

WOOD BONDING BY MELTING OF NON-TOXIC FILLERS USING LINEAR FRICTION WELDING

Properzi Milena*, Ganne-Chédeville Christelle, Tondi Gianluca and Pichelin Frédéric

*Berne University of Applied Science, School of Architecture, Civil and Wood Engineering
HSB, Biel, Burgdorf, Switzerland*

Pizzi Antonio

University of Nancy I, ENSTIB-LERMAB, Epinal, France

**Corresponding author: Tel: +41(0)32 344 03 44 Fax: +41 (0)32 344 03 91
Email: Milena.Properzi@bfh.ch*

Summary

Wood to-wood welding was shown to yield high quality joints with challenging perspectives for producing new environmentally-friendly wooden products. The same welding technique was recently applied to solder wood by melting of non-toxic organic fillers to generate coalescence through softening and recrystallization of the material across the interface. Researchers have been undertaken to clarify the effect of the fillers on the final properties of the joints. To this purpose, three types of fillers were tested and the results were compared with those obtained without fillers. Furthermore, the influence of the welding parameters on the joints' strength was evaluated.

Keywords: Wood welding, polymer melting, soldering, adhesion, wood modification, renewable resources, wood friction.

Methodology

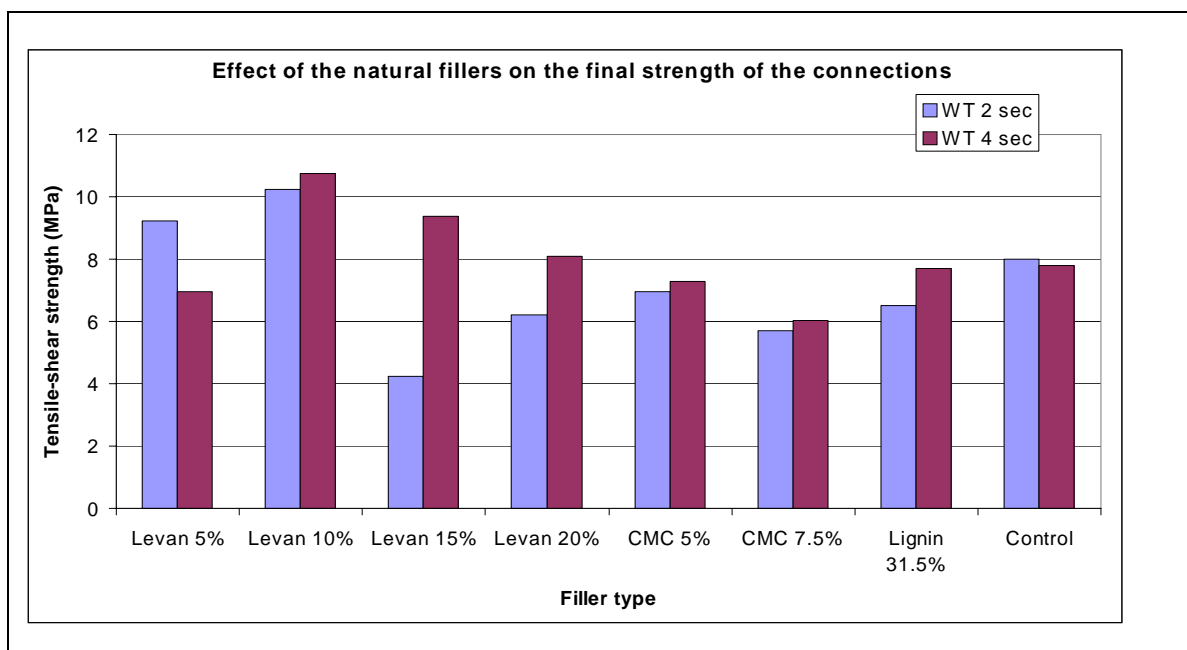
The mechanical welding machine used was a Branson Type 2700, 100 Hz. Two beech (*Fagus sylvatica* L.) specimens with dimensions of 150x20x30 mm³ were welded together to form cubes of 150x20x60 mm³ with a welded area of 3000mm². To test the effect of natural fillers on the final properties of the joints the wood specimens were pretreated with different water suspensions (Table1) and then dried for 24h at normal climax before welding. The welded connections were manufactured with cuts in radial grain orientation. Ten pairs of specimens were welded for each test series. The specimens were conditioned in a climate chamber (20°C and 65%RH) to 12% equilibrium moisture content (EMC) prior welding. The tensile-shear strength was measured according to the EN 205 (2003) standard.

Test serie	Filler type	Concentration of the suspension (%)	Welding time (s)	Welding Pressure (MPa)	Amplitude (mm)	Holding Time (s)
Control	-	-	2 and 4	1.5	3	15
1	CMC	5	2 and 4	1.5	3	15
3	CMC	7.5	2 and 4	1.5	3	15
5	Lignin	31	2 and 4	1.5	3	15
7	Levan	5	2 and 4	1.5	3	15
9	Levan	10	2 and 4	1.5	3	15
11	Levan	15	2 and 4	1.5	3	15
13	Levan	20	2 and 4	1.5	3	15

Table: Experimental Design

Results

Graphic 1 summarizes the results of the study. As it is readily visible, the addition of natural fillers can have, under a certain extent a positive effect on the final strength of the welded connections. To this regard it has been found that the pretreatment of the specimens with of a cross-linked polysaccharide (Levan) can enhance the tensile-shear strength of the joints from 8 to 10 MPa (N/mm²). At the opposites the addition of both CMC (carboximethyl cellulose) and lignin doesn't improve the mechanical quality of the connections. Within the scope of the parameters investigated, it was found that the welding time (WT) doesn't influence the strength of the joints pretreated with CMC and Lignin. However, for the specimens treated with the solution of Levan at 10, 15 and 20% of concentration, there is a positive correlation between the welding time and the tensile-strength.



Graphic 1: Effect of the natural fillers on the final strength of the connection