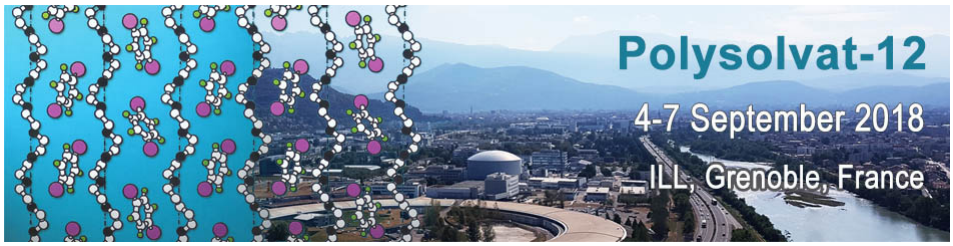

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Swelling and visco-elastic behaviour of wood in mixed solvents

The relevance of solvents and technical treatments used for wood-based products requires a proper identification of the specific role of each solvent on wood biopolymers to better understand their influence on wood properties. In particular, wood impregnated with aqueous solutions of organic solvents has shown to give rise to a stronger swelling than that observed in pure water. This unexplained phenomenon, described as "hyperswelling", can hardly be elucidated because of the complexity of wood microstructure. In this study, the effect of the impregnation of aqueous solutions of ethanol of variable concentrations on the physico-mechanical properties of poplar wood has been investigated [1]. The sorption behaviour of veneer sapwood samples has been analyzed by vapour sorption gravimetry, dynamic mechanical analysis and optical microscopy monitoring. Pure water and ethanol showed two really contrasting sorption behaviours. Despite comparable amounts sorbed, ethanol leads to a lower swelling and a very limited softening, suggesting different affinities of ethanol and water for wood biopolymers. With mixed solutions, larger swelling and stronger variations in visco-elastic behaviour than in pure solvents were observed, confirming the synergistic effect of water/ethanol mixtures on wood cells physico-mechanical properties. Microscopic observations evidenced that ethanol, both alone and in aqueous solutions, generates intercellular decohesion and disbonding of the wood cell wall layers in the middle lamella region. These observations are consistent with a mechanism of partial solubilisation by ethanol of phenolic compounds such as lignins, which leads to a release of constraints and allows a stronger swelling of the cell wall polysaccharides by water. Such phenomenon is likely to be at the origin of the hyperswelling observed in mixed solutions. Finally, the methodologies developed in this study opens interesting perspectives for the analysis of the swelling, visco-elastic behaviour and stability of technical wood-based products in controlled environmental conditions (relative humidity, temperature). In this regard, dynamic mechanical analysis in controlled relative humidity atmosphere was conducted on pine and beech wood impregnated with polymers having different glass transition temperature and hydrophilicity. The results showed contrasted visco-elastic behaviour according to relative humidity and wood – polymer systems.

1. J. Bossu, N. Le Moigne, S. Corn, P. Trens, F. Di Renzo, *Wood Sci. Technol.* 52 (2018), 987-1008.

Preferred topic

Biopolymers

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