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Surface hardening of cutting elements agricultural machinery vibro arc plasma

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Abstract. At present, the state technical policy aimed at the modernization of worn equipment, including agriculture, based on the use of high-performance technology called nanotechnology. By upgrading worn-out equipment meant restoring it with the achievement of the above parameters passport. The existing traditional technologies are not suitable for the repair of worn-out equipment modernization. This is especially true of imported equipment. Out here alone - is the use of high-performance technologies. In this paper, we consider the use of vibro arc plasma for surface hardening of cutting elements of agricultural machinery.

1. Introduction.

The most suitable high-performance technologies when recovering of agricultural equipment are plasma technology [1]. For plasma technologies typically use low-temperature plasma gas discharge [2-11]. A wide range of energy, thermal and gas-dynamic characteristics of low temperature plasma gas discharge enables its use in a variety of technologies. This is - the technology of heating, cutting, welding, welding, spraying a variety of metal, non-metallic and dielectric coatings, thin film deposition, various plasma-chemical reactions to produce products with unusual properties, the impact on the surface for the purpose of decontamination, polishing, hardening, changes in the structure . The heat capacity of the plasma jet can be varied from tens of watts to tens of megawatts, the temperature - from a few hundred degrees to 50 000ºS, effective efficiency Heating may be up to 90%, the continuous operation period - up to 1000 hours 12, 13]. In this plasma apparatus, called plasma torches are relatively simple in structure and easy to operate process.

Analysis of the plasma properties and possibilities of its application has shown that for hardening of cutting elements agricultural units the most appropriate technology is vibro arc plasma technology hardening [14-16]. There is applied to the surface of the reinforcing composite material comprising aluminum oxide Al^2O^3 and SiO^2 silicon, and boron carbide B4C. When vibro arc cladding formed on the surface coating containing ceramic superhard inclusion of boron carbide, corundum and carbo corundum.. Simultaneously, welding takes place hardenable surface doping boron and nitrogen due to dissociation boronitro containing composite components, and carbon through its diffusion from the sublimation of the graphite electrode arc during combustion. The hardened layer is composed of three zones: a reinforced base transition and the main upper. Hardened base is characterized by a pronounced phase changes caused by the diffusion of the elements that make up the composite material. The transition zone is an alloy melted the top layer of the composite parts and mother. The

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main upper band is the most solid and consists of a steel matrix containing FeC formed iron carbides. Fe^2 C^3, borides FeB and Fe^2B and ceramic phase - iron spinel FeO Al^2O^3, boron carbide B^4C, corundum and carbo corundum. With this treatment, the surface of the working bodies of machines becomes a hardness of about 70 HRC and their endurance increases by 2.0 - 2.5 times.

2. Materials and methods of research.

For research were used 45 samples of steel 4 mm thick. As the composite material was chosen paste of the following composition: Powder PG-10H-01 - 55%, boron carbide - 20% borax - 10%, cryolite - 8%, SiO^2 - 5%. Al - 2%. Binder - 20% water glass solution. Research Methodology: The sample is pressed into a disc, grinding the resulting ground and polished. Microhardness measurements performed on one instrument KMT-1 Vickers method. The load F = 1 H, the holding time t = 10 seconds. The increase of 370.

3. Results and discussion.

Sample without treatment. Figure 1 shows a photograph of the grinding surface of the starting material. To study the microhardness was stamped 16 prints. On the surface of the section it can be seen that the structure of the starting material is uniform. Differences in the indentation of the device is not noticeable. The microhardness values of the sample are shown in table. 1.

