American Journal of Biodiversity
https://biojournals.us/index.php/AJB
ISSN: 2997-3600

Analysis of Factors Influencing the Wear of the Deep Softening Organs of the Chisel-Cultivator

Umarova Shakhnoza Olimovna
Basic Doctoral Student, Andijan State Technical Institute

Received: 2025, 04, Oct
Accepted: 2025, 05, Nov
Published: 2025, 26, Dec

Annotation: The quality of soil tillage, energy consumption, and total tillage costs significantly depend on the design parameters and condition of the working bodies. Therefore, prominent scientists and companies are paying special attention to the improvement of working bodies.

Keywords: Soil cultivation, deep ripper, abrasive particles, moisture, plowshare, column.

In the conducted research, it was established that the main type of wear of the working bodies of tillage machines, in particular, blades, chisels, naralniks, and others, is abrasive wear. A great contribution to solving the problem of wear of working bodies was made by J. Flyischer, S.V. McGregori, R.J. Bayer, G. Poltser, G. Pursche, U. Kimura, D.N. Garkunov, A.V. Chichinadze, S.V. Pinegin, G.Ya. Yampolsky, N.M. Mikhin, V.S. Kombalov, U. Ikromov, K.Kh. Makhkamov, K.K. Nuriyev, M.T. Madazimov, and others.

Wear of the working bodies of deep rippers (blade, column cover, column, and share) occurs as a result of constant contact with the soil. During this time, the technological characteristics and design parameters of the support and bit also change. The nature and intensity of wear depend not only on the properties and nature of the soil, but also on the conditions of interaction of the working parts with the soil.

Analyzing previous scientific works, it is possible to identify the main factors forming the wear of deep ripper bits: physical and mechanical properties of the soil, moisture content, heterogeneity and density, speed of movement and configuration of working bodies, material properties.

As a result of the influence of these factors, the tip of the bits becomes smooth (blunt) - which occurs due to abrasive wear. As a result, the quality of softening deteriorates and the energy consumption of the process increases.

The main component of the soil is quartz sand, which significantly affects the abrasive wear of the working bodies of the deep ripper. The relative wear of the working parts of the soil differs depending on the amount of abrasive particles in the flour. This indicator varies from 0.3 to 3.5 coefficients. A small amount of the weathering coefficient of abrasive particles in the soil indicates wear along the width of the working bodies, and a large value indicates wear along the thickness. (The term abrasive wear is derived from the definition given by I.V. Kragelsky).

The greatest wear intensity of the working bodies of the deep ripper is observed in sandy soils. Then, in descending order, the following soil types are placed: loamy (sandy) soils, light saline soils, medium saline soils, heavy saline soils, meadow-sierozem (high moisture) soils.

The moisture content of the soil and its acidity also affect the wear of the working bodies of deep rippers. It has been established that saline and meadow-sierozem (high moisture content) soils have the least destructive properties at 14-18% absolute moisture. With a decrease in moisture content below the established values, the abrasive property first increases, and then significantly decreases. In loamy (supsan) soils, maximum abrasive wear is observed at an absolute moisture content of 14%. If moisture content is reduced or increased above this value, weathering in these soils decreases. In supsanian soils, minimal abrasive wear is observed at an absolute moisture content of 9-10%.

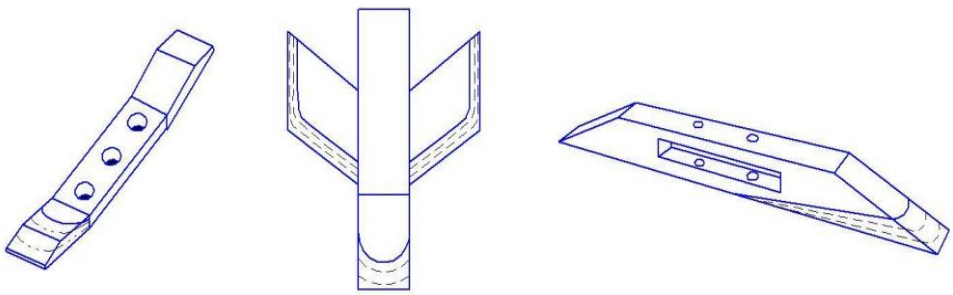
By studying the processes of friction and analyzing theories of friction, it was established that the speed of soil movement along steel does not have a significant influence on the coefficient of friction. The opinions of the authors of different works differ. However, it has been established that when the soil velocity along the steel is in the range of 0.5-4.0 m/s, the coefficient of friction does not change significantly and does not affect wear.

The operability of deep rippers mainly depends on the condition of the tiller . Regardless of the shape of the support column, it cuts through the crack, and the chisel cuts through plant residues and forms the seed-laying layer. During the cutting of the soil layer, the chisel is subjected to the greatest pressure in the front (nose) part and less pressure in the back (elbow) part, which leads to uneven wear.

