Background

Thermo-hydro-mechanical (THM) processing of wood is a potential innovation for improving the utilization rate of light weighted wood species as solid wood products. The compressing of wood structure enhanced with moisture and heat may result, for example, in the increase of density, water resistivity and mechanical strength. However, THM processing has not become a widespread treatment method for solid wood material since there have been only few industrial systems available, and problems related to the set-recovery have not been totally solved.

The objective of the study was to determine the effect of combined compression and thermal modification on density profile in the direction of thickness, degree of compression, and set-recovery of radially and tangentially sawn birch (Betula pendula) and aspen (Populus tremula) wood.

An industrial scale pilot plant by Korwensuu Ltd. designed for drying, compression and thermal modification of wood was used for modification of sawn timber (Fig. 1). After the modification, the density profile of specimens was measured in the direction of board thickness using X-ray microdensitometry. Dimensional stability and set-recovery were tested in climate chamber at variable humidity and temperature conditions.

Results and Conclusions

The most advantageous result regarding the density of wood was obtained with the compression of green aspen boards, which resulted in a densified peak having the maximum at the relative depth of 10–15% from the surface (Fig 2). Thus, a light planing could reveal the most densified layer and enable the improvement of hardness and wear resistance of wood products. The compression of birch boards at green state also resulted in a narrow densified peak near to the surface.

The set-recovery is the main drawback regarding the THM processing of sawn wood. The reversed changes of thickness indicated negligible or only minor set-recovery during the weather chamber tests when the climatic conditions changed first from the EMC of 10% to 20% and then down to 5% (Fig. 3). However, the differences in dimensions during the test may indicate the differences in set-recovery, which had actually taken place already at the end of the modification process during the releasing of the compression. Thermally modified birch material showed slightly better dimensional stability than the other treatment processes (Fig. 4).

Thermal modification improves the dimensional stability of compressed wood material. In addition the instantaneous spring-back could most likely be reduced by including an efficient cooling stage for the treated boards already before releasing the compression.

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