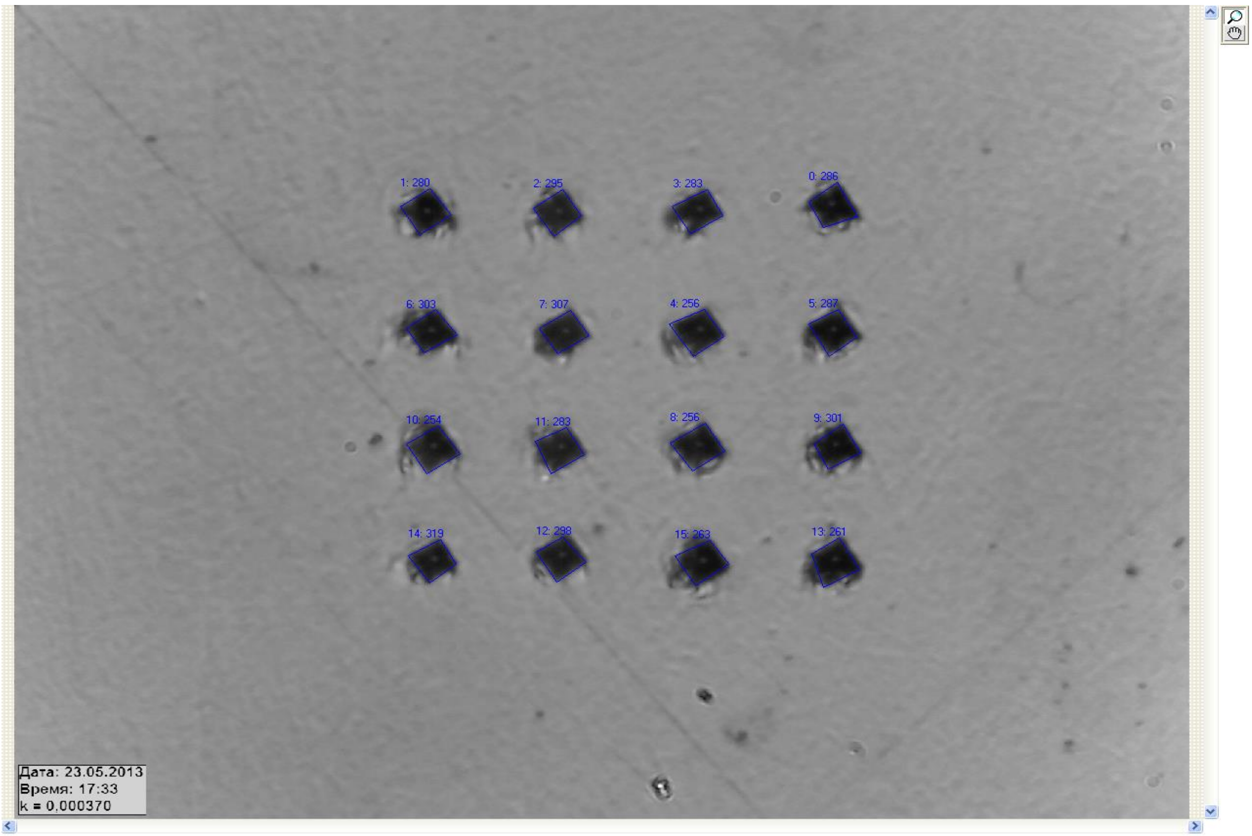

Figure 1 - Sample without treatment

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Table 1 - The values of the microhardness of the initial sample

The study area	Microhardness, kgf/mm^2				Average value of microhardness, kgf/mm^2
The zone of the base material	280	295	283	286	286
	303	307	256	287	288
	254	283	256	301	274
	319	298	263	261	285
The mean value of microhardness of the base material, kgf/mm^2					283

Conclusion: The mean value of microhardness of the base material was 283 kgf/mm^2.

The sample after processing. Figure 2 shows a photograph of the grinding surface of the material after processing. To study the microhardness was stamped 36 prints: on the deposited layer 20 prints on the base material 16 prints. On the surface of the section it can be seen that the structure of alloy layer is homogeneous. The boundary of a clear transition. Microhardness was investigated on the weld layer, as well as on the base material. The microhardness values of the sample obtained in the border area of the two zones are shown in table. 2.