In the process of deep loosening, gradual dulling and wear of the blades occur, which negatively affects the degree of weed cutting, increases the tractive resistance of the unit, and disrupts the uniformity of its movement along the depth.

Testing of claws during deep loosening in soils containing quartz sand showed that up to 45% of claws become unusable due to breakage, blunting, and bending. This applies to both straight and needle-shaped bits. In addition, the "wings" on the arrow-shaped paws wear out in width and have a rounded shape. The wear profile of panches of various shapes can be seen in Picture 1.

The main abrasive particles affecting the working parts of deep rippers are quartz (HV 10.5-12.5 GPa) and feldspar (HV 6.5-7.2 GPa). They are the main components of sandy loam and sandy loam soils, which leads to significant wear of the working parts.



Picture 1 - Wear profile of bits of various configurations:
a - straight bit; b - boom-shaped bit; c - steady-state bit.

It is known that abrasive wear prevails over other types of wear if the following condition is met, i.e., the hardness of abrasive particles is higher than the hardness of the material of the working parts of the soil-cultivating machine.

The main materials from which the working bodies of the deep ripper are made are 55 XGS or 65G steels, the hardness of which is approximately 50 HRC. Thus, intensive wear of the material is observed.

Consequently, the use of worn paws when using deep rippers leads to a decrease in the quality of deep loosening. Factors that significantly influence the wear of working parts are the structure, composition, moisture content, and density of the soil, as well as the material of the working parts. The remaining factors do not have a significant effect on the wear of working organs.

1. Bartenev, I.M. Exhausting capacity of soils and its influence on the durability of working parts of soil-cultivating machines/I.M. Bartenev, E.V. Pozdnyakov // Forestry Journal. - 2013. - No3. - Б.114-123
2. Bondarev, S.G. Study of the working capacity of blades on stony soils and development of methods for increasing their durability / S.G. Bondarev // diss.... cand. tech. sciences. - Тошкент, 2021. - 210 p.
3. Vinogradov, V.V. Increasing the wear resistance of the arrowheads of soil-cultivating tools by carbide-arc reinforcement of their cutting surfaces / V.V. Vinogradov // Diss.... Cand. Tech. Sciences. - Orel,135 p.
4. Golubina, S.A. Increasing the wear resistance of plow scraps with semi-automatic vibration-arc flooding / S.A. Golubina // Diss.... Cand. Tech. Sciences. - Калуга, 2016. - 131 p.
5. Kashfullin, A.M. Increasing the resource of the working bodies of soil-cultivating machines by applying wear-resistant coatings with arc metallization / A.M. Kashfullin // Diss.... Cand. Tech. Sciences. - Тошкент, 2017. - 117 p.
6. Kozarez, I.V. Strengthening restoration of plowshares with a double-layer coating / I.V. Kozarez // Diss.... Cand. Tech. Sciences. Bryansk, 2008. - 178 p.
7. Ozhegov N.M. Ensuring the effectiveness of surfacing technologies in the hardening of the working bodies of soil-cultivating machines / N.M. Ozhegov, D.B. Slinko, D.A. Kaposhko // Repair. Restoration. Modernization. - 2018. - No 11. - P. 43-48.
8. Ozhegov N.M. Strengthening of plowshares by the method of sign-change deformation of the abrasive soil layer /N.M. Ozhegov, S.I. Budko, D.A. Kaposhko, V.M. Kuzyur, E.D. Shibin // Proceedings of the International Academy of Agricultural Education. - 2019. - No 44. - P. 22-27.
9. Orlov, B.N. Forecasting the durability of working bodies of land reclamation machines / B.N. Orlov // diss.... doctor of technical sciences. - Тошкент, 2020. - 348 p.
10. Kragelskiy, I.V. Some Concepts and Definitions Related to Friction and Wear / I.V. Kragelskiy. M.: USSR Academy of Sciences Publishing House, 1957. 12 p.
11. Prigozhay, M.G. Determination of the coefficient of friction of steel against the soil / M.G. Prigozhay // TSA Reports. Moscow: Geodesy, 1959. - Б. 143-149.
12. Solovev, S.A. Influence of the location of the boom blades of cultivators of sowing complexes on their wear / S.A. Solovev, I.V. Kozarez, S.A. Feskov // Tractors and Agricultural Machines. - 2015. - No 11. - P. 40-42.
13. Sineokov, G.P. Theory and Calculation of Soil Cultivation Machines / G.P. Sineokov, I.M. Panov. M.: Mashinostroyeniye, 1977. 328 p.

14. Fayurshin A.F. Modeling the process of wear and tear of the cultivator blade / A.F. Fayurshin, A.R. Akhmadiev, A.A. Aralov// In the collection: Achievements of science and innovation - to agricultural production materials of the national scientific conference. - 2017. - P. 165-172.
15. Shitov, A.N. Increasing the durability of the working bodies of soil-cultivating machines using pulsed electrocontact heating (on the example of a plowshare) / A.N. Shitov // Diss. Cand. Tech. Sciences. - Тошкент, 2020. - 143 p.