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INCREASING THE LIFETIME OF TILLAGE MACHINE OF PLOWSHARES MADE STELL MADE BY FOUNDRY TECHNOLOGIES

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ABSTRACT:

This article is devoted to the production of tillage plowshares of agricultural machinery aggregates in a durable, corrosion-resistant, energy-saving and economically in expensive casting method.

Keywords: Tillage machines, shock-abrasive wear, hardness, plowshare, hardening, tempering.

INTRODUCTION:

Increasing the resource of replacement parts of tillage machines is an urgent problem in the agro-industrial complex. In the process of performing tillage operations by tillage machines, their working parts, in particular, cutting rods, experience dynamic loads, abrasive and chemical effects of the external environment, which provokes their wear. A promising direction for improving the wear resistance of cutting bit blades is their alloying during casting preparation. Tillage operations are the most important and most labor-intensive in the production of agricultural products. The quality of these operations depends on the parameters and condition of the working bodies of agricultural machinery and equipment. The operation of the working bodies of tillage machines is carried out under conditions of constant abrasive and shock-abrasive wear. Therefore, 70-80% of faults are due to wear of the working body, and the remaining 20-30% - to their deformation.

The plowshare is one of the most critical and quickly wearing parts of the plow, the mean time between failures of which, depending on the types of soil, ranges from 2 to 20 hectares.

MAIN PART:

The analysis of the literature and the results of the research show that the results of the research on increasing the service life of tillage plowshares made of different materials while reducing their body cost were as follows.

The technical conditions for the manufacture of plowshare from Л53 steel provide for a surface hardness of 48...50 HRC. But with such hardness, the impact strength of steel will be no more than 10 J/cm², which is extremely insufficient for working on soils that have any obstacles. Based on the shock loads acting on the share at this plowing speed, for arable implements with the specified tractor, the plowshare could be made of steel 65Г, which, after quenching and tempering at a temperature of 400°C, provides a shock viscosity not less than 30 J/cm², surface hardness about 50 HRC.

Shows the change in the basic characteristics of steels 45, Л53, 65Г, 40Х, 40ХС, 30ХГСА and 35Г2 depending on the tempering temperature. Consider which of these steels are the most preferable for making a plowshare. For this purpose, we will use the analytical by the expression of the dependence of the relative wear resistance of medium-carbon alloy steel on its chemical composition and hardness at an abrasive pressure p = 0.33 MPa:

$$\varepsilon = 0.24X_1+0.07X_2+0.11X_3-3.54$$

where ε is the relative wear resistance of steel. Steel 45 as delivered, hardness 90 HB was taken as a standard; X_1-carbon content, %; X_2-chromium content, %; X_3-hardness, HRC.

As you can see from the table 1, the highest relative wear resistance of steels 40ХС and 40Х, while 40ХС steel also has the best impact toughness. Steel 30ХГСА with the highest impact toughness and high value of ultimate strength is inferior to steels 40Х, 40ХС in relative wear resistance, and steels 45, Л53 and 65Г, currently used for the manufacture of workers bodies of tillage machines are inferior to them both in terms of wear resistance and strength [1-9].

An increase in the wear resistance of steels, associated with an increase in the content of carbon and alloying elements in their composition, is also associated with the price these steels. Therefore, when choosing a steel grade for the manufacture of working bodies must also take into account the cost factor.

The cheapest steel, from which some working bodies of tillage machines are made, is steel 45.

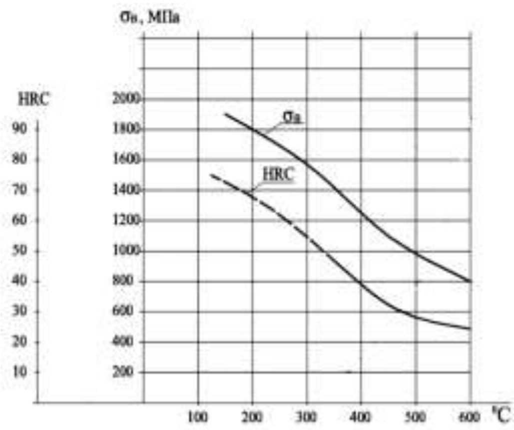
The cost of alloy steel depends on the chemical composition. Low-alloy steels containing relatively inexpensive alloying elements (silicon, manganese) are close in cost to carbon steels. Higher cost have steels containing nickel, chromium, vanadium. The most expensive steels are alloyed with tungsten, molybdenum and cobalt.

Due to the fact that currently the prices on materials are not stable and depend on many factors (including from the manufacturer, commercial organization, delivery volume, etc.), it is advisable to operate them not with specific, but with relative values. As a reference, as with the characteristic of wear resistance, it is possible to accept sheet steel 45 with a thickness 6...12 mm. The relative price of this steel is taken as a unit.

