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

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

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.

Most agricultural machinery include internal combustion engines, and among the items to restore, crankshafts occupy a special place. The cost of one crankshaft domestic engines ranges from 10 to 25%, and foreign – from 20 to 50% of the motor [3]. During the operation they are subjected to torsion and bending lose initial accuracy and partially margin.

Wide application of coatings to restore crank allows you to return the functional properties of the surface and increase the structural strength of the product. Tensile strength and viscosity changes with applied coatings reducing or changing the chemical composition of the deposited alloy. The creation of various structures in the coating nonequilibrium transition zone increases the strength, hardness, wear resistance, but it lowers the fatigue strength.

During the deposition, in areas which are heated to a temperature above the phase transformation due to the rapid cooling , and , as in the weld metal, and the transition zone the following processes occur: burning of alloying elements, the occurrence of residual internal stress, formation of non-equilibrium structures such as carbon supersaturated and alloying elements, solid solutions, and increase the grain size (area of overheating), which have different effects on the performance of the shafts.

On the one hand, the metastable none quilibrium structures provide high hardness, strength and wear resistance of the surface layer parts, but on the other hand, the surface layers none quilibrium structure, increased grain size, internal residual tensile stress and lower the resistance to cyclic impact loading.

Because of uneven wear necks, short time overload motor uneven fuel into the cylinders, the cylinder displacement of supports due to the aging of the metal, and for other reasons there is a condition in which the crankshaft is working with congestion. As a result, there are places with most intense fatigue damage.

It has been found that the endurance limit of extremely worn crankshafts to restore was reduced by 25 – 30% [4]. The main dangerous load for diesel engines is the bending moment, and for gasoline – torque. Typical fracture crankshafts first occur on the cheeks, secondly – on the cervix. When rounding shaft gasoline engines are removed from the surface layers of the necks of accumulated fatigue damage, and their capacity leads to unload most intense metal layers. All this contributes to the restoration of their resource. Completely to remove a manner extremely destroyed layers of metal shafts in the area of diesel engines fillets is difficult, so their life cannot be restored.

Thus, the range of items to be restored continues to grow, expanding repair production leads to the introduction of resource-saving technologies , welding is widely used to restore crankshafts of agricultural machinery, the main parameters determining post-restoration engine hours are wear resistance and fatigue strength . To improve post-restoration operated internal combustion engines it is necessary to improve operational performance such as wear resistance and fatigue strength, which are influenced by the material and the resulting microstructure of the coating.

The aim of improving the fatigue strength and wear resistance is in the reduction shaft agricultural machines.

The material used for the manufacture of steel samples 45. The samples were prepared in accordance with GOST 25.502-79.

Used for coating wire marks U7 and 08H13. Coating on the samples were applied by using electric welding environment [Ar + (20 ... 30 % CO_2)] .

Then surfacing was carried out on samples of grinding machines mod. 3A151 to a roughness Ra 0,32 ... 0,63 m.

Fatigue tests were carried out on the machine UKI-10M. Destruction of the sample, the machine stops and the counter allows to determine the number of cycles prior to destruction. Type of loading for all cases was the same – cantilever bending torsion, in which the voltage varies over a symmetric cycle (skewness $R\sigma = -1$). The external environment for all testcases was constant.

The results of experimental studies of fatigue curves were constructed samples weld various brands of wires (Fig. 1). Coatings resulting from the welding are characterized by high hardness and wear resistance, but they are characterized by high brittleness, as it occurs with the formation of coatings significant heat input [6], and as a consequence there is a decrease in fatigue strength.

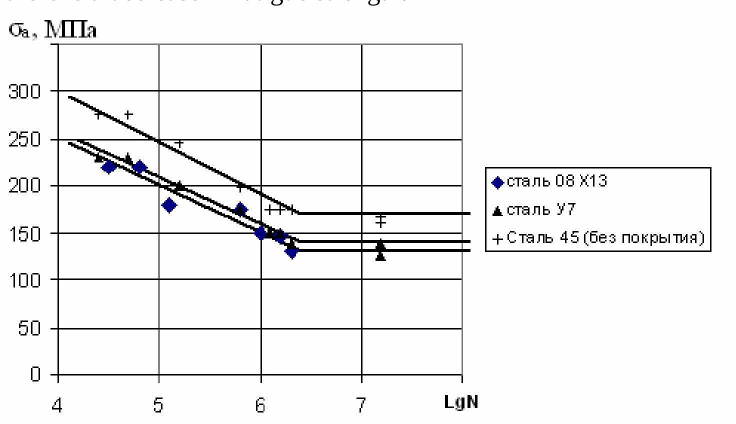

Fig. 1. Fatigue curves of samples with weld deposit:
$\sigma_a$and – voltage in a dangerous section of the sample, N – number of loading cycles

Maximum values of the fatigue strength obtained during surfacing wire U7. In this case the hardness of the weld metal is determined by the carbon content: the higher the carbon contenti, the higher the hardness. Wire carbide contains alloying elements, however during surfacing, more intensive burning of carbon, as well as stirring with a basis (Steel 45), which leads to lower hardness of the coating material, but this increases the fatigue strength of samples. The coating hardness weld wire U7 HRC 35 ... 40. After surfacing due to the high cooling rates formed quench structure (martensite-troostite).

The hardness of the coating produced by welding wire 08H13 – HRC 30 ... 33. One indicator of the properties of the weld metal is hardness, which is sometimes identified with the wear resistance, but when assessing the durability necessary to consider the structure of the obtained coatings hardness of the matrix, the presence of carbides and their dimension, fastening carbides in the matrix. The microstructure of the coating is a "solid solution + chromium carbides". Alloys with similar structure with a low content of carbon have the ability to significantly increase the hardness, strength and wear resistance as a result of work hardening (when plastic deformation with a significant degree of plastic deformation), the use of surface plastic deformation after welding wire 08H13 improves fatigue strength of 25 ... 30%.

Implementing recovery technologies crankshafts promotes saving, as the cost of crankshafts on domestic engines ranging from 10 to 25%, and foreign – from 20 to 50% of the cost.

To restore steel crankshafts surfacing medium [Ar + (20 ... 30% CO_2)] 08H13 wire diameter of 1,6 mm is recommended, followed by hardening of surface plastic deformation .

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ASSESSMENT OF HEALTH STATE OF WATER TREATMENT WORKERS OF AN OIL REFINING ENTERPRISE

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The influence of harmful production factors on human health is analyzed. The negative impact of those factors on morbidity with temporary disability of the water treatment workers of JSC "Naftan" is established.

In the current conditions of the development of Belarusian leading industries the problems of efficiency and reliability of professional activity, as well as health protection and working capacity under the impact of unfavorable factors are becoming the main directions of occupational health and safety policy [1, p. 22].

A third of their lives people are busy with working activity. Therefore, it is very important that occupational conditions don't do any harm their health. The working activity of a person is necessarily influenced by various factors of the production environment, difficulty and intensity of labor process.

It is repeatedly proved that adverse production factors have negative impact on workers' health, cause all professional pathologies and account for up to 30% of the cases of morbidity with temporary disability. All these unwanted implications demand essential material inputs on carrying out medical and preventive measures, as well as on social benefits and compensations related to adverse working conditions [2, p. 67].

It is also necessary to consider that unfavorable economic situation of many enterprises caused by the financial crisis considerably complicates the solution of many problems of labor protection. Among the most serious problems