

## Enhancing Mechanical Properties of Wood by Thermo Hydro Mechanical Treatments

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### ABSTRACT

With the climate change challenges the world is facing, also wood processing has been putting more focus on wood modification treatments with lower environmental impacts. It is not only about modifying the wood into very durable wood with long service life, but also about the environmental impacts of the processing and end of life of modified wood, its reuse and recycling. In this presentation the work that has been done in the past fifteen years, with the focus on the thermo hydro mechanical (THM) treatments, will be discussed. Furthermore, the need for future research in the field will be presented.

In a THM process, the thermo hydro (TH) process is combined with external forces to shape the wood. The force may be applied to the wood in the longitudinal direction, in the transverse directions, or in combination of both. In the longitudinal direction, the force may be tensile or compressive; in the transverse directions, the force usually is compressive. The purpose may either be to join pieces of wood, to compress the cell structure to increase the bulk density, or to shape the wood material in its cross-section or into a 3D-form.

In general it is possible to densify any wood species by the THM treatment. The degree of densification is however depended on the initial density of the species. Furthermore, the orientation of the wood to be densified influences the densification. The densification is easier on diffuse porous hardwoods than on softwoods. Densification of softwoods is best in the radial direction, while for hardwoods with large aggregated rays in the tangential direction. The densification pattern and resulting density profile depends on the morphology of the wood and plasticization of the material at the time of compression.

Wood densification is performed on the wood that has been soften prior mechanical compression by heat, steam, or chemicals. However, the mechanical compression can be applied also on wood without pre-treatment or softening. There have been many examples of wood compression techniques up through the last century. The methods have varied from mechanical to hydrostatic compression with added steam and/or heat. However, the methods have only proved limited commercial success. Examples of typical THM products are:

- high-density and thermally modified veneer panels without adhesive,
- welded wood dowels in cross-laminated timber,
- surface-densified flooring,
- bulk-densified wood component for electrical installations or wear-resistance mechanical transmissions, and
- different type of shaped wood mainly for interior use.