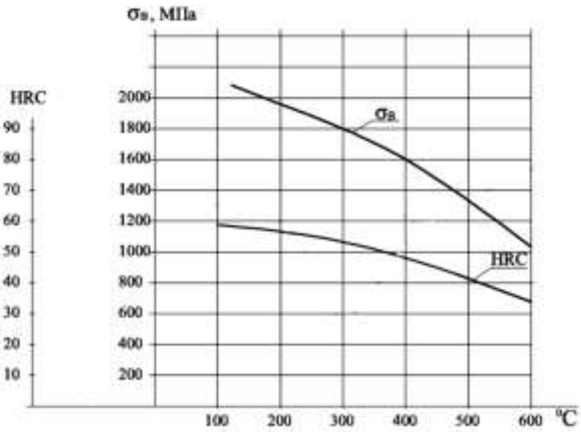
Table 1.Values of hardness, strength and relative wear resistance of various steels

Steel grade	Minimum tempering temperature, °C	Hardness HRC	Temporary resistance σ_B in, MPa	Calculated relative wear resistance ε
45	175	30	1050	Until 1
Л53	325	30	1080	Until 1
65Г	400	48	1650	1.86
40Х	180	55	1800	2.6
40ХС	175	57	2000	2.8
30ХГСА	180	52	1700	2.27
35Г2	450	33	1050	Until 1

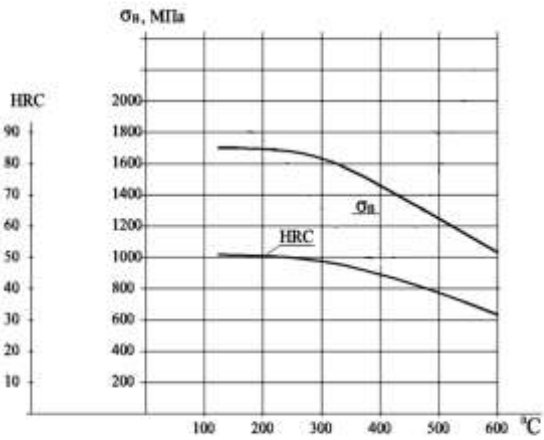
The minimum value of the relative cost estimate of wear resistance is for 40ХС steels and 40X, therefore their use for the manufacture of plowshares is most preferable. Plowshares from this steel will provide not only a higher abrasive wear resource, but also, which is no less important, safety from deformations and fractures due to more high strength and impact strength.



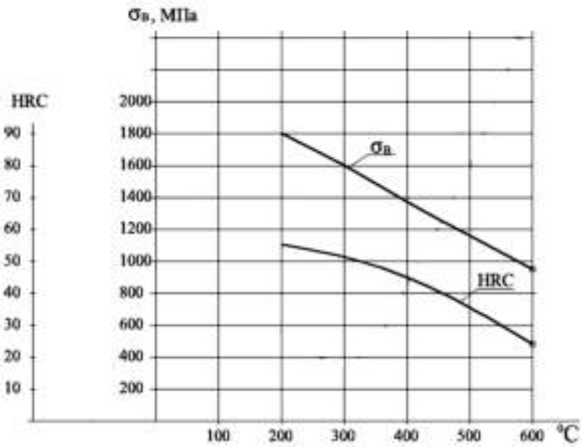
Steel 35Г2 (hardening at 830°C, cooling in oil, tempering, cooling in oil)



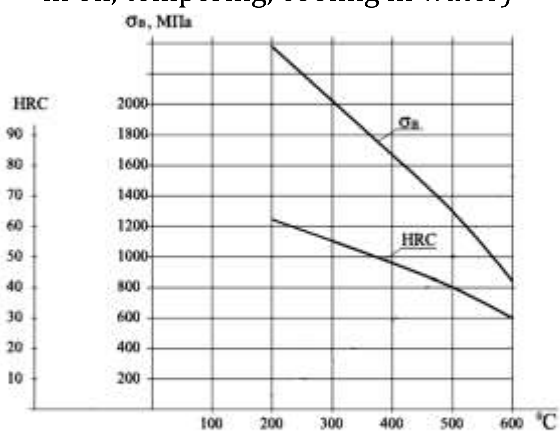
Steel 40XC (hardening at 900°C, cooling in oil, tempering, cooling in air)



