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INCREASING DURABILITY OF WORKING Soil, forage and crop MACHINES

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The article considers promising structural materials and technology to strengthen the working of agricultural machines. A new method of strengthening work, which provides a significant increase in their durability.

Ploughshare plow, cultivator paw, abrasive wear powder composite materials, layered structure.

Formulation of the problem. Quality of agricultural machinery and equipment is determined by their operational reliability and durability. The problem of durability and reliability of agricultural machinery and tractors now are one of the primary challenges in the struggle to improve machine productivity and reduce the cost of the products obtained. Seasonal agricultural work puts special demands on machine reliability in their operation. Techno-economic performance of many agricultural machines still very low due to the small length of service of their workers and forced outages at the last periodic replacement, which requires a significant investment of funds and for spare parts.

In particular this applies tillage machines and tools, working bodies are working in difficult field conditions, with considerable stress, vibration, shock, tilting. Rapid wear blades Blades cultivators paws and reduces the performance of units and the quality of performance and, ultimately, to increase the cost of agricultural products. In arid southern regions of Ukraine blades and plows cultivators paws have to repair or replace thatchanges [1]. It should also be noted that the cutting of the soil is the most common operation in agriculture: plowing, cultivation, harrowing, harvesting of grain and industrial crops, representing not less than 70% of the total volume of mechanized operations.

Analysis of recent research. The interaction of soil tillage working bodies and planting machines undergo intensive abrasive wear. From the technical condition of the blade working body agricultural machine depend on such performance, as

the degree of weed cutting, the stability of the course work in depth, average depth of cultivation, the resistance movement.

The process of wear metals in interaction with abrasive environments are the subject of research by many authors and creative teams both in our country and abroad. Several researchers [3,4,5] believe that the abrasive wear mechanism is simple, and is applied to the surface friction of a large number of small scratches. IV KRAGELSKY distinguishes three types of wear, with an elastic contact, plastic sealings and mikrorizanni [6]. PN Lions [7] considers that the deterioration of abrasive particles is due to plastic deformation of the surface layers of metal. This notes that the surface layer of embossed ridges on the edges of scratches turns into a fragile state.

BI Kostecki argues that the small difference in the hardness of the metal and abrasive wear surfaces (friction on the ground), possibly due to the formation and destruction of oxide films, but in this case, is leading the process of plastic deformation. In normal use wear cutting elements tillage machines by plastic deformation occurs, activation of the surface layer of the metal and its interaction with the active components of the environment, the formation of secondary structures weakened and their destruction [8, 9]. Methods for increasing the durability of the agricultural working machines used in their manufacture can be divided into the following groups: the chemical state and properties of the material; heat treatment, surface chemical and thermal strengthening; surfacing of hard alloys.

A specialized enterprises, many companies involved in the release of only working bodies.

As an example, the company La Pina, Bellota (Spain), Fordes de Niawx (France), Land (USA). Machine building plants in Germany produce about 30 types of blades to meet farmers who are operating plows in different climatic zones. In reversible plow blades Rabe, Germany applied carbide coating (Plasmabid), which significantly increases their operation.

Company Bellota (Spain), not only is the main manufacturer of disc harrows with boromistkoyi steel. Here the strict quality control, which guarantees total uniformity drives, providing high-quality implementation of field work. The hardness of the friction surfaces ensures elasticity and strength needed to absorb shocks without damaging the disk, and resistance to the most abrasive soils. The company "Veles-Agro Ltd" is one of the first manufacturers in the CIS, which has mastered the production of spare parts using stainless steel. Made for this technology detail tillage machines (blades, clutches, discs) with a surface hardness up to 50 units can increase the life of three parts compared to parts manufactured from steel 65G.

So one of the ways to achieve high wear resistance is the use of hard alloys. Hard alloys are increasingly used as a structural material

worn parts of friction and cutting tool. They consist of carbide and binder phases and produced by powder metallurgy. The presence in the deposited layer of carbides of refractory metals (TiC, NbC, VC, WC, MoC) increases hardness and wear resistance of the metal, which in turn increases the service life of the working of agricultural machinery. For example, titanium carbide has the highest melting point and hardness with all widely used to alloy carbides of refractory metals. In addition, the structure of weld metal in the complex vehicle ready doping titanium carbide compound provides high wear resistance and hardness of the alloy, which allows multiple increase in service life of products.

In this regard, one of the main objectives of the creation of new welding consumables for arc welding, which has high physical-mechanical and technological properties is to develop a special powder materials (including powdered electrodes) as well as economic and environmentally friendly technologies receiving them.

During the restoration of worn parts manufacturing operations reduced the number of 5-8 times in leveling the playing field with the manufacture of new parts. This durability of manufactured parts can reach a new level, and their cost is 40-70% of the cost of new parts.

