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THE RESULTS OF ABRASIVE WEAR TEST IN LABORATORY CONDITIONS OF PLOUGHSHARES WITH INCREASED RESOURCE BY HEAT TREATMENT

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Abstract:

Increasing the resource of the worn parts of agricultural machines, especially the working bodies that work the soil, which make up most of them, is considered one of the most important issues. Due to the fact that this issue remains relevant today, it is included in the research plans of many universities, research institutes, design and construction bureaus, other organizations and enterprises. This article presents the results of laboratory tests of ploughshares which resource has been increased by high-frequency heat treatment. The amount of wear of the samples was studied in a related case of pressure force, friction speed and hardness of the sample material.

Keywords: ploughshare, plowing, wear, abrasive environment, heat treatment, resource, working body, pressure force

INTRODUCTION

Soil is the main means of production in agriculture. In order to preserve the soil, increase its productivity and use it rationally, it is necessary to use the optimal systems of tillaging and the optimal working bodies of tillaging machines. The main purpose of mechanical tillage is to create the most favorable conditions for the growth and development of cultivated plants and to increase soil fertility.

Plowing the land is of great importance in growing high yields from crops. When the plowing is carried out qualitatively, the seeds will sprout without fail, the plants will develop well, and favorable conditions will be created for growing an abundant harvest. Plowing is mainly done with plows. The main working body of the plows is considered to be ploughshares (Figure 1). Ploughshares are versatile tool with highly flexible impact and bending failuree.

Figure 1. П-702 Ploughshare

It should be noted that increasing the wearing resistance of machine parts leads to an increase in their reliability. That's why our research is to determine the wearing laws of ploughshares, to analyze the causes of wearing ploughshaeres used in the conditions of Andijan region, and to create resource-efficient technologies based on them.

For this purpose, samples of ploughshares used in our Republic were taken and they were thermally treated with high-frequency current, then parameters such as physical-mechanical properties of the samples and the wearing speed in an abrasive environment were studied.

METHODS

High-frequency current heat treatment device "TGG-45 KW" was used for the heat treatment of the working surface of the samples taken from ploughshares (Figure 2).

Figure 2. High frequency heat treatment device

Table 1. shows the technical parameters of the TGG-45 KW high-frequency heat treatment machine.

Table 1.

Technical parameters of the TGG-45 KW	
Max. output power, kW	25 kW
Max current, A	40 A
Input voltage, V	380 V
Oscillation frecuency, kHz	30-80 kHz
Load duration, %	100% 24 hour
Cooling water requirements:	≥0.3 MPa .≥10/min

In conducting research on increasing the resource by heat treatment, we use steel 45G, "Experimental sample" developed by us, T-590 electrode and metal powders such as PG-S27, PG-FBX6-2, PG-SR4, PJ-4S and their mixtures in a certain combination.

The studies were conducted based on the sample testing program. Based on it, parameters such as pressure force acting on the sample, test duration, friction speed, consumption of abrasive material were taken into account. The amount of wearing was determined by the ratio of the difference of sample masses and dimensions to the duration of the experiment.

Tests on the abrasion resistance of the samples were carried out at the Andijan Mechanical Engineering Institute in an "Abrasion testing device" (Figure 3).

Wearing test of the samples in an abrasive environment was carried out according to the principle scheme indicated in accordance with the GOST 23.208-79 standard.

Figure 3. Abrasion testing device

The abrasion test of the samples was carried out by the roller made of rubber with the abrasive particles on the test sample. Sand with a size smaller than 0.1 mm was used as an abrasive material. 1, 2, 3, 4 and 5 kilogram stones

were used as a pressure load on the sample. Loads were applied to the surface of the sample in the range of 35 N to 185 N. Abrasive material consumption was 12.0 gpm. A roller with a diameter of 50 mm had a bending distance of 1130 m in one cycle with an angular speed of 60 min^{-1}.

St45 steel material, which is widely used in the production of ploughshares in the conditions of Uzbekistan today, was selected as a standard sample. Selected samples were sheared and tested and the results were compared with standart sample performance.

Testing of samples was carried out according to the pressure force and friction speed corresponding to the surface unit of ploughshares based on plowing and tillage in an abrasive environment.

The average arithmetic value of the creep rate of the samples was compared with the sample selected as a standard. The rate of wearing within a unit of time was determined by the following expression.

$$\varepsilon_{u.t} = \frac{m_b - m_{fin}}{t}$$

m_b– mass of the sample before the experiment, g;
m_{fin} –mass of the sample after the experiment, g;
t - experiment time, min.

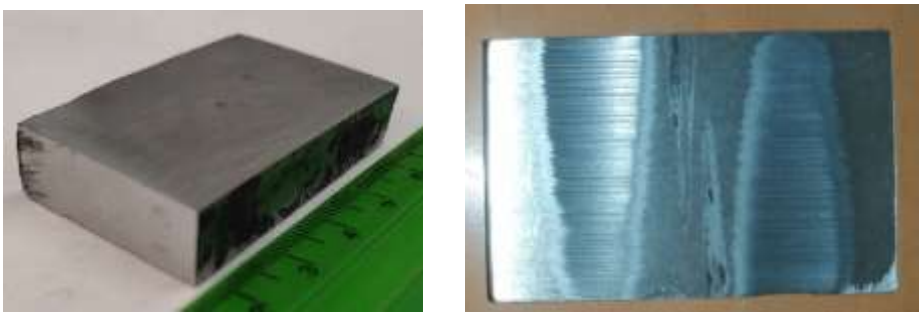


Figure 4. The sample before and after the abrasive test

Compared to the standard material, the relative wearing velocity was determined by the following formula

$$\varepsilon_{rel} = \frac{\Delta m_{exp} * t}{\Delta m_{eth} * t}$$

бунда m_{exp}-amount of wearing of the experimental sample, g
$m_{эт}$- amount of wearing of the ethalon, g

