]
([1] Ilyich Iron and Steel Works in Mariupol, Mariupol;
[2] HSEI "Pryazovskyi State Technical University", Mariupol)

PARTS RENEWAL BY MEANS OF HARDFACING OF WEAR-RESISTANT METASTABLE METAL AND NEW METHODS OF ITS SURFACE STRENGTHENING

E-mail: cheylyakh_o_p@pstu.edu

Electric-arc hardfacing with powder electrodes of metastable deposited metal (DM), is especially efficient, as it has a series of advantages over other methods, including wide possibilities of obtaining various of chemical composition and consequently properties. Its advantages is using the deformation induced martensite transformation at wearing (DIMTW) as effect of self-strengthening for rise wear-resistance and others properties.

For different wear conditions (dry wear of metal against metal, abrasive and impact-abrasive wear) cost-saving alloyed compositions of flux-cored wire, ensuring obtaining of metastable Fe-Cr-Mn deposited steels with prescribed relation of austenite and martensite were developed at PSTU.

Under the influence of carbon (mass. %): 0,12…0,45; alloying (mass. %): 8...14 Cr; 6...13 Mn; 0,18...0,25 C; 0,40...0,95 Si, small additions (N, Ti, V) form the microstructure of the wear resistant deposited Fe-Cr-Mn steel with a regulated amount of martensite and austenite in the range from 0 to 100%, degree of austenite metastability, and its $\gamma \rightarrow \alpha'$ DIMTW provides enhanced properties.

New methods of strengthening DM is: tempering; quenching; thermo-cyclic treatment; strengthening with application of sources of highly concentrated energy; surface plastic deformation; thermo-chemical treatment (carburizing, nitro-carburising; nitriding); combination of its technologies.

Tempering not only makes it possible to relieve stresses, but also regulate the degree of metastability of the austenite component by modifying its temperature within 200…700 ºC range and holding time from 0,5 to 6 hours, thus modifying its ability to DIMTW. Under conditions of dry sliding friction tempering from even 300 ºC increases wear-resistance of DM ~ by 2 times approximately, as compared to the state without application of heat treatment, and at tempering at 500…600 ºC this value is 2,7…2,8 higher.

For different conditions of the usages of surfaced parts it is necessary to select the mode of quenching, providing optimum phase composition, the degree of austenite metastability: for conditions of dry sliding friction temperature of quenching must be 950 ºC, and for impact-abrasive wearing – 1150 ºC.

After the appropriate modes of low-temperature thermo-cyclic treatment 600↔20 ºC for conditions of dry sliding friction type relative wear-resistance of DM of 12Cr13Mn12SiTiNV grade was greatly increased after 5 cycles, and for impact-abrasive wear-resistance – after 11 cycles.

An increase of wear-resistance of DM of 20Cr12Mn9SiTiNV grades is observed after plasma treatment with different degrees of melting, with increase heating temperature within ~1400…1700 ºC internal, when high-disperse austenite-martensite-carbide mixture of an improved hardness HV ~7000…9000 MPa. The main reasons of such increase in wear-resistance are dispersion of the structure and optimization of the kinetics of $\gamma \rightarrow \alpha'$ DIMTW.

Ways of surface plastic deformation of deposited metal can vary: e.g. shot blasting, vibration-strengthening (hammering) treatment, running-in with rolls, diamond polishing and many others.

On the whole carburizing and subsequent quenching of DM for example, 20Cr(8…13)Mn(6…12)SiTiNV grades made it possible to improve drastically (by 1,5…2) times its wear-resistance. This is explained by metastability of the DM structure, which undergoes in its thin surface layer $\gamma \rightarrow \alpha'$ DIMTW as well as intense deformation dynamic ageing, it causing intense self-strengthening of the surface layer and simultaneous relaxation of micro-stresses during wear tests and operation.