The purpose of research. Development of designs operating cutting elements of agricultural machinery, materials and technologies to strengthen and wear-resistant parts production work of tillage, planting and forage machines.

Results. Technological methods of strengthening of surface layers of machine parts, providing change their mechanical and physical-chemical properties play an important role in enhancing the durability and longevity of machine parts. Using different methods of strengthening in combination with the design tools to create friction in the pairs of these conditions that produced the phenomenon of structural adjustment in friction materials, which makes dynamic equilibrium and self-activation process and passivation of the surface layers [10].

Optimizing these processes as a result of using different methods of strengthening achieves optimal balance between the intensity of the formation and destruction of secondary structures (various oxide films) and a wide range of conditions of friction pairs, eliminate obstacles that vyzyvayut inhibition of these processes [11]. Research microstructure surface layers of secondary structures formed by friction construction materials showed that for each characteristic to strengthen the development of friction that differ significantly from each other. Increased durability due to the use of methods of strengthening is achieved by increasing the hardness and ductility decrease in the surface layer, and in some cases - by changing the phase and chemical composition of this layer.

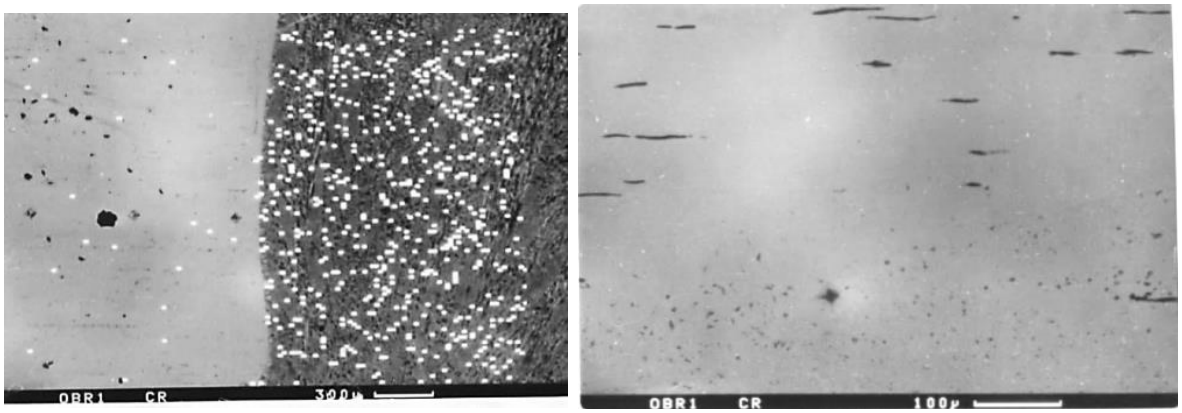
Protective structures on the working surfaces of machine parts and mechanisms to help improve their reliability and durability, productivity, reduce the consumption of ferrous and nonferrous metals, and as a result, save enormous material, energy and labor. Introduction to production technology methods that ensure wear-resistant structures prior modeling of friction units, setting external factors in its performance, learning processes that develop on the surfaces of friction strengthened studied coatings.

Coating provides durability cutting edge of the blade working body, effectively removing heat from the cutting area, reducing vibration and damping effects, and carbide coatings are more effective than nitrides. One of the effective methods to achieve high wear resistance is the use of hard alloys, carbides such as refractory metals. In addition, wear surfacing material essentially depends on the type and amount of carbide phase in alloys. Most often reinforcing phase should have the following carbides: Fe3 C; Mn3 C; Cr7 C; W2 C; WC; VC; TiC; B4C; Mo2C, and others, as well karboboridy, nytridy iron and alloying elements. At present, the friction machines using metallic, non-metallic and composite materials, solid and porous with homogeneous and heterogeneous structure. The material is produced by casting, powder metallurgy, welding, spraying. In materials obtained powder metallurgy, strength is achieved both by the heterogeneity of structure and by obtaining optimal porosity.

Powder metallurgy allow to synthesize materials that vary in composition, structure, properties and functional efficiency, which opens opportunities for use in friction units of machines. In, general, structural strength of materials is achieved with the optimum combination of bulk characteristics of hardness, toughness, borders strength, yield strength and fatigue. Alloys based on nickel chromium carbide (KHN) and phosphoric nickel (KHNF) bonds different set of functional properties, which makes it possible to effectively use them for the manufacture of parts, working in conditions of friction, abrasive wear, aggressive chemical environments and high temperatures [12].