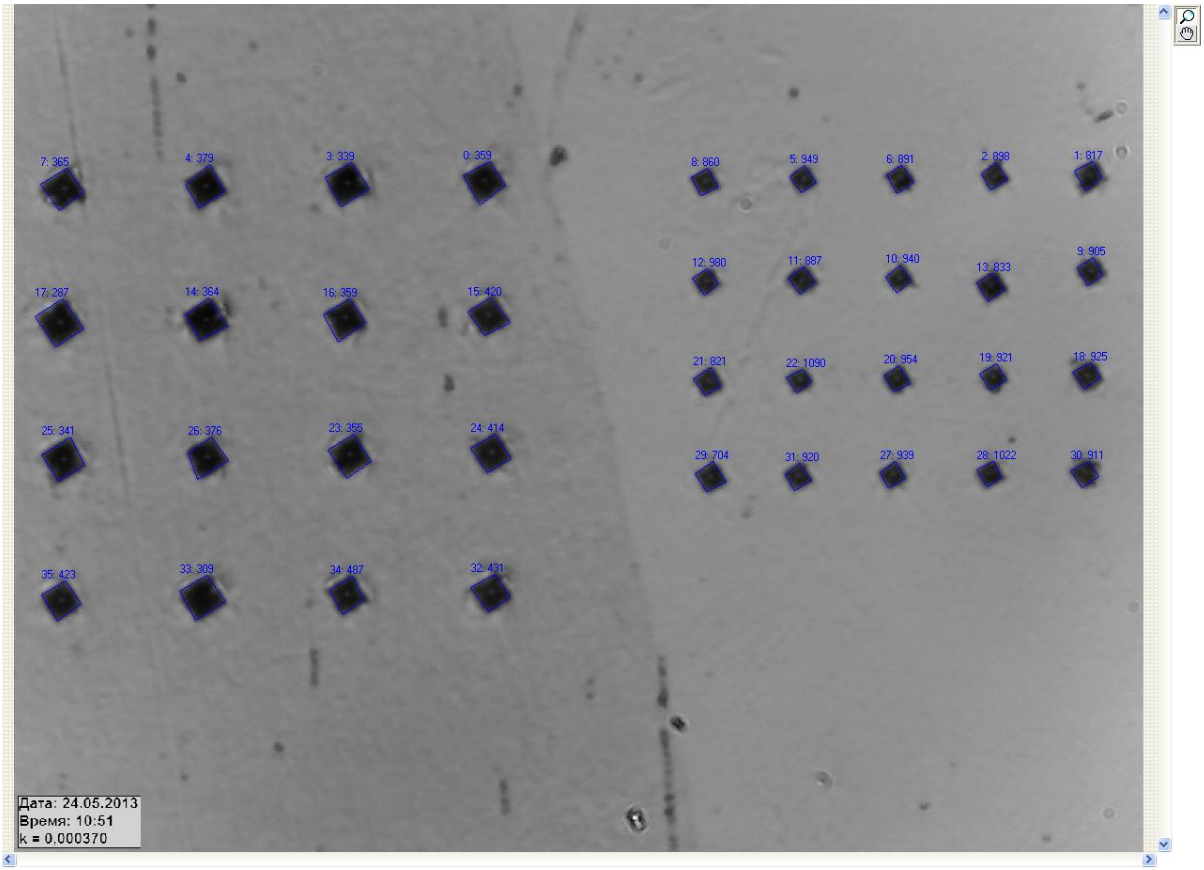

Figure 2 - The sample after processing

Table 2 - The microhardness values of the sample obtained in the border area of the two zones are shown

The study area	Microhardness, kgf/mm^2				Average value of microhardness, kgf/mm^2
The zone of the base material (hardened layer)	365	287	339	359	338
	379	364	359	420	381
	339	359	355	414	367
	359	420	487	431	424
The mean value of microhardness of the base material, kgf/mm^2					378
Coverage	860	980	821	704	841
	949	887	1090	920	962
	891	940	954	939	931
	898	833	921	1022	919
	817	905	925	911	890
The average microhardness of the coating material, kgf/mm^2					909

Conclusion: The mean value of microhardness of the base material near the surface of the sample was 378 kgf/mm^2. The mean value of microhardness of the coating material was 909 kgf/mm^2.

