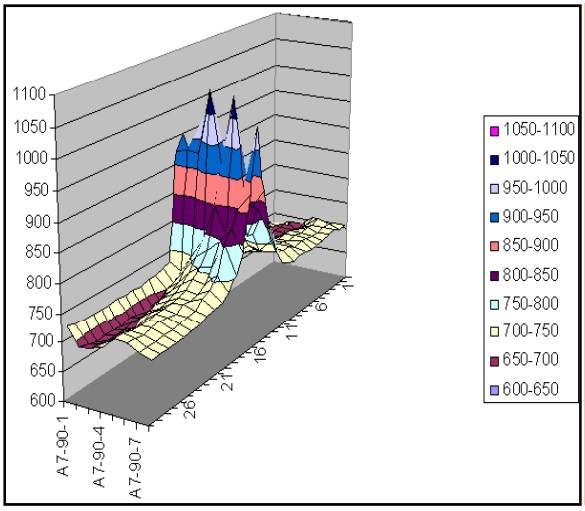
Success story

ENSTIB, Université Henri Poincare, Nancy, France

LINEAR WELDING OF WOOD: An alternative to using adhesives

Mechanically-induced linear wood welding, face to face, without any adhesive, has been shown shown here to rapidly yield wood joints satisfying the relevant requirements for structural applications. The mechanism of mechanically-induced vibrational wood fusion welding is due mostly to the melting and flowing of some amorphous, cells-interconnecting polymer material in the structure of wood, mainly lignin, but also hemicelluloses. This causes partial detachment, the "ungluing" of long wood cells, wood fibres, and the formation of a fibres entanglement network in the matrix of molten material which then solidifies. Thus, a wood cells/fibres entanglement network composite having a molten lignin polymer matrix is formed. During the welding period some of the detached wood fibres which are no longer held by the interconnecting material are pushed out of the joint as excess fibres. Cross-linking chemical reactions also have shown to occur (the main one of these being a cross-linking reaction of lignin with carbohydrate-derived furfural). These reactions, however, are relatively minor contributors during the very short welding period. Their contribution increases after welding has finished, explaining why long holding times under pressure after the end of welding contribute strongly to obtaining a good bond.

The concept of linear welding has developed as a result of collaborative research between LERMAB-ENSTIB, Université Henri Poincare, Nancy and HSB Biel, Switzerland. The development of this French – Swiss wood welding process resulted in the award of the Schweighofer Prize (European Innovation Award for Forestry, Wood Technology and Forest Products) in 2005. Work is continuing to further develop the process and demonstrate the commercial applicability of linear welding of wood.



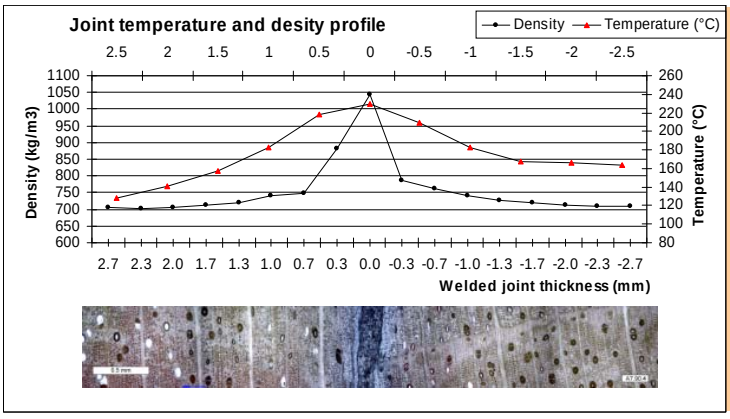
By comparing temperature profiles and tensile-shear strength of specimens welded in longitudinal, radial (at both 90°C and 45°C) and tangential (0°) grain orientation, it has been found that a direct correlation exist between mechanical proprieties and temperature values reached. By investigating the heat affected zone different zones have been identified. The extension and the characteristics of these zones have probably an influence on the final proprieties of the welded joints. Therefore, interdependence exists between the welding parameters, the temperature reached during the process and the physico-chemical characteristics of this region.

Success story

ENSTIB, Université Henri Poincare Nancy, France

LINEAR WELDING OF WOOD: An alternative to using adhesives

Panels products such as particleboard, OSB, plywood and MDF panels can be welded to each other and to solid wood to have good bonding strength by linear vibration mechanical welding. Edge-to-edge welding gives better strength results than face-to-face welding. In general the strength of the edge-to-edge weldline is just slightly lower than the mechanical strength inherent to the panels itself while the trend for face-to face welding is the weldline strength is stronger than the strength of the material when tested in the same direction



Linear welding results in an extremely localised effect, where the molten region is limited to the immediate region of the weld interface. The molten region causes cell wall collapse and densification within this local region, resulting in a dense region around the weld. Correct processing will result in a strong wood-wood bond, without the use of adhesives. Work is continuing to understand the welding process.

The research team at Nancy is by Prof. Antonio Pizzi, with several research students furthering process development and possible applications.

Contact:
A.Pizzi (Dr.Chem, Ph.D., D.Sc.) Prof. Industrial Chemistry
ENSTIB, Université Henri Poincaré - Nancy 1
27 Rue du Merle Blanc, BP 1041
88051 EPINAL Cedex 9, France
Directeur Adjoint-LERMAB, UMR 1093 UHP/ENGREF/INRA
Tel: (+33) (0) 329 29 61 17. Fax: (+33) (0) 329 29 61 38
e-mail: pizzi@enstib.uhp-nancy.fr