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**Academic Supervisors:**

**Marchenko D.D.**

*Candidate of Technical Sciences, Associate Professor*

**Lymar O.O.**

*Candidate of Physical and Mathematical Sciences, Associate Professor*

*Mykolaiv National Agrarian University*

## INCREASING THE DURABILITY OF AGRICULTURAL MACHINERY PARTS UNDER ABRASIVE WEAR BY SURFACE HARDENING

**Viktor SOLOVIOV, Oleh STEBLIUK**

Higher Education Students, Specialty H7 Agroengineering

Mykolaiv National Agrarian University

Mykolaiv, Ukraine

**Abstract.** *This article examines the wear characteristics of agricultural machinery components operating under intense abrasive conditions. The influence of hard mineral particles, contact pressure, relative displacement, impact loads, and surface condition on damage formation is analyzed. The need for a comprehensive*

*approach to increasing component life is substantiated. This approach encompasses not only increased hardness but also structural stability, crack resistance , and reliable interaction between the hardened layer and the base metal. Surface hardening, particularly diffusion chromium plating, is considered as a promising approach to improving the wear resistance of agricultural machinery components.*

**Key words:** *agricultural machinery, abrasive wear, wear resistance, surface hardening, diffusion chromium plating, tribology, part resource.*

The reliability and durability of agricultural machinery are directly related to the wear rate of the working surfaces of its components. During operation, equipment constantly interacts with soil, plant debris, moisture, and various solid inclusions. This combination of factors creates a complex abrasive-mechanical environment in which the component's surface is subjected to both normal and tangential loads. This results in gradual destruction of the surface layer, changes in the geometry of the mating surfaces, and a reduction in the component's performance.

Agricultural machinery components are characterized by highly variable operating conditions. Soil composition, moisture content, sand and mineral particle content, tool speed, and load magnitude all change even within a single work cycle. Therefore, assessing wear resistance solely by material hardness does not fully describe the component's actual behavior. A modern tribological approach takes into account a combination of material properties, abrasive environment characteristics, and contact parameters.

Abrasive wear develops due to the penetration of hard particles into the surface and their relative movement across the material. Depending on the contact conditions , microcutting , microploughing , plastic deformation, and subsequent separation of fragments of the surface layer occur. For tillage components, the soil's mineralogical composition, particle size and shape, moisture content, the speed of the working tool, and the angle of contact with the soil are of significant importance. Changing the characteristics of the abrasive medium can significantly alter the rate of material loss.

At the initial stage of wear, localized scratches and grooves form. With repeated loading, microdefects coalesce, the surface microgeometry changes, and the

actual damage area increases. For mating parts, this is accompanied by increased gaps and a loss of geometric accuracy. A feedback loop occurs: localized pressure increases accelerate the destruction of the most heavily loaded areas, and the wear debris sustains further abrasive action.

Surface hardening is a technological method for locally modifying the mechanical and tribological properties of a material. Its primary purpose is to create a working layer with increased resistance to plastic deformation, scratching, and material removal upon contact with an abrasive. At the same time, the core must maintain sufficient viscosity and the ability to withstand variable and impact loads.

Engineering practices utilize carburizing, nitriding, boriding , surfacing, functional coating application, and diffusion methods. Carburizing and nitriding create hardened diffusion zones; boriding ensures the formation of highly hard boride phases; and surfacing technologies enable the restoration of the geometry of a worn part while simultaneously creating a wear-resistant layer. The effectiveness of each method is determined by the base material, the thickness of the working layer, and the nature of the operating environment.

The application of boronizing to components operating in contact with soil serves as a notable example. Studies on plow components made of SAE 950C steel have shown that the formation of a boride layer can significantly enhance abrasive wear resistance compared to the material's initial state. However, achieving high hardness must be accompanied by control over the layer's microstructure, as an increased proportion of hard phases can heighten susceptibility to brittle fracture.

A promising option is diffusion chromium plating. During processing, chromium atoms diffuse into the surface of the steel, forming a modified layer whose properties are determined by the composition of the substrate and the saturation regime. Unlike some surface coatings, the diffusion layer is bonded to the base metal via a transition zone, potentially increasing the surface's resistance to mechanical damage.

Increasing the durability of agricultural machinery parts subjected to abrasive wear is a complex task involving managing the surface layer properties and frictional

coupling parameters . The most effective hardening option is one that provides a combination of high hardness, sufficient crack resistance , geometric stability, and a reliable bond with the base metal. Diffusion chromium plating represents a promising approach to increasing the wear resistance of critical agricultural machinery components.

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**Academic Supervisors:**

**Lymar O.O.**

*Candidate of Physical and Mathematical Sciences, Associate Professor*

**Marchenko D.D.**

*Candidate of Technical Sciences, Associate Professor*

*Mykolaiv National Agrarian University*