

Influence of regimens of plating consolidating coverage on parameters of dotted reinforcement of end-effectors of tillers

Goal. Determination of the relationship between the parameters of local strengthening of cultivar paws and modes of surfacing. **Methods.** Determining how the modes of applying to the working bodies of materials with nano-component on the quality indicators of surface formation were used, the method of arc surfacing of powder materials was used, with the voltage on the arc ranging from 20 to 60 V, the current 150-300 A. The deductive and inductive analyzes were used, mathematical and statistical methods. **Results** The rational modes of local hardening have been established, which provides the minimum value of linear wear during the operation. **Conclusions** The influence of cuvette leg reinforcement modes, which allows to control the parameters of local strengthening, is substantiated.

Key words: cultivar paws, strengthening, restoration, electroerosive treatment, abrasive deterioration, working out.

Formulation of the problem. High quality soil cultivation is a prerequisite for increasing crop yields. In turn, the quality of cultivation depends on the state of the working bodies of soil machinery, which operate under difficult conditions of contact loads and abrasive action of the environment. In the process of work, the working bodies wear out, which causes an increase in traction resistance, their depression, poor quality trimming rhizomes of weeds, accumulation of plant remains [5].

Improving the performance of working bodies, in particular the cultivators, is an urgent task in agricultural production. In particular, it is promising to develop technologies for strengthening the cutting edge with powder materials with nanoparticles, which have component particles with dimensions of about 0.1 μm , which allows to increase the physicochemical properties of applied layers, namely the strength limit of 1.5 to 2.5 times while maintaining sufficient plasticity [10].

For the restoration of the working bodies of the tillage machines, the number of production operations is reduced by 5-8 times compared with the production of new ones. At that, the recovered parts may have a resource at the level and above new parts, but the cost of restoration is 40-70% of the new [13 - 15].

The promising direction of increasing the resource of the working bodies of the soil cultivators is the local strengthening of the cutting edge with materials from wear-resistant solid alloys up to 2 mm thick. An important task There is a substantiation of the modes of surfacing, which makes it possible to apply a coating with a minimum depth of penetration into the main material, while providing self-exacerbation [1].

Analysis of recent research and publications. The nature of the wear of the cultivator's leg blade depends on the moisture content of the soil, which varies significantly at depth of cultivation during the season considerably more than in the depths of plowing, with the decrease of soil moisture the cutting edge wears out more intensively. The intensity of wear of the blade increases as the density of the soil increases, and at a high humidity of 20 - 28%, the wear of the working organ is significantly reduced, as the soil becomes consistent [11, 12].

As you know, the cultivator blades on different soils have different wear rates [8, 9], resulting in traction resistance of the aggregate increasing on sandy soils by 16%, loamy ones by 26%, and clay by 33%. At the same time, the wear of the working surface of the cultivating paw affects the regularity of the resistance of the unit during continuous soil treatment. Specific resistance of the cultivator during working with worn-out paws is 20-30% higher than with new ones. Over 60% of the paws lose their ability to work due to extreme wear of the toe and wings in width. As you know, the cultivator blades on different soils have different wear rates [8, 9], resulting in traction resistance of the aggregate increasing on sandy soils by 16%, loamy ones by

26%, and clay by 33%. At the same time, the wear of the working surface of the cultivating paw affects the regularity of the resistance of the unit during continuous soil treatment. Specific resistance of the cultivator during working with worn-out paws is 20-30% higher than with new ones. Over 60% of the paws lose their ability to work due to extreme wear of the toe and wings in width.

The institute carried out preliminary research on the creation of new technologies for the preparation and restoration of working bodies of soil machinery with the use of carbon steels (carbon content up to 0.7%) and with the application to strengthen their electroerosive processing and powder materials [2-4]. These ways to strengthen the working surfaces are promising and well-proven in the production environment. However, today a number of other materials have been developed to strengthen the parts that work in the abrasive environment. In particular, the Experimental Plant of Welding Materials of the Institute of Electric Welding EO. The electrodes of grades T-590 and T-620 are issued.

The purpose of the research is to determine the interconnection of the parameters of local strengthening of cultivars and surfacing modes.

Research methodology. Investigations on the application of reinforcing coating were carried out on the working units for the cultivator QUANT-12. For this, on the working surfaces of the cultivator's paws by the electric arc method, with the help of equipment VDU-506, reinforcing layers were applied using powdered materials with nanoparticles, in particular, such as PG-10K, PS-12NVK, and others. (Fig. 1). It is advisable to apply such materials on the surface of the work units locally, in the places of the most intense wear to reduce their costs.

Approximately 0.1 kg of reinforcing material is used for this kind of hardening, which according to our data costs about 12 UAH, and wear resistance is expected to increase by 2 - 2.5 times in comparison with the serial working body.

To study the effect of the number of point strengthening and the zones of local strengthening on the epicure, the nature and extent of wear, it is suggested to apply 3 schemes of local strengthening of the cultivator legs blades, namely: strengthening of the bow and wings' ends, which will provide a working width of capture (rice 2, a); intense strengthening of the nasal part of the cultivar leg and the ends of the wings (Fig. 2, b); strengthening the wings of cultivar paws all the length in a step of 25 mm (Fig. 2, c).

