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TECHNOLOGY OF CREATION OF COMPOSITE MATERIALS FOR MANUFACTURING HIGH-LOADED EQUIPMENT AND TOOL

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The article presents the results of studying of composite materials on boron basis on carbon steels from developed powder environment with application of various activators of treatment process and coverings properties analysis - hardness, microhardness, tendency to spelling, wear resistances in conditions of hydroabrasive wear and sliding friction.

As operational life of tool and equipment is determined first of all by physicochemical and mechanical surface properties the purpose of the given work was development of technology of surface hardening high-loaded equipment and tool use boride coverings with the set characteristics on carbon steels surface, management of their structure and phase compound.

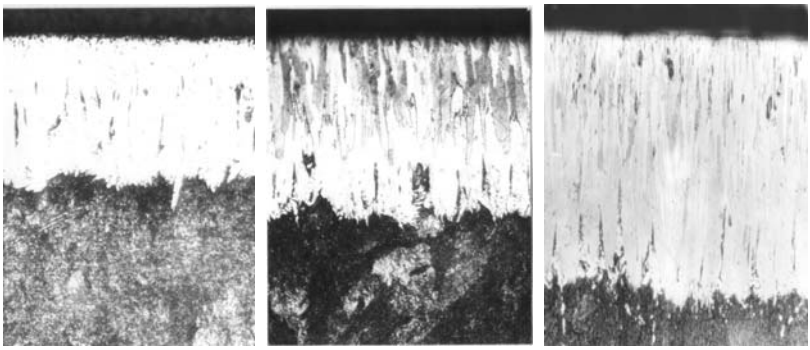
The analysis of the domestic and foreign literature [1 - 3] has shown application perspective of thermodiffusion hardening of the tool and industrial equipment used in the mining industry, building materials manufacture:

The industrial equipment and the tool which is using in these productions work in the conditions of intensive abrasive wear and high pressures. Level of protective properties of a covering is defined by its phase structure. Efficiency of use of coverings with boron will be defined by correctness of a choice like covering (single-phase or two-phase).

The operational properties of coverings, the structure and chemical composition of the phases have been investigated using Microscopy, X-ray spectral analysis.

Thermodiffusion coverings on boron basis have been received from powder mixes prepared without electric power consumption by method of out-of-furnace metallothermy of metals, nonmetals and aluminum oxides [4-5]. From the research of effect of initial components composition of powder mix and thermite additive compound necessary for initiation of their reactivation, to thermal-kinetic parameters of metallothermic reaction behavior have been determined conditions of receipt on carbon steels boride coverings of various phase and chemical composition: single-phase (Fe_2B), two-phase ($FeB + Fe_2B$) and single-phase chromium alloyed (FeCr)B, differing by chemical compound and physicomechanical properties [6].

The microstructures of the boride layers obtained on the steel 45 are represented on fig. 1



a b c

Fig. 1. Microstructures of thermodiffusion boride layers produced on carbon steel 45
a- a single-phase boride layer (Fe_2B); b –a two-phase boride layer
c – a single-phase boride layer (FeCr)B

Numerical researches of not isothermal borating modes and mathematical modeling have confirmed, that at sufficiently high chemical potential of boron-containing mix variants both single-phase and two-phase borating are possible and at various heating rates of mix at its identical compound it is possible to receive both single-phase and two-phase layers as well.

From the research of formations kinetics of thermo diffusion coverings with boron on carbon steels from developed powder environments with application of various activators of treatment process and coverings properties analysis - hardness, microhardness, tendency to spelling, wear resistances in conditions of hydroabrasive wear and sliding friction it has been determined:

- use of developed powder environments has allowed to receive on carbon steels diffused single-phase boride layers thickness up to 160 microns, two-phase - up to 400 microns and single-phase chromium alloyed coverings - up to 500 microns;
- The highest surface hardness - up to 2200 kg /mm^2 – single-phase chromium alloyed coverings bear;
- Minimal tendency to spelling and ultimate ductility have single-phase boride coverings and single-phase chromium alloyed coverings;
- At work in conditions of sliding friction at low speeds the greatest resistance have shown single-phase boride layers, at high speeds – two-phase and single-phase chromium alloyed layers and in conditions of hydroabrasive wear - single-phase chromium alloyed layers.

Production tests of some types of the tool and details of the equipment with thermal diffusion coverings on the basis boron (Fig. 2) showed increase in term of operation by 2-2,5 times.

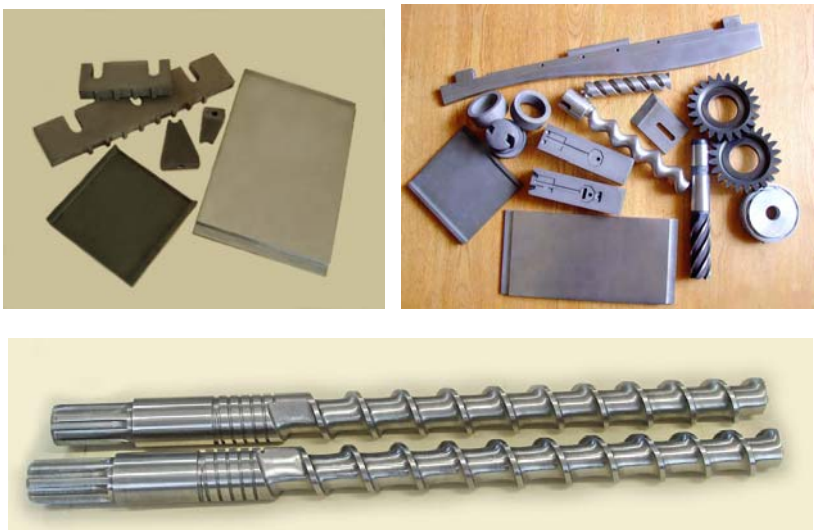


Fig. 2. Some types of industrial equipment and the cutting tool
with coverings on the basis boron

Results of conducted theoretical researches, laboratory and production researches showed that thermal diffusion boride coverings on carbon steels possess a high complex of physicomechanical characteristics. They can be used with success for hardening highly - the loaded fast-wearing-out details of construction cars and mechanisms, tool and industrial equipment at the industrial enterprises for production of various construction materials.

Literature

1. Uslu, I. Evaluation of borides formed on AISI P20 steel /H. Comert, M.Ipek,O. Ozderimir, C.Bindal // Mater. and Des. 2007. 28, №1, p.55-61.
2. Genel, K. Kinetcs of boriding of AISI W1 steel /I. Ozbek, C. Bindal//Mater. Sci. and Eng. A. – 2003.-V. 347, № 1-2.- P. 311-314.
3. Genel K. Boriding kinetics of H13 steel / K.Genel// Vacuum. 2006. 80, №5, c. 451-457.
4. Хина, Б.Б. Определение фазового состава алюмотермических смесей для борирования / Б.Б. Хина, Н.Г. Кухарева, В.Ф. Протасевич - Литье и металлургия, 2010. - № 4. – с.20-24.
5. China, B. Termodynamiczne modelowanie syntezy proszków do borowania / B.China, N.Kuchariewa, I.Basałaj // Obróbka cieplna I cieplno-chemiczna stopów metali (Poznań)– 2010.- p.35-41.
6. Kuchrieva, N.G. Badania wpływu składu proszków na strukturę I budowę fazową warstw borowanych dyfuzujnie / N.G. Kuchrieva, Galanskaia N.A., Petrovwić S.N., Babul T // Nowoczesne procesy obróbki cieplnej w produkcji narzędzi, Krakow.-2010 г.- с.49-58