From the materials VIII of the periodic table of elements, is widely used as a cementing bond receipt carbide, cheapest and most non-deficient is iron. Strength characteristics of powder composites increased by doping iron base alloy. One of the most common dopants are chrome. Products chromium carbide alloys produced from a mixture of powdered chromium carbide Cr3C2 and nickel pressing and sintering in a protective environment at temperatures above 1200o C. nickel content may be 5-40%. For details, working in conditions of abrasive wear, choose low-nickel, which provide high hardness and resistance to wear.

Thus, for coatings designed for application to surface friction working bodies, it is important to not only the composition, structure, physical and mechanical properties, but also the duration of the coating on the contact areas until their destruction (durability during production operation. The intensity of wear and macro destruction depends on the hardness of coverage appropriate relation between viscosity and hardness, adhesion strength between layers. it should be noted that composite nanocoating between phase and boundaries between grains are areas of intense energy dissipation and crack deviation from the direction of motion, their partial or complete inhibition, leading to the strengthening of the surface. Therefore, coating with nano-sized structure and a multilayer structure have significantly more long-term work to fracture. a promising ply composite materials produced by powder metallurgy. In this case, no clear boundary between the working layer and the base (Fig. 1) .In our work the composite powder materials and powder mixes KHZH50 KHZH85 and knives crushing drum-propelled foragers KPI 2.4. Production tests have shown that the production of feed working machines (Fig. 2) with a ball working part KHNF15 provides samozahostryuvannya effect due to regulatory differences and wear resistance of faces and core (Table. 1).



and b

Fig. 1. The depth of penetration of chromium at the interface (coating-base), and - steel 65G after microwave; b - composite KHZH-50 h1000.

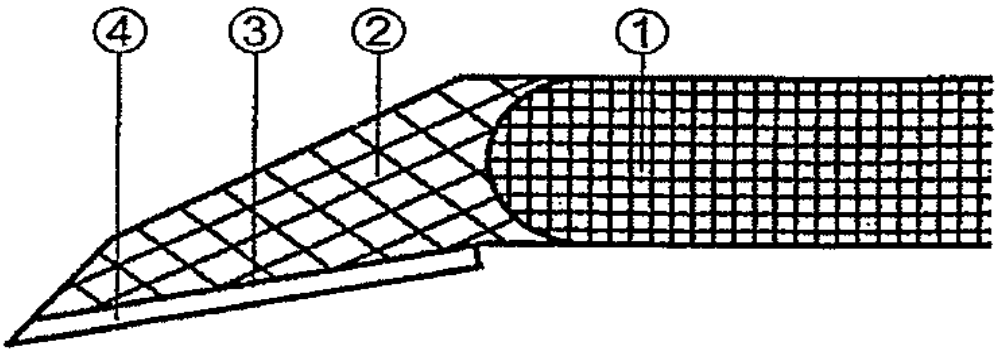
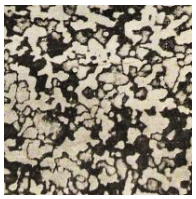
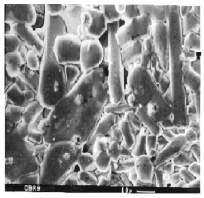


Fig. 2. The original than the chopper forage harvester.

1. Scheme of knife manufacturing crushing drum

number	Name	Special property	Benefits for consumers	The picture under the microscope
1.	Base knife	it is cutting zone; has a maximum viscosity, because it consists of high-strength steel knife upgraded, which was repeated heat treatment	higher resource less risk of breakage	
2.	The cutting area	forms the cutting edge of the knife and bears carbide coating; subjected to hardening by high frequency to achieve optimal blade hardness while maintaining its maximum possible viscosity	reduce the cost of grinding	
3.	Zone coverage communication with the base	free of pores and a thin layer of binder (matrix) connecting carbide carbide coating of hardened base material	prevents flaking individual fragments covering	
4.	Carbide coating embodiment him carbide material	protects against wear cutting edge and forms a zone of extension of knife blade; provides "effect samozahostryuvannya"	a decrease in the storage sharpening precision cut	

Comparison of properties of alloys of chrome carbide, iron carbide and chromium-nickel shows that to achieve similar values of hardness, flexural strength and impact strength, mass fraction of chromium carbide

alloys with iron in the bunch should be 1.5-2 times lower than that of nickel alloys.

The interaction of titanium with chromium carbide during sintering was investigated in [13], which the authors found that sintered materials produced new phase-TiC. Dissolution of chromium carbide takes place at temperatures ranging from 950 to 1250o C.

To address this issue was proposed the idea of using as a matrix material chromium carbide and relaxation with high damping properties, which are manifested in the details of the load due to structural phase transitions. The use of this type of matrix material can be used as a strengthening phase of titanium carbide and renounce the use of scarce tungsten carbide.