The surfacing process was carried out with breaks (pauses). Time of surfacing 1 - 6 s, break 2 - 5 s. At the same time measurements of height, diameter and roughness of point strengthening were made (Fig. 3).

Fig. 1. Scheme of point strengthening of cultivating paws: a - distance of point strengthening to the end of the blade, $a \geq 1,5$ mm; d - diameter of point strengthening, $d \leq 25$ mm; h - height of point strengthening, $h \leq 2,5$ mm; 1 - rectifier welding universal VDU-506; 2 - electrocontroller; 3 - graphite electrode or T-590; 4 - point strengthening; 5 - the cultivator leg of the blade; 6 - Welding table

Fig. 2. Schemes for point strengthening of cultivator paws

Fig. 3. Scheme for determining the height of point strengthening with respect to the sample: 1 - a sample of steel 65 g; 2 - point strengthening; 3 - line of troughs of point strengthening; 4 - a line of precision reinforcement performances; 5 - the middle line of point strengthening; 6 - line of specimen projections; 7 - line of sample hollows; 8 - middle line of the sample; N - height of point strengthening

The value of the roughness of the applied wear-resistant coating was determined by ten points and calculated on this dependence [6, 7]:

$$(1)$$

where R - roughness of the applied wear-resistant coating in the form of a point, mm; $n_{\max} H$ - height of the largest projections, mm; $n_{\min} H$ - value of the depths of the largest valleys, mm. By converting formula (1) to determine the height of the point reinforcement relative to the surface of the part, we obtain the following dependence:

$$(2)$$

where H - height of point strengthening with respect to the sample, mm; $T_{n\max} H$, $T_{n\min} H$ - respectively, the maximum and minimum values on the surface of the point hardening, mm; $3n_{\max} H$, $3n_{\min} H$ - respectively the maximum and minimum values on the surface of the sample, mm.

Fig. 4. Dependence of the height of the point strengthening from the voltage: - zone of intensive change in the height of point strengthening; - zone of non-intensive change of height of point strengthening

Research results. In conducting research on point strengthening of cultivar paws, it was found that the height of the point strengthening is influenced by the voltage at the arc (Fig. 4). The dependence of the height of the point strengthening from the voltage is described by polynomial dependence (3):

$$H = -0,047U^3 + 0,64U^2 - 2,949U + 6,66, \quad (3)$$

where H - height of the point strengthening, mm; U is the voltage applied to the coating, B. The voltage on the arc also significantly affects the roughness of the point strengthening (Fig. 5).

Fig. 5. Dependence of the roughness of the coating on the change in voltage: - the roughness of the coating, applied with a graphite electrode; - roughness of the coating applied by the electrode T-590

Roughness of point strengthening is described by polynomial dependencies:

$$R_{T-590} = 5 \cdot 10^{-4} U^2 - 0,03U + 1,03, \quad (4)$$

$$R_{\text{граф}} = 7 \cdot 10^{-4} U^2 - 0,05U + 1,36, \quad (5)$$

where T-590 R, graph. R - respectively, the roughness of the coating, which is formed during the application of electrode T-590 and graphite electrode, mm; U - coating stress, V.

It was established that at a voltage of less than 30 V and a time of applying a point of less than 2, the coating process deteriorates, the depth of the melting and the adhesion of the coating decreases, the height of the point strengthening ranges from 3 to 4 mm. When the voltage exceeds 60 V and the time of application of 6 seconds occurs, the material is sprayed, the part is significantly deformed, and inequalities are formed on the surface (Fig. 5).

The most effective modes of coating application range from: voltage 38 - 42 V, current 190 - 220 A, application time 3 - 4 s, while receiving a welded point with a diameter of 20 ± 2 mm, a thickness of 2 - 2.5 mm, Hardness up to 64 HRC.

According to the results of the tests it was established that the least wear (4 to 6 mm) of the wings of cultivar legs was obtained according to the third reinforcement scheme (Fig. 2, c), but with such a strengthening during operation, the radius of the cutting edge increased to 3 - 4 mm, which leads to increased traction resistance.

Successful laboratory-field trials in the ground conditions of the PE "Agroecology" of Shishatsky district, Poltava region, were strengthened by the developed technological paws for the cultivator QUANT-12. and showed up to 60 hectares.

Conclusions

It has been established that for voltage less than 30 V and when the point of application of the point is less than 2, with the process of forming the coating deteriorates, the depth of sintering decreases, adhesion of the coating decreases, the thickness of the point is within 3 - 4 mm. When the voltage exceeds 60 V and the time of application is 6 seconds, the material is sprayed, the component is significantly deformed, and inequalities are formed on the surface.

The most rigorous modes of coating application range from: voltage 38 - 42 V, current 190 - 220 A, application time 3 - 4 s, while obtaining a coiled point diameter 20 ± 2 mm, thickness 2 - 2,5 mm. It has been established that the rational scheme of reinforcement by electro-erosive treatment (Fig. 2, b) and additional local point electrodaroval strengthening with T-590 electrodes of the blade part of the cultivar legs makes it possible to obtain reinforced layers with hardness up to 64 HRC. Such a reinforcement technology makes it possible to achieve self-excitement of the cultivator legs in the process of operation. The resource of experimental paws with this strengthening technology averages 55-60 hectares, which is 35-40% more than the stock of serial paws.

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