Thermal Treatment: Myth or reality

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With the increased interest in the bio-based low carbon economy combined with the public perception on the impacts of "chemicals used " on climate change, wood will continue to be the most economical, sustainable , renewable and carbon neutral construction materials. However, the biological, chemical, physical and mechanical properties variation limits its uses. For centuries, effective organic and inorganic biocides have been used to improve biological durability. Quite often, migration of biocide from wood to the surrounding environment is difficult to control resulting in potential ecological issues. Mechanical means such as compression has been proposed to increase the dimensional stability of wood products and the density of the low density Chinese fir (Jieying et al. 2000). Chemical modification such as acetylation or sillylation has been used to increase the durability of wood products, mainly for low volume high value products. Charring and light heat treatment considered as physical modification have been used for millennia in construction and boat manufacturing and still used in some places in Africa for farm posts and pickets. Centuries ago, Europeans used fire to lightly burn the surface of wood to improve the durability. It is well documented in the literature that high temperature heat treatment of wood products improve some properties of timber (Stamm 1956; Kollman and Schneider 1963; Kollman and Fengel 1965). The foremost advantages of heat treated wood are the remarkable resistance to fungal decay attack (Ruyter 1989) the noticeably improved water repellency, and the improved dimensional stability to moisture variations. However the mechanisms of reactions taken place during heat treatment and the improvement of properties are not well understood, making heat treatment an art rather than science. The main thermal treatment parameters include temperature and atmosphere. Several commercial heat treatment processes are available : the Finnish THERMO WOOD, the Dutch PLATO WOOD, the French RETIFICATION and the German heated oil treatment.

The Finnish process is a three steps process which includes an initial period of 0 to 48 hours with temperature rising to 150E C (Syrjanen 2001; Jamsa and Viitaniemi 2001). The second step is the actual heat treatment with temperature increasing from 150E C to 240E C in 4 hours and a final step where the wood is cooled and stabilized at 70E C during 24 hours. The Finnish process is expected to last for an average of 72 hours. It is estimated that four heat treatment units in Finland produced a total of 33.000 m3 annually (). Steam and heat are used to control the temperature and the relative humidity during the Finnish heat treatment.

PLATO

The Dutch process known as PLATO uses two-steps heat-treatment (Militz and Tjeerdsma 2001) . In the first step green wood is treated between 160E C and 190E C from 3 to 5 days under increased pressure to produce wood with less than 10% MC depending on species and sample size. In the second step dried wood is heated at 170E C -190E C during 14 to 16 hours and then conditioned for 2 to 3 days. The duration of the PLATO process varies from 6 to 8 days. Heat air and/or steam are used in the PLATO process.

FRENCH Processes

Two processes have been used to heat treated wood in France (Vernois 2001). One of the process known as RETIFICATION developed by the Ecole des Mines de Saint Etienne and commercialized by S.A. NOW consists in heating wood with a moisture content of about 12% in a chamber up to 240E C in nitrogen atmosphere with less than 2% oxygen. Nitrogen is used to control the color of the final products by limiting oxidation under high temperature.

The second process called “Le Bois Perdure” uses green wood instead of dried wood. In this process, wood is dried first and then heated at 230E C under steam atmosphere. Several commercial units with total capacity of 8000 m^3 per year are in operation in France.

The total production of heat-treated wood in France is about 8000 m3 per year.

German Process