

# A novel method to study abrasion resistance of surfacedensified wood

Nouat Agathe, Rostand Moutou Pitti, Scharf Alexander Scharf, Schleicher Frank, Neyses Benedikt, Jones Dennis, Sandberg Dick

### ▶ To cite this version:

Nouat Agathe, Rostand Moutou Pitti, Scharf Alexander Scharf, Schleicher Frank, Neyses Benedikt, et al.. A novel method to study abrasion resistance of surfacedensified wood. 11TH European Conference on Wood Modification (ECWM11) 2024, Université de Florence, Dec 2024, Florence (IT), Italy. hal-04366416

## HAL Id: hal-04366416 https://hal.science/hal-04366416

Submitted on 29 Dec 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

### A novel method to study abrasion resistance of surfacedensified wood

Agathe Nouat<sup>1,2</sup>, Alexander Scharf<sup>1</sup>, Frank Schleicher<sup>1</sup>, Benedikt Neyses<sup>1</sup>, Dennis Jones<sup>1</sup>, Rostand Moutou Pitti<sup>2</sup>, and Dick Sandberg<sup>1</sup>

<sup>1</sup>Wood Science and Engineering, Luleå University of Technology, Forskargatan 1, 931 87 Skellefteå, Sweden. E: agathenou-2 @student.ltu.se, alexander.scharf@ltu.se, frank.schleicher@ltu.se, benedict.neyses@ltu.se, dennis.jones@ltu.se, dick.sandberg@ltu.se

<sup>2</sup>Civil Engineering Department, Polytech Clermont, Campus Universitaire des Cézeaux, 2 avenue Blaise-Pascal, 63178 Aubière, France. E: rostand.moutou\_pitti@uca.fr

Keywords: density profile, surface densification, test method, wear, wood protection

#### ABSTRACT

Thermo-mechanical surface densification of wood is a process where the density of the outer layers of wood is increased to create a mechanically strong surface material, suitable for flooring and other products exposed to mechanical wear and surface loads (Navi and Sandberg 2012). By applying heat and pressure to the material the wood cells soften and deform, effectively collapsing into their own lumen, reducing the void volume, which results in an overall increase in density (Neyses 2019). The load resistance of the densified wood surface is most often assessed by testing its hardness, where the compressed wood cells lead to higher values. Other surface properties such as abrasion resistance are rarely tested, and therefore it is a lack of knowledge whether and how the deformed cells of densified wood are affected by abrasion. Abrading devices intended for wood exist but are limited to measuring a single parameter such as weight loss (Németh *et al.* 2014). To study abrasion of densified wood in more detail a new test method was developed which utilises a rotation machine and a sensor unit originally designed to measure cutting forces in wood machining. The test setup is shown in Fig. 1.

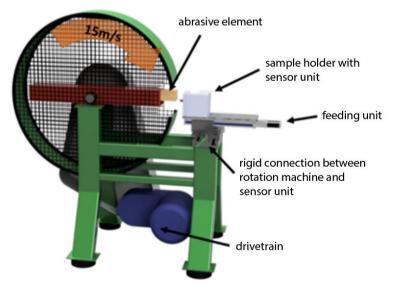


Figure 1: Model of the rotation machine used in this study, in which an abrasive element was rotated with up to 15 m/s, establishing contact with the sample on every rotation. The sample was connected to a sensor unit which measured force in three directions. Adapted from Schleicher (2023).

In the test method, abrasive paper was attached to the rotating arm of the machine. On every rotation of the arm, the abrasive element met the densified surface of the wood sample and the force perpendicular to the densified surface was measured. The first stage of this study was to validate the repeatability of the method. In the second stage, the correlation between the density of the abraded layers and key parameter from the force measurements was studied. Fig. 2 shows a schematic representation of the measured forces and expected differences between undensifed and densified wood. Several variables, such as the slope of the curve (derivate) and the residual force were used for the correlation analysis.

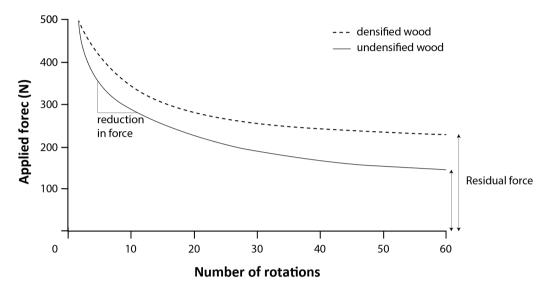


Figure 2: Force perpendicular to the sample surface as afunction of numbers of rotations. Abrasion resistance of the wood was characterised based on these measurements in two different ways: (1) The reduction in force per rotation indicated how fast a sample was abraded, and (2) the residual force described the force which was too low to further abrade the sample.

Initial results showed a correlation between the peak-density value of the densified wood, and the derivate of the abrasion curve. The residual force also showed signs of correlation to the density profile. These first results proved to be promising, but additional measurements with varying degrees of densification need to be done to validate the determined correlations.

#### REFERENCES

Navi, P. and Sandberg, D. (2012). Thermo-hydro-mechanical processing of wood. EPFL Press, Lausanne, Switzerland.

Németh, R., Molnarné Posch, P., Molnár, S. and Bak, M. (2014). Performance evaluation of strip parquet flooring panels after long-term, in-service exposure. *Drewno*, **57**(193), 119–134.

Neyses, B. (2019). Surface Densification of Solid Wood: Paving the Way Towards Industrial Implementation. PhD dissertation, Luleå University of Technology.

Schleicher, F. (2023) Start-up of a Kistler 9129AA dynamometer on a custom rotation machine and investigation of its potential eligibility for cutting force measurement in wood. Master's thesis, Wood Science and Engineering, Luleå University of Technology.