Since the deflection expressed in masses for different materials is relatively imprecise, it is convenient to obtain it in relation to the density of the material, that is, in the unit of volume.

$$\Delta_{rel} = \Delta_{mass}/\rho \cdot 1000$$

Δ_{mass} – amount of wearing per mass;
ρ – density of the material, **, kg/m³ (for example, the density of steel is equal to 7800 kg/m³).**

RESULTS

In the test of abrasive wearing in an abrasive environment, the samples were tested by applying loads of 35 N, 70 N, 105 N, 140 N, 185 N for 10 hours.

The test results of samples under laboratory conditions are presented in Table 2.

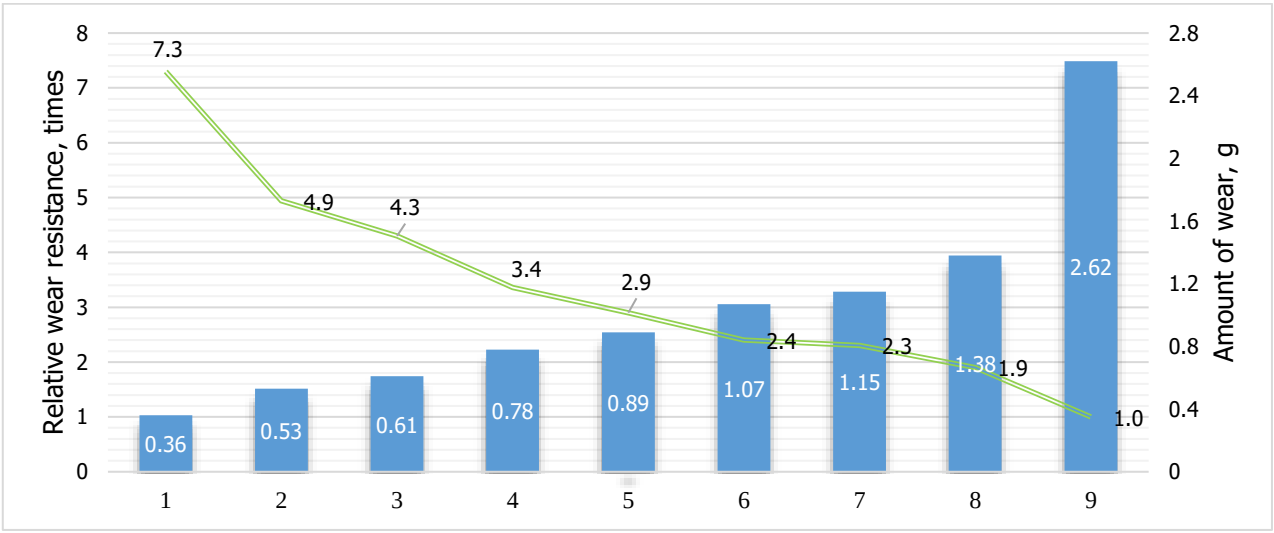
Table 2

Wear test result

№	Name of sample	Hardness HRC	Amount of wearing under the loads, g					The amount of wear of sample, g
			35	70	105	140	175	
1	45G unquenched	29	0,34	0,46	0,54	0,63	0,65	2,62
2	45G quenched with water	56	0,08	0,1	0,13	0,14	0,16	0,61
3	45G quenched with oil	51	0,12	0,14	0,17	0,22	0,24	0,89
4	Sample experience unquenched	31	0,24	0,2	0,29	0,29	0,36	1,38
5	Sample experience quenched with water	41	0,16	0,19	0,20	0,22	0,30	1,07
6	Sample experience quenched with oil	39	0,18	0,19	0,21	0,25	0,32	1,15
7	T-590 surfacing electrode	58	0.05	0,06	0,08	0,09	0,13	0,36

8	PJ-4C (50%) +PG-C27 (50%) +JSL422	44	0,10	0,13	0,15	0,18	0,22	0,78
9	PG-FBX6-2(50%) +PG-SR4(30%) +PJ-3C(20%)	53	0,06	0,08	0,10	0,13	0,16	0,53

The test results show that the relative wearing strength of the heat treated and coated samples was 1.9..7.3 times higher than the reference sample (Figure 5).



1) T-590 surfacing electrode; 2) 45G quenched with water; 3) PJ-4C (50%) +PG-C27 (50%) +JSL422; 4) PG-FBX6-2 (50%)+PG-SR4(50%) +JSL422; 5) 45G quenched with oil; 6) Sample experience quenched with water: 7) Sample experience quenched with oil; 8) Sample experience unquenched; 9) 45G unquenched

Figure 5. Relative wear resistance and amount of wearing

CONCLUSION

Based on the obtained results, it can be seen from the graph (Figure 5) that the relative wear resistance of the heat-treated samples is much higher than that of the non-heat-treated 45G steel.

After heat treatment of the samples, the results obtained from the hardness and wearing tests can be summarized as follows:

Compared to the 45G steel selected as a reference sample, the wearing resistance of this grade increased 4.3 times by heat treatment, and the experimental sample, after heat treatment, wear 1.07 g and the wearing resistance was 2.4 times higher compared to the standard sample.

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