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Popular Article

## Enhancing the durability of wood using heat treatment

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Heat treatment is an effective method to improve the durability of wood against biodegradation as well as dimensional stability. Heat treatment of wood at different temperatures is targeted to improve the dimensional stability, hygroscopic properties and biological resistance of wood by modifying the chemistry of its cell components. These chemical changes can be expressed as increased dimensional stability, decreased hygroscopicity and ultimately increased durability of the wood.

Wood is a sustainable, renewable, aesthetical, technologically diverse and energy-efficient raw material for indoor and outdoor applications due to its multiple uses and unique properties. It has been the versatile and valuable material for many decades and is therefore considered as one of the best renewable constructional materials. As an easily accessible natural substance, wood has diverse applications in different fields due to its excellent characteristics, such as texture, colour, density, good strength to weight ratio and aesthetic appearance. Anatomically, wood is secondary xylem whereas, chemically it is composed of cellulose, hemicelluloses, lignin and extractives like; resins, fats, waxes, terpenes *etc.* Among these, two major chemical components *viz.*, lignin (18-35%) and carbohydrates (65-75%) are complex polymeric materials and are present mostly in the form of organic extractives and inorganic substances (ash). Each of these components has an impact on ultimate strength properties of wood. Hence, the fitness and ability of wood to resist the applied and external forces such as tension, compression, bending, shear, cleavage *etc.* are governed by both chemical as well as physical properties of wood.

Due to rise in human population, the pressure on high quality timber forests has also increased. This ultimately has resulted in unavailability of quality and durable timber from the forests. Hence, one way to neutralize this pressure on the forests is to modify the other non-durable wood species having undesirable properties like hygroscopicity, anisotropy, dimensional instability and biodegradability. Wood modification could be either active modification (change in chemical nature



of wood) or passive modification (change without affecting chemical parameters which includes use of wood preservatives). Although, use of preservatives is an effective chemical treatment and extends the service life of wood but is hazardous to environment and involves high cost. Therefore, as a solution to these problems, many advance technologies have been evolved to improve the durability of wood without causing ecological hazards, and among these one of the methods is heat treatment, also known as thermal modification of wood.

This involves treatment of wood at high temperature in the absence of oxygen that affects the wood properties by modifying their constituents and altering the chemical composition of wood cells by decomposing their cell wall components (chiefly hemicelluloses and cellulose) and extractives so as to improve the quality, increase in durability, enhancement of dimensional stability and decrease in hygroscopicity as well as equilibrium moisture content of wood. Research on heat-treated wood has contributed significantly for improving wood properties in various countries, for several decades. The improved characteristics of heat-treated timber offer the furniture industries new scopes and opportunities, because of its good weather and decay resistance and therefore, the modified timber can be put into its worth market value. Heat-treated wood has a promising market in applications like; panelling, home interiors and decors, garden and kitchen furnishing, ceilings, doors and windows, musical instruments *etc.* The method of heat treatment of wood is considered very effective so as to produce sustainable building material having less toxicity as all the improvements in wood properties are achieved only by heat treating the wood at different temperatures without adding any chemical. Hence, thermally modified wood has also been designed as an ecological alternative material to impregnated wood. Heat-treated wood has been commercialized and produced on a large scale during the last decade. Finland currently has the highest production of thermally modified wood.

Thermally modified wood is, therefore, applicable for higher value end-uses such as surfacing, flooring, making windows and doors, musical instruments, boats, and other general outdoor uses. Many tree species that have no commercial value can be used for specific purposes and put into the better utilization by using heat treatment.

Within the last several years five different types of heat treatments have gained industrial significance. Some of the products developed by thermal treatment include thermowood in Finland, ratification process and bois perdure in France, oil-heat treatment in Germany and plato-wood in The Netherlands. The temperature and duration for heat treatment generally vary from 180 to 280 °C and 15 min to 24 h depending on the heat treatment process, wood species, sample size, moisture content of the sample, and the desired mechanical properties, resistance to biological attack, and dimensional stability of the final product. Temperature has a greater influence than time on many properties. Treatment at lower temperatures for longer periods, however, does not give similar results compared to treatments at higher temperatures.

