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MECHANICAL CHARACTERISTICS OF SINTERED HARD ALLOYS WITH CARBIDE LAYERS

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Cutting tools made of hard alloys allow to improve the processing of parts for their cutting speed is 2-4 times higher than that of the tools made of high speed steel (HSS). In addition to this, a solid carbide tool can process hard materials that are difficult to process or not treatable at all by a HSS tool. The operational stability of carbide inserts is greatly influenced by mechanical properties changing during the deposition of carbide layers by CTP. This paper deals with the study of the mechanical properties of hard alloys with carbide layers.

In the process of thermochemical treatment of standard grades of carbide it is a change of chemical composition and structure of the surface layers, as well as the occurrence of internal stress, which has a certain influence on the mechanical and cutting properties of hard alloys.

Diffusion saturation surfaces of the insert of hard alloys simultaneously by two or more elements (multicomponent saturation) allow a much greater modification of the properties of the surface layer than that of the one-component saturation.

Cementation process is conducted in alumothermal mixtures on separate embodiment, a preliminary restoration of the mixture at a temperature of 800 – 1100◦C using reagents classification "chemically pure", "W".

Before performing the processes carbide plate was degreased, and then packed in a refractory vessel with a saturating mixture. For sealing the container shutter fuse boric anhydride was used. Maintaining the desired temperature in the furnace was realized automatically during the process of saturation.

The performance properties of the alloys with carbide deposited layers are influenced by the strength of adhesion layer with the substrate material, the ability of the diffusion layer to withstand static and dynamic loads, the absolute value and the nature of the residual stress distribution in the layer [1].

The study found that there is an optimum thickness of the diffusion layers, equal to 3.10 microns, at which mechanical properties of coated carbide maximized. The sharp decrease in values for carbide layers thicker than 10 microns says the deterioration of the adhesive strength of the layers obtained with the base, the accumulation of structural stress, the nature of the phase, which leads to chipping layer.

Carbide cutting process is a subject to high unit loads (both static and dynamic). For this reason, the output of their failure often occurs as a result of mechanical failure, which is why the mechanical properties of hard alloys largely determine their performance characteristics.

The most common measure used in the evaluation of mechanical properties of hard alloys is tensile strength transverse bending (determined according to GOST 20019-74).

The samples are used for testing ground capping (size 5 × 5 × 35 mm carbide TT20K9 GOST 3882-74). Tests were concentrated load applied at mid-span at the loading rate of 1 mm/min. Tensile strength transverse rupture was calculated by the formula:

$$\sigma_{изг} = \frac{M}{W}, \tag{1}$$

where M is a maximum bending moment; W is a moment of resistance.

For specimens of rectangular cross section transverse bending

$$M_{изг} = \frac{F \cdot l}{4}; \tag{2}$$

$$W = \frac{b \cdot h^2}{6};\qquad (3)$$

$$\sigma_{изг} = \frac{3 \cdot F \cdot l}{2 \cdot b \cdot h^2},\qquad (4)$$

where F is a breaking load, N; l is a span (distance between supports), mm; b, h are width and height of the sample, respectively, mm.

The results of investigation of the saturation conditions and the type of carbide layers on the tensile strength transverse bending carbide TT20K9 are given in table 1.

Table 1 – Tensile strength transverse bending carbide TT20K9 with different carbide layers

№ p/p	thermochemical treatment	Saturation mode, time 4 hour					
		t = 1000°C			t = 1200°C		
		$\sigma_и$, МПа	$\sigma_и/\sigma_{orig,}\cdot 100\%$	f, %	$\sigma_и$, МПа	$\sigma_и/\sigma_{orig,}\cdot 100\%$	f, %
1	Original alloy (uncoated)	1611	-	17,2	1611	-	17,2
2	(TiO_2:Nb_2O_5 =3:1)	1329	82,5	3,5	1158	71,9	4,8
3	(TiO_2:Cr_2O_3=1:1)	1331	82,6	5,3	958	59,5	5,9
4	(TiO_2:Cr_2O_3=3:1)	1333	82,7	6,1	1086	67,4	8,2
5	(Cr_2O_3:Nb_2O_5=1:1)	1041	64,6	3,8	980	60,8	4,4
6	chromium-plating	1222	75,9	3,0	1124	69,8	6,9

In all cases, after saturation at 1200◦C the greater decrease in strength of carbide than after saturation at 1000ºC was detected. This is due to the growth of the carbide layer, and as a consequence, increasing the thickness of the brittle η – phase.

Plate with carbide deposited layers is characterized by considerable homogeneity properties, which is very important when they are used as the material of the cutting tool on automatic, CNC machines and slot machines.

The table shows that the tensile strength in transverse bending after thermochemical treatment is reduced to 20 %, which is consistent with the results of [2], which refers to a decrease in flexural strength alloys of VC and TC for coating carbide titanium.

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RESTORATION OF SHAFTS OF AGRICULTURAL MACHINERY

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Technical progress in agriculture is continuously connected with the constant improvement of repair production. Nomenclature of parts whose recovery is advisable for most repair facilities is continuously expanding. An important condition is to achieve quality of new parts at low costs. These circumstances necessitate the development and implementation in the repair manufacture resource saving technologies.

Limited public stocks of fuel and materials in Belarus cannot provide adequate reproduction of vehicle fleet forces and engineering along with its preservation, maintenance require the development of production, which saves a lot of labor and materials. Overhaul require, for example, seven thousand harvesters, 20 thousand tractor engines, 50 thousand vehicles, 150 thousand units of process equipment. Repair is economically feasible. About a quarter parts repair fund is not frayed or worn within acceptable limits and can be reused in their cost of 2-3%, and about half of the parts can be used after restoration at a cost of 15 – 30% of the price of new parts , respectively [1, 2]. Parts restoration retains a large number of materials, energy and labor.