



Numerical analysis of the load on the surface of a wood chipping tool

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Assumptions

The analyzed tool (mulcher flail) is subject to significant mechanical degradation due to dynamic loads and abrasive wear during forestry operations. The simulation considered real operating conditions, including forces encountered while working in soil containing abrasive particles such as SiO_2 . It was assumed that the appropriate selection of material (e.g., alloy steel, tungsten carbide) and design features has a direct impact on the tool's operational durability.

Achieved Objectives

A geometric model of the mulching tool flail was developed using Ansys Workbench. Finite Element Method (FEM) simulations were conducted to identify zones of maximum stress and displacement. The study confirmed the importance of material selection and structural design in enhancing wear resistance and extending tool life.

Methods of Implementation

Implementation Finite Element Analysis (FEA) was performed in the Ansys Workbench 2024 R2 Mechanical module. The model included detailed geometry, meshing (using PrimeMesh with 2 mm elements), material assignment, boundary conditions, and force application. The analysis used nonlinear deformation settings to increase simulation accuracy and assess realistic tool behavior.

Achieved Results

High-stress zones were identified near the fixture and force application areas—potential initiation points for material fatigue. Displacement analysis indicated structural regions requiring reinforcement. Cemented carbide tips showed superior wear resistance, but their performance depends on mounting method and structural support. The simulation validated the use of FEA for predicting performance, optimizing design, and reducing prototyping and testing costs.

Other informations about project

The project was carried out as part of the activities of the Student Research Group "B@jt" at the Department of Engineering Materials and Biomaterials, Faculty of Mechanical Engineering, Silesian University of Technology. The research was conducted in collaboration with the Technical University in Zvolen (Slovakia), within a joint scientific initiative focused on analyzing tools used in mulching technology. The project was supported by the "Excellence Initiative – Research University" program.