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A novel method to study abrasion resistance of surface-densified wood

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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.

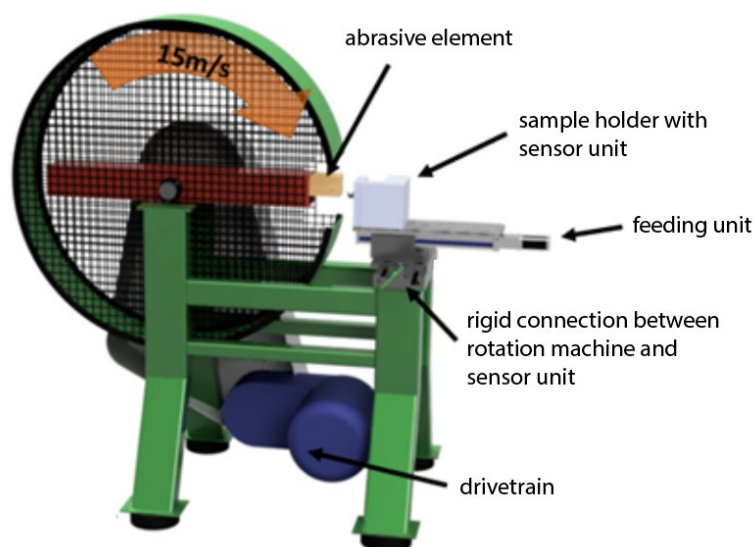


Figure 1: Model of the rotation machine used in this study, in which an abrasive element was rotated with up to 15 m/s, establishing contact with the sample on every rotation. The sample was connected to a sensor unit which measured force in three directions. Adapted from Schleicher (2023).

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 undensified and densified wood. Several variables, such as the slope of the curve (derivate) and the residual force were used for the correlation analysis.

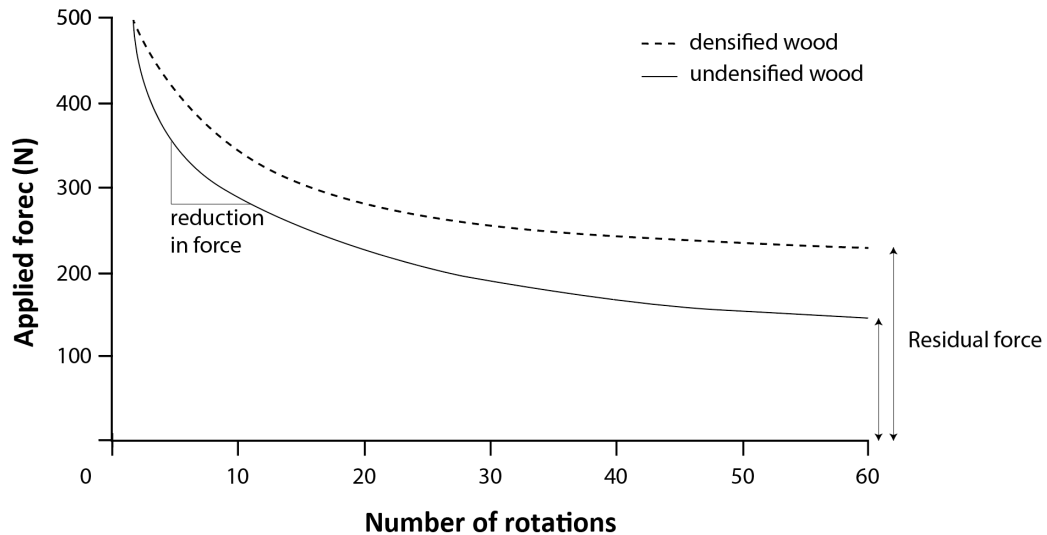


Figure 2: Force perpendicular to the sample surface as a function of numbers of rotations. Abrasion resistance of the wood was characterised based on these measurements in two different ways: (1) The reduction in force per rotation indicated how fast a sample was abraded, and (2) the residual force described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

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