When used in a mixture with titanium carbide particles of chromium (particles less than 20 microns), in the same temperature range is dissociation of chromium carbide and titanium carbide formation in places of concentration of carbon. For the formation of titanium carbide seasons presence is not necessary.

Working bodies of agricultural machines in addition to intensive abrasive wear undergo corrosion damage that is associated with their use in soil. Therefore, one of the promising areas of materials research is mathematical modeling of nanoparticles and their interactions. For multilayer coatings consisting of phases and components, construction of phase diagrams allows you to set how many phases, and which specific phases form a system with the parameters of the data values. Analysis of the relative location of stations by volume, surfaces, lines and points that form the state diagram, can clearly determine the conditions of phase equilibrium, the emergence of a new system of phases and chemical compounds formation and collapse structures.

The second important point in the study of surfaces is contact modeling processes at border-lining covering. To create a protective coating triathl technical now use different chemical, physical and physicochemical methods that allow to form on the working surfaces of machine parts structures with predetermined properties.

Traditional methods of coating fewer satisfy high demands on materials for use in dynamic loads, aggressive and abrasive media flows.

Conclusions

1. One method of increasing the durability of working organs of agricultural machines is to use laminated composite materials obtained by powder metallurgy.

2. The formation of structure and phase composition and properties of the composite material layer influencing carbon and chromium. Value concentration of chromium and carbon determines the type carbide phase.

List of references

1. *Kanivets ID* Increased durability of working organs of agricultural machines / ID Kanivets. - Dnepropetrovsk: Promin, 1968. - 62 p.
2. *Tkachev VN* Yznos and Increase Durability detail agricultural machines / VN Tkachev. - M .: Engineering, 1971. - 263 p.
3. *Khrushchev MM* Abrazyvnoe yznashyvanye / MM Khrushchev, MA Babicheva. - M .: Nauka, 1970. - 252 p.
4. *Khrushchev MM* Study yznashyvanyya metal / MM Khrushchev, MA Babachev. - M .: Publishing House of the USSR Academy of Sciences, 1960. - 264 p.
5. *Khrushchev MM* Resistance yznashyvanyyu abrasive materials neodnorodnыh structural and / NN Khrushchev, MA Babicheva. - M .: Publishing. AN USSR, and Trenye yznos in cars. - Vol. XII. - 1958. - P. 124-132.
6. *Krahelskyy IV* Trenye and yznos / IV Krahelskyy. - M .: Mashhyz, 1962. - 240 p.
7. *Lions PN* Yznosostoykost parts of building and road cars / *PN Lions*. - M .: Mashhyz, 1962. - 280 p.
8. *Kostetskyy B.* Trenye a normal phenomenon in povrezhdaemosty machines / *B. Kostetskyy, L. Bershadskyy*. - M .: Engineering, 1970. - 340 p.
9. *Kostetskyy B.* Эksperymentalnoe Study Physical model yznashyvanyya normal metal / Kostetskyy B., L. Bershadskyy // Problems trenyya and yznashyvanyya. - K .: Engineering, 1972. - Vol. 2. - C. 12-19.
10. *Kostetskyy BI* Resistance yznashyvanyyu machine parts / BI Kostetskyy. - M.-C .: Mashhyz, 1959. - 476 p.
11. *reliability of* Durability and cars / [BI Kostetskyy, IG Nosovskyy, LI Bershadskyy, AK Karaulov]. - K .: Techniques, 1975. - 408 p.
12. *VN Klimenko* Spekanye, strukturoobrazovanye and properties of materials poroshkovыh system karbyd chromium-iron / VN Klimenko, VA Maslyuk, Y. Sambros // Poroshkovaya Metallurgy. - 1986. - №8. - C. 39-44.
13. *Vlasyuk R.* Oh strukturoobrazovanyy spekanyy compositions with Ti-karbyd chrome / Vlasyuk R., I. Radomыselskyy // Poroshkovaya Metallurgy. - 1977. - №11. - C. 22-25.

In Article rassmotrenы perspektyvnыe konstruktsyonnыe materials for bodies uprochnenyya workers agricultural machines. New proposals perspektyvnыy method uprochnenyya workers organs, obespechyvayuschyy Significant Increase yznosostoykosty s.

Lemekh plow, cultivator paw, abrazыvnoe yznashyvanye, kompozytsyonnыe poroshkovыe materials, sferoydalnaya structure.

In paper perspective composite materials, effective for hardening of working bodies of the cars working in the abrasive environment are considered. The new perspective method of hardening of working bodies, providing substantial increase of its wear resistance is offered.

Plow ploughshare, cultivator paw, abrasive wear, composite powder materials, spheroidal structure.