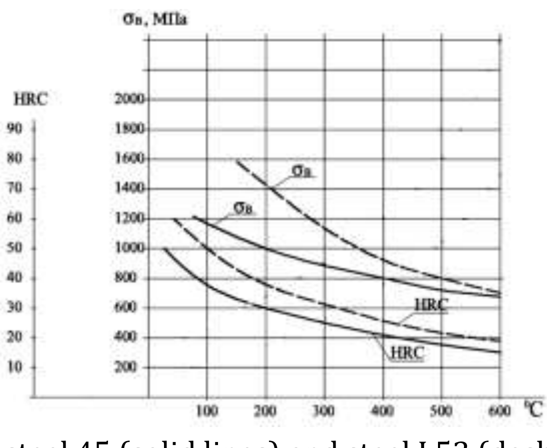
Steel 30ХГСА (hardening at 880°C, cooling in oil, tempering, cooling in water)



steel 40X (hardening at 850°C, cooling in water, tempering, cooling in water)



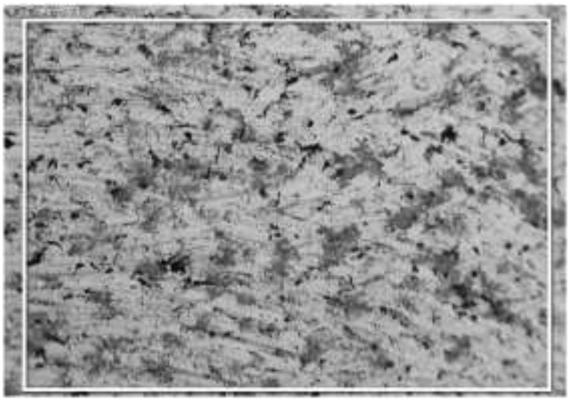
steel 65Г (hardening at 830°C, cooling in oil, tempering, cooling in air)



steel 45 (solid lines) and steel L53 (dashed lines) (hardening at 840 ° C, cooling in water, tempering, cooling in air

Full-scale field comparative tests of experimental plowshares hardened by surface alloying with commercially available plowshares were carried out.

For research and field tests, experimental experimental plowshares were made, according to the technological map of production with by surfacing the alloying layer. The ploughshare obtained as a result of casting without post-processing shown in Picture 1 with the main geometrical dimensions of the finished share.



Picture 1. Plowshare made steel 45 made by casting

During the experiments, the main control period of operation was one working shift and the amount of operating time performed during its time. After the completion of each shift, possible mechanical damage was monitored, the thickness and degree of sharpening of the cutting edge of the blade was determined, special attention was paid to monitoring the formation of the nape chamfer with its negative angle and development dynamics, and the quality of work of the self-sharpening effect of the sock and the plowshare blade was assessed [10-15].

During the experiments, attention was paid to stability and quality work of the machine-tractor unit as a whole. The following were monitored and evaluated parameters such as stability of the plow stroke, stability of the working depth, load on tractor. If you identify any shortcomings in the operation of the unit, for example, such as self-deepening, work was stopped until the identified cause was clarified and eliminated with the obligatory entry of data into the test log. When conducting of the final analysis of the tests of the studied samples, this information played a certain role in assessing their quality and stability of work.

During the experiments, the experienced plowshares showed stable quality work, without revealing possible hidden defects as a result of manufacturing defects, and in general did not cause any complaints. Experimental plowshares have demonstrated resource intensity significantly surpasses its serial counterpart, with more uniform wear [15-17].

CONCLUSION:

Currently used steel L53 for the manufacture of plowshares with the existing design does not meet the requirements high wear resistance and durability due to deformation and fractures.

Most economically feasible according to the criterion of the minimum cost estimate, wear resistance and higher impact toughness are 40XC, 40X and 30XГСА steels.

The wear rate of plowshares made of 40X steel is about 1.5 times lower than that of plowshares made of steel 65Г.

The efficiency of the plow body is determined by the amount of plow share wear, it is this value that has a significant impact on the energy and quality indicators of the plowing unit. Promising manufacturing technology plow share is their casting from high-strength metal with hardening of the cutting the plowshare edges are made of high-alloy materials. The alloyed layer of the plowshare, obtained by casting, has a significantly greater thickness and increased hardness compared to the deposited layer, which makes it possible to increase the resource of the product. The resource of experimental plowshares almost three times exceeds the resource of its serial analog and is 14.5 hectares of operating time per body, while the same figure for a serial share is only 4.7 hectares.

The hardness of steel 45 is HB 143-234 units and the service life of plowshares made from it is short. Therefore, steels of this grade are liquefied in an induction furnace (ИСТ-1,0), ferroalloys are added, and hardness HRC 30-40 is obtained by pouring the cast product into a sand-clay mold. At the same time, the service life of 1 plowshare is 14-15, while energy-saving and cheaper than other types of materials.

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