Development of a numerically controlled rotational dowel welding device for hand-held screwdrivers to determine and optimize important process parameters

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ABSTRACT

Wood welding is an innovative bonding technology, which works without the addition of adhesives. In rotational friction welding a wooden dowel is inserted into a pre-drilled hole in a wood piece. During the process the lignin of the two wood parts is softened due to the friction temperature and a strong bond is obtained. Among the largest obstacles for an industrial application is the interdependence of the various production parameters e.g. feed force and rotational rate and its impact on the quality of the final bond.

Therefore, a numerically-controlled rotational wood welding device was developed, used for the optimization of process parameters in order to achieve defined bonding properties for a variety of wood species such as *Fagus sylvatica*, *Carpinus betulus, Acer pseudoplatanus, Juglans nigra and Abies alba*. The influencing factors analyzed were speed of the dowel, feed force, feed rate as well as acceleration and energy consumption by the drill during the wood dowel welding process.

The maximal tensile strength of the dowels was analyzed with regard to different process parameters to investigate on the influence of these factors on the quality of the bonding strength. Based on the differences between the species could be observed and an optimum was found for the combination.

Based on these findings the effectives of the device could be proven and allows now to control the process to such an extent that excellent properties could be achieved for the investigated species in dependence of the process parameters.

Key words: numerically controlled rotational dowel welding device, hand-held screwdriver, different wood species, optimized process parameters, bond-line optimization