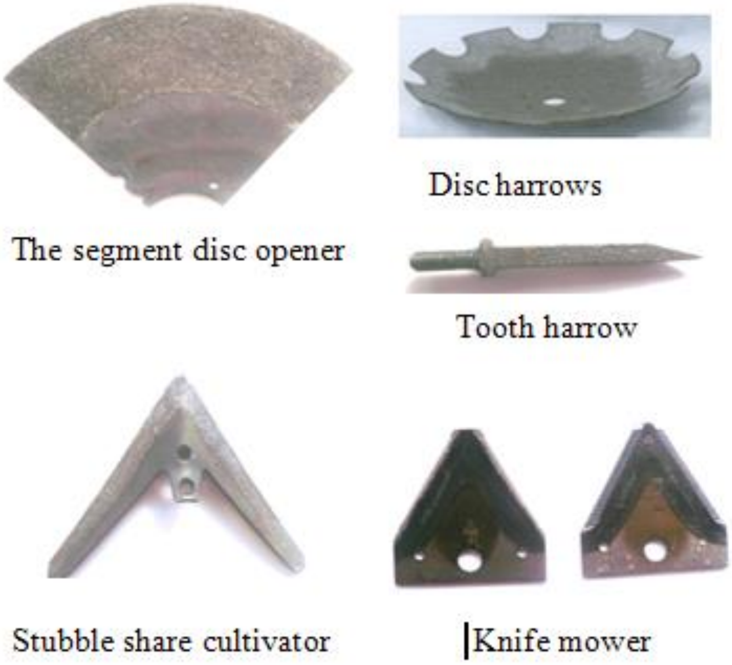

Figure 3 - Some hardened cutting elements agricultural units

Comparison of the results of processing the steel surface weld layer 45 of the composite material shows that the microhardness of the deposited layer is 3 times the microhardness of the substrate material, and the microhardness of the hardened backing layer - 1.5 times. Studies have shown that the hardening layer of the base material, depending on the injected power discharge may reach 1.5 - 2 mm thick, and in some cases up to 3 - 4 mm.

It was investigated the variation of microhardness steel surface 45 when processing vibro arc plasma without the use of a composite material. In this case, the depth of the foundations microhardness increased 1.5 times, and in the surface layer of the sintered to 4 times. Because of limited space complete these studies do not give.

Considered technology has been used for hardening elements such agricultural units, the disc coulter, claw cultivator, disc harrow, tooth harrow et al. (Figure 3). Processing is performed without the use of a composite material.

Below are photos of the surface of the disc opener to vibro arc after hardening (Figure 4). They show that after hardening sharply deteriorating the roughness of the original surface. However,

a

b

Figure 4 - the surface of the disc coulter images before (a) and after (b) vibro arc hardening. Increased 100 times. Photo size 1,6x1,2 mm

it must be assumed that such a deterioration of the surface will not affect the ability of the cutting tool. Figure 5 shows a photograph of the section opener after hardening. It can be seen that the upper layer of the molten alloy parts has a sharp boundary with the base.

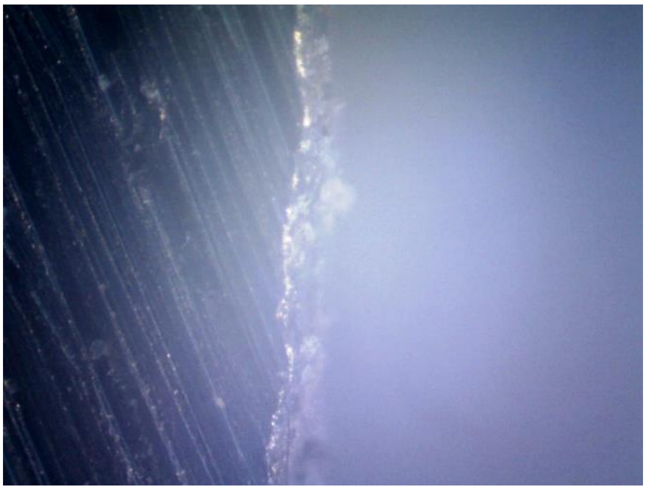

Figure 5 - Photo of the section opener. Increased 100 times. Photo size 1,6x1,2 mm

4. Conclusions.

1. A new enabling technology hardening surfaces cutting elements agricultural units, allowing 2.0 - 2.5 fold increase in their operational life;
2. The proposed technology has the versatility and can be used to upgrade technology.
3. Notwithstanding the applicability of the technology vibro arc hardening of surfaces in practice to this day remains to examine how the process of hardening and plasma-chemical processes occurring